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MADREPORARIA, HYDROCORALLINAE, HELIOPORA AND TUBIPORA

BY

CYRIL CROSSLAND, D.Sc.
(1878–1943)

WITH ONE TEXT-FIGURE AND FIFTY-SIX PLATES

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EDITOR'S NOTE

Cyril Crossland undertook to report upon the coral collections of the Great Barrier Reef Expedition and the material was sent to him just before the outbreak of war in 1939. *The task, interrupted by illness, took him three years, but he had completed it before his death early in* 1943. *Thanks to the kindness of the staff of the Zoological Museum of the University of Copenhagen, and especially of Dr. P. L. Kramp, his typescript and notes, and the collections were carefully preserved until communications were re-opened at the end of the war. Although the report was complete in most respects, no illustrations had been prepared. The difficult task of choosing material to illustrate to the best advantage the points made by the author and of supervising the preparation of the plates has been carried out with meticulous care by Capt. A. K. Totton, M.C. and Mr. E. White of the Zoological Department, British Museum (Natural History) ; they have also been responsible for the final checking of the text and seeing it through the press. It has been their aim to preserve, as far as possible, the integrity of the original text and any necessary departures from it, except the most trivial, have been indicated by notes bearing Capt. Totton's initials.*

In a covering letter, found with the typescript, the author stressed the importance of good and numerous illustrations for any paper dealing with corals. He also urged that his report should be accompanied by actual photographic prints, or collotype reproductions, in order that details not mentioned in, or not clear from, the text could be made out by examination under a lens. It is hoped that the number of illustrations now presented with his report would not have disappointed him. It is also hoped that in the future no one will again be compelled to rely, as Crossland was, on illustrations alone, but that there will be freedom to consult the actual specimens or photographs prepared specifically for any particular investigation.

CONTENTS

FOREWORD

CYRIL CROSSLAND, STUDENT OF CORALS

" The foundation of my love of science is my love of beauty."

This is the first sentence of some autobiographical notes left by Cyril Crossland, and to which he has given the heading " How I became a Coral Reef Man."

Crossland died in his 65th year on 7th January, 1943, in Denmark. A general outline of his life has been given elsewhere (Vidensk. Medd. fra Dansk Naturhist. Forening, CVI, Copenhagen 1943). Here I shall try to give a picture of Crossland as a student of corals and coral reefs.

It is based on the autobiographical notes mentioned and letters from the time when I first met him in Tahiti (or Tahaiti, as he always maintained was the correct spelling) in 1928, and not least from memories of a close friendship developed during his last years in Denmark from 1938 until his untimely death.

Crossland had a very high opinion about what ought to be the standard of scientific papers and was most self-critical. This may to some extent account for the fairly restricted number of Coral papers he produced, while he himself, modestly admitting " it has been very little," accounts for it by the force of circumstances : " for, except when in Tahaiti, when I was greatly hindered by ill health, corals and coral-reefs have been secondary to the work for which I drew the pay, and I have conscientiously kept them secondary." The number of coral papers published in his later years, of which the present was finished just before the final illness that led to his death, indicates that this was the real reason.

No better example of his patient study of detail can be given than his account of the Forskål Collection of Corals, so important for nomenclature. By a wonderful coincidence he had all the qualifications required for taking up that study ; he had a wide knowledge of Latin and Arabic, he knew all the places where Forskål collected his specimens, and had some twenty years of personal knowledge of the coral reefs of the Red Sea. Without being a specialist on corals I venture to say that that paper will range among the classics of coral taxonomy.

But systematics was but one of the tools for Crossland in his study of the general coral reef problems which right from the start in 1900 thrilled his imagination when he first saw living corals at Prison Island, in Zanzibar harbour. " The great reef of the east coast from which the roaring surf has been heard at Dunga, in the centre of the island, 10 miles inland, about 15 from the actual reef edge, was my Mecca. I would see the great waves from Chuaka rise up white, apparently standing still like the sail of a boat, before falling in foam. Even after I had settled at Chuaka it was some time before I could get out to the reefs, in calm weather at low tide, and walk on the edge. To my great surprise I found it all quite dead."

From his studies of the reefs of Zanzibar, Equatorial East Africa, the Red Sea, Tahiti and some other places Crossland arrived at the astonishing conclusion, suggesting that " the age of corals is past, not only in Tahiti and elsewhere, and the cliff which generally surrounds atolls, at about 50 fathoms below the surface " (J. Linn. Soc. Lond. XXXVI, 1928). He was fully aware that the reefs he had seen appeared to be unlike those described by others, but he was convinced that they had to be taken into account. At the same time he always stressed the point that no coral reef area and almost no coral reef has yet been completely examined ; this was not meant to underrate good work done by other scientists, but from his own experience he knew what an enormous amount of work is still left. As an example he mentioned the East African reefs, which he examined " when I was young (very *young*) in 1900, and, in the succeeding 39 years no one else has been there to verify, disprove, or to complete my description of those vast dead reefs, nor are they mentioned in any recent literature, though they are a really stupendous phenomenon of obvious importance to the history of coral growth."

Among the principal omissions from many accounts of reefs he found the most obvious to be the description of the outer slope, beneath and outside the breakers, as far as the bottom is visible ; he was aware of the difficulty and danger of the job, though he thought the danger more apparent than real. He found the observations from the Funafuti expedition most valuable, but to have any general value they must be multiplied many times.

He would also claim that for most areas we have only incidental references to what are the dominant genera of corals, mentioning vast and wholly unexplained differences such as the dominance of *Porites* (*Synaraea*) and leafy *Pavona* in the Maldives, where the leafy species, usually so much more abundant, are absent, and the rarity of all colonial Fungiidae in the northern Red Sea, and several others. " Nature has so many tricks to play upon us, only some of which have been discovered that, as in all other investigations, no one man's work can be anything but a beginning."

He considered himself the last of the pioneers, who work alone with no elaborate equipment, " the present fashion being to go out in parties, which may degenerate into crowds, a distraction and hindrance to the leader."

" Simplicity, Scepticism, and Patience ; Walking, Cycling, and Canoe Paddling, have been, for the most part, my own methods, and they have served me well."

At the same time he fully admitted that a coral reef man cannot work in isolation, the problems are too complex. The biologist, geologist, oceanographer, and meteorologist, etc., should work together and hold discussions *on the spot*. " Team work is thus even more necessary in coral reef work than in others, but it is not necessary that the team should work simultaneously in a crowd, hindering each others' movements, and leaving little privacy for that quiet thought, apparent idleness, which is so essential for anything but routine work."

For the future he wanted much more accumulation of " mere " descriptions and " mere " observations, with a programme of experiment running parallel, general theory to grow step by step as progress was made ; he thought that theory has outrun observation to a large extent.

It is my hope to have given some glimpses of Crossland as the Coral Reef Man behind his printed works. To have been with him, he wearing a native loin cloth, a *pareo*, and a straw hat, in a leaking outrigger canoe on the lagoons of Tahiti, to have listened to his enthusiastic explanations of the wonderful sights in his water telescope I reckon as a very great privilege ; a still greater to have known this noble and gentle character.

ANTON F. BRUUN.

INTRODUCTION.

This is the largest collection of corals brought from any one area, containing as it does 174 species, divided among 54 genera. Of these, 30 species are new, 2 of Bernard's have been given names, and there are several curious varieties, 3 of which have been given new names. This is evidence, not only of the richness of the fauna but of very careful collecting, since several species, which have not been seen for many years, are included. Yet it is clear that the collection does not include all the species which inhabit the Great Barrier Reef area; even assuming that Brook and others have made many synonyms, there are species described by them which have not been found again, and some of those described by T. W. Vaughan from Murray Island do not occur in this collection. This latter difference probably indicates a real difference in the faunas, the Murray Islands being about 10° S. and Low Isles 16° 20′ S., but the difference in their positions with respect to the Barrier has probably an even greater influence. Dr. and Mrs. Stephenson and others remark of Yonge Reef (Vol. III, No. 2, p. 83): "The coral and alcyonarian species are unlike those with which we had become familiar, and although closer study showed that many of them represent modified growth-forms of Low Isles species, or forms which in the latter place are limited to the windward side, others were actually new, and everything looked a little different." Low Isles is distinctly muddy. The quite unexplained difference in the faunas of different reefs is frequently referred to in what follows. My experience corroborates Umbgrove's, who (1939, p. 12) writes: "We are only in the very beginning of having an idea of the true distribution of species which abound in one reef but seem absent in some other reefs." I continue this quotation under *Acrohelia horrescens*, *Montipora foliosa* and *M. ramosa*, but the fact applies to other species also.

I have noted of some species that they are absent from the Red Sea or Tahaiti, but proving a negative is, of course, always a doubtful business. For instance in my three years in Tahaiti I found only one specimen each of *Astreopora*, *Pachyseris*, and *Echinophyllia*, the latter the extraordinary specimen illustrated in Plate II (1935). In the Red Sea I specially looked for the *Cymodocea* with strong stems rising from rhizomes and bearing tufts of broad leaves, which is such an ubiquitous feature of the reefs of Zanzibar and neighbourhood, but it was some years before I found one small patch on the Sudan coast. Years later I found it abundant at Ghardaqa, in the north.

Here is a list of Murray Island species described by T. W. Vaughan, but not found by the Great Barrier Reef Expedition:—

Seriatoporidae:

Seriatopora angulata, possibly the same as *S. hystrix:*

Acroporidae:

Montipora turgescens (the only species of *Montipora* not found); *Acropora decipiens; A. pectinata; A. spicifera; A. sarmentosa; A. plicata; A. murrayensis* V. (possibly the same as *A. rosaria*)*; A. squarrosa; A. syringodes.*

Thamnastreidae :

Psammocora gonagra.

Fungiidae :

Fungia sp. aff. *concinna.*

Poritidae :

Porites murrayensis Vaughan ; *P. mayeri* Vaughan ; *P. viridis Gardiner.*

Faviidae :

Coeloria stricta, synonymous with *C. daedalea ; Leptoria gracilis*, probably the same as *L. phrygia* ; *Hydnophora exesa*, possibly the same as *H. microconos.*

Here is the list of species, with previous records, if any, from the Barrier Reef region, the recorder's name being indicated by initials, as in the list of abbreviations below. Note *Cynarina savignyi*, which has been, so far, found only in the Gulf of Suez, and turns up again now on the other side of the world. On the other hand, the fewness of the species common to the Great Barrier Reef and the Red Sea, among the Fungiidae and Perforata, is somewhat surprising. There is, for a considerable part of the fauna, a Pacific region, beginning in Malaysia and dying out beyond Fiji (the continental limit), considerably reduced in Samoa, still further in Tahaiti,* with relics only in the Marquesas.

LIST OF SPECIES COLLECTED BY MEMBERS OF THE GREAT BARRIER REEF EXPEDITION,

WITH A NOTE OF PREVIOUS RECORDS OF THEM FROM THE GREAT BARRIER REEF AND OF THEIR WIDER DISTRIBUTION.

	Other recorders from Gt. B. Reef.†	Wider distribution.	Page.	Plate.
MADREPORARIA				
[CARYOPHYLLIIDAE]				
CARYOPHYLLIINAE				
Trachyphyllia geoffroyi	M.	Northern Red Sea, Indo-Pacific to Philippines ; Indian Ocean, including Natal and Equatorial East Africa ; Persian Gulf ; W. Australia ; Pacific to Philippines.	101	
Heterocyathus aequicostatus			102	
[THECOCYATHINAE]				
Thecocyathus minor		Loyalty Is.	103	
[EUSMILIINAE]				
Euphyllia glabrescens	M.	Indian Ocean, including Gulf of Aden ; Pacific to Samoa.	104	II
E. fimbriata	M.	Red Sea, Indo-Pacific (western).	105	
FLABELLIDAE				
Flabellum rubrum		Indian Ocean, including Cape ; New Zealand ; Pacific as far as Palau Islands.	105	
F. vacuum sp. n.			106	I

* I adopt this spelling after Kotzebue, since one of the early travellers explained to a correspondent that the original Otaheite rhymed with "mighty." It is still the pronunciation used by old residents and natives.

† M. stands for George Matthai ; T.W.V. for T. Wayland Vaughan ; Död. for L. Döderlein and H.M.B. for H. M. Bernard.

	Other recorders from Gt. B. Reef.	Wider distribution.	Page.	Plate.
[SERIATOPORIDAE]				
Seriatopora hystrix	T.W.V.	? Red Sea; Indo-Pacific to Fiji.	107	
Stylophora pistillata	T.W.V.	Red Sea, including Suez; Indo-Pacific to Fanning Atoll.	107	
S. septata		Rotuma.	108	II
Pocillopora damicornis		Indian Ocean, including Natal and Mauritius; Pacific, including Tahaiti and Hawaii.	110	
P. danae		S. Indian Ocean, including Natal and Mauritius; Fiji and Tahaiti.	110	
P. verrucosa		Red Sea; Indo-Pacific, including Marquesas and Tahaiti.	111	
P. eydouxi	T.W.V.	Indian Ocean; Pacific, including Marquesas, Tahaiti and Hawaii.	112	I
[ASTRAEIDAE: with distinct calices and cyclic septa]				
Leptastrea purpurea	T.W.V.	Red Sea; Indo-Pacific to Tahaiti and Hawaii.	115	I, III
L. ehrenbergana		Red Sea; Indo-Pacific to Tahaiti.	115	
L. transversa		Red Sea; Indo-Pacific to Tahaiti.	115	LIV
L. bottae		Red Sea to Hawaii.	116	I, II
L. pruinosa sp. n.			116	III
Cyphastrea chalcidicum		Northern Red Sea, Pacific to Philippines, ? Hawaii.	117	
C. serailia		Northern Red Sea to Philippines.	118	
C. microphthalma		Northern Red Sea to Tahaiti.	118	
Echinopora lamellosa		Indo-Pacific to Fiji.	119	
E. horrida		Malaysia to Fiji.	120	IV
[OCULINIDAE]				
Madrepora kauaiensis		Hawaii, Indian Ocean.	121	
Galaxea fascicularis		Red Sea; Indo-Pacific to Samoa.	122	
G. clavus	Quelch	Indo-Pacific to Samoa.	122	
Acrohelia horrescens	T.W.V.	Red Sea to Palao Is. and Fiji.	123	
[MONTASTREINAE]				
Orbicella curta	T.W.V.	Pacific to Tuamotu Atolls.	124	
O. vacua sp. n.			124	II, III
[ASTRAEIDAE: without cyclical septa]				
Favia favus		Northern Red Sea; Indo-Pacific to Samoa.	125	
F. favus var. *crassidens* var. n.			126	XIV
F. valenciennesi		Red Sea and Indian Ocean.	126	
F. doreyensis		Indo-Pacific to Samoa.	127	
F. speciosa		Northern Red Sea; Pacific to Fiji and Fanning.	127	

	Other recorders from Gt. B. Reef.	Wider distribution.	Page.	Plate.
F. stelligera		Northern Red Sea; Indo-Pacific to Tahaiti.	128	
Favites halicora	T.W.V.	Northern Red Sea; Indo-Pacific to Samoa.	128	
F. abdita		Northern Red Sea; Indian Ocean, including Mauritius and Natal; Pacific to Fiji.	129	
F. virens	T.W.V.	Northern Red Sea; Indo-Pacific to Samoa.	130	VI
F. aspera		Maldives, Japan, Philippines.	132	V
Goniastrea retiformis	T.W.V.	Northern Red Sea; Indo-Pacific to Samoa.	133	
G. pectinata	T.W.V.	Northern Red Sea; Indo-Pacific to Samoa.	135	
G. benhami		Kermadec Isl., Formosa.	136	VIII
G. mantonae sp. n. = *G.* K5 and K18 S. Manton			136	VII
[ASTRAEIDAE: Meandroid species]				
Cynarina savignyi		Gulf of Suez.	137	IV
Lithophyllia vitiensis		Fiji and Loyalty Is.	138	IX
Caulastrea simplex sp. n.			139	III
C. furcata	M.	G.B.R., China Sea, Tongatabu.	140	
Acanthastrea echinata	T.W.V.	Northern Red Sea; Indo-Pacific to Tahaiti.	141	VIII, IX
Lobophyllia corymbosa	Quelch	Northern Red Sea; Indo-Pacific to Tahaiti.	142	IX
L. hemprichii	M.	Northern Red Sea; Indo-Pacific to Tahaiti.	143	X, XXX
Symphyllia recta	M.	Indo-Pacific to Samoa.	144	XI
S. radians	M.	Indo-Pacific to Tongatabu.	146	
Oulophyllia crispa		Indo-Pacific to Bismarck Is.	147	
Coeloria astraeiformis	T.W.V.	? Red Sea, Indian Ocean, Fiji.	147	
C. daedalea	M.; T.W.V.	Red Sea; Indo-Pacific to Tuamotus, but not Tahaiti.	148	XI, XII
C. lamellina	T.W.V.	Northern Red Sea; Indo-Pacific to Samoa.	149	
Leptoria phrygia	T.W.V.	Northern Red Sea; Indo-Pacific to Samoa.	150	
Hydnophora microconos		Northern Red Sea; Indo-Pacific to Samoa.	151	
[MERULINIDAE]				
Merulina ampliata	M.	Northern Red Sea; Indo-Pacific to Samoa.	151	
FUNGIIDAE				
Fungia echinata		Red Sea to Tahaiti.	152	
F. actiniformis		Zanzibar, E. Indian Is. to Rotuma.	152	
F. scutaria		Red Sea to Hawaiian Is.; Tahaiti.	152	
F. paumotensis		Red Sea to Hawaii.	153	
F. fungites	T.W.V.	Red Sea; Indo-Pacific to Marquesas.	153	

	Other recorders from Gt. B. Reef.	Wider distribution.	Page.	Plate.
F. cyclolites	Död.	Red Sea; Indo-Pacific to Philippines.	153	
F. patelliformis		Malaysia to Samoa and Hawaii.	154	XVI
Stephanophyllia formosissima		Kei Is., Philippines, E. Africa, Hawaii.	154	
Herpolitha limax		Red Sea to Tahaiti.	154	
Halomitra robusta		Malaysia and Pacific to Society Is.	155	
*Polyphyllia talpina**	T.W.V.	Malaysia, as far as Santa Cruz.	155	
Podobacia crustacea		Ceylon, Maldives to Philippines.	156	XII, XIII
[PECTINIIDAE]				
Oxypora lacera		Doubtfully known.	158	
O. aspera			159	
Tridacophyllia lactuca		Indo-Pacific to Fiji.	160	
T. paeonia		Fiji and Philippines.	160	
[AGARICIIDAE]				
Pavona decussata		Red Sea; Indo-Pacific to to Samoa.	161	
P. danai		Northern Red Sea to Tahaiti.	161	
P. cactus		Indo-Pacific to Tahaiti.	162	
P. varians	T.W.V.	Northern Red Sea; Indo-Pacific to Tahaiti and Hawaii.	162	XIII, XIV
P. duerdeni		Hawaii.	163	
Pachyseris speciosa	T.W.V.	Northern Red Sea; Indo-Pacific to Tahaiti.	164	
P. torresiana	T.W.V.	G.B.R., Timor, Tahaiti.	164	
Coeloseris mayeri	T.W.V.	Indian Ocean (?), G.B.R., Philippines, Palao Is.	164	
[SIDERASTREIDAE]				
Anomastrea irregularis		Equatorial E. Africa and Natal.	165	
[THAMNASTREIDAE]				
Psammocora contigua		? Red Sea; Indian Ocean to Mauritius; Pacific to Marquesas.	165	XV, XVII
P. exesa		Maldives, Pacific to Fiji.	165	XVI, XVII
[AGATHIPHYLLIDAE]				
*Diploastrea heliopora**		Gulf of Aden to Samoa.	166	
[DENDROPHYLLIIDAE]				
Balanophyllia incisa, sp. n.			166	XV
B. yongei, sp. n.			167	XIV, XV
Dendrophyllia arbuscula		Doubtful.	170	XIV
D. micranthus		Red Sea.	171	
D. micranthus var. *grandis*, var. n.			173	LV, LVI
D. velata, sp. n.			173	LV
Turbinaria peltata	H.M.B.	Torres Straits, W. Australia, Singapore, Fiji, Philippines.	174	XVI, XVIII XIX
T. peltata var. *gibiari*, var. n.	H.M.B.	? Indian Ocean, Malaysia to Fiji.	175	XIV, XVI–XVIII, XXII
T. bifrons		West Australia.	176	XXI
T. frondens		Fiji, ? Samoa.	176	XXIII
T. stephensoni, sp. n.			178	LV, LVI
T. mantonae, sp. n.			179	XVI, XVII, XIX

* Not collected.—[A.K.T.]

	Other recorders from Gt. B. Reef.	Wider distribution.	Page.	Plate.
[PERFORATA]				
[ACROPORIDAE]				
Astraeopora myriophthalma		Northern Red Sea to Samoa and Tahaiti.	180	
Montipora granulosa	H.M.B.	Macclesfield Bank.	181	XXV, XXVII
M. millepora, sp. n.			182	XX, XXII
M. prominula, sp. n.			182	XXIV, XXVII
M. digitata		Banda, Solomons, Fiji.	183	XXVI
M. fruticosa	H.M.B.; T.W.V.	G.B.R. only.	184	XXIII
M. ramosa	T.W.V.; H.M.B.	(as *M. indentata*) Ceylon to Fiji.	184	XXVI, XXVII
M. fossae, sp. n.			186	XXVI
M. foveolata		Tongatabu and Fiji.	188	
M. socialis		Madagascar.	188	
M. venosa var. *angulosa*	T.W.V.	Red Sea; Celebes, G.B.R., Samoa.	188	XXVI–XXVIII
M. prolifera		Amboina, Carolines.	190	
M. undans, sp. n.			190	XXIII, XXVIII
M. sulcata, sp. n.			191	XXVIII, XXIX
M. tertia, sp. n.			192	XXV, XXVIII
M. verrucosa	H.M.B.	G.B.R. to Hawaii, but not Samoa or Tahaiti.	193	
M. erythraea		Red Sea, Batavia.	193	XXIV, XXVII
M. foliosa		Indo-Pacific to Palao Is.	194	
M. informis	H.M.B.	Cocos Keeling, N. Celebes, G.B.R.	195	
M. composita, sp. n.			195	XXVIII, XXIX
M. angularis, sp. n.			197	XXV, XXVIII

The 40 species of *Acropora* are here in alphabetic, not classificatory order.

Acropora abrotanoides	Brook; T.W.V.	Singapore, G.B.R., Tahaiti.	204	
A. affinis	Brook	G.B.R., China Sea.	205	XXXIV
A. armata		Diego Garcia, Singapore, ? Tahaiti.	212	XXXVII
A. aspera	Brook	G.B.R. to Fiji.	205	XXXIII
A. brooki, sp. n.			228	XLI, XLVI
A. bruggemanni	Brook	G.B.R., Singapore.	221	
A. canalis		Philippines.	219	
A. cancellata		Louisiade Arch.	225	XLI
A. clavigera		G.B.R. only ?	226	XL, XLII
A. corymbosa	Brook	Red Sea, Indo-Pacific to Tahaiti.	211	
A. digitifera	Brook; T.W.V.	Madagascar, G.B.R.	207	XXXV
A. elseyi	Brook	G.B.R., Torres Straits.	223	
A. exilis	Brook	G.B.R., China and Arafura Seas.	223	XXXIX
A. fruticosa	Brook	G.B.R., Samoa.	220	
A. gemmifera	Brook	G.B.R., Fiji, Arafura Sea	220	
A. glochiclados		Indian Ocean.	213	XXXIX
A. grandis	Brook	G.B.R. only.	202	XXXI
A. haimei	T.W.V.	Red Sea; Indo-Pacific to Fiji.	207	XXXIII, XXXV

	Other recorders from Gt. B. Reef.	Wider distribution.	Page.	Plate.
A. hebes	Brook; T.W.V.	Malaysia, G.B.R. to Samoa.	217	
A. humilis	Brook	G.B.R. and Fiji.	221	
*A. hyacinthus**	Brook	Tizard Bank, G.B.R., Fiji.	215	
A. intermedia		Maldives.	200	XXXII
A. jeulini, sp. n.			227	XLII
A. laevis, sp. n.			230	XLV
A. latistella	Brook	G.B.R. and Samoa.	216	
A. lutkeni, sp. n.			229	XLI, XLVI
A. macrostoma		Mauritius.	214	
A. otteri, sp. n.			229	XLIII, XLIV
A. pacifica		China Sea, ? Samoa.	202	XXXI, XXXII
A. palifera	Brook; T.W.V.	Indo-Pacific; G.B.R. to Samoa.	218	
A. patula	Brook	G.B.R. only.	215	
A. prolixa		"Ousima," Samoa.	226	
A. pulchra	Brook; T.W.V.	Keeling Atoll, G.B.R., China Sea.	203	
A. quelchi		Amboina, Solomons, Samoa.	209	XXXVI
A. rosaria	Brook	G.B.R. to Samoa.	224	XL
A. spectabilis		G.B.R. only.	220	
A. squamosa	Brook; T.W.V.	"E. Indies," G.B.R.	216	
A. surculosa	Brook	Indo-Pacific to Tahaiti.	214	XXXVIII
A. tubigera		Singapore, Banda, Louisiades, Palao.	208	
A. variabilis var. *pachyclados*	Brook	Red Sea, Indo-Pacific.	222	XXXVIII
[PORITIDAE]				
Goniopora tenuidens	T.W.V.	G.B.R., Amboina, Philippines.	231	
G. lobata		? Red Sea, Amboina.	232	XLVII
G. minor, nom. nov.	H.M.B.	G.B.R. only.	233	XLVIII
G. hirsuta, sp. n.			233	XLVIII
Porites stephensoni, sp. n.			238	L
P. haddoni	T.W.V.	G.B.R., Pacific to Samoa.	241	
P. lobata		Fiji, Fanning, Samoa, Hawaii.	242	
P. solida		Red Sea and probably whole Indo-Pacific.	242 243	
P. australiensis	T.W.V.	G.B.R., Philippines.	243	
P. lanuginosa		Hawaii.	243	LI
P. evermanni		Hawaii.	243	
P. densa	T.W.V.	G.B.R. only.	244	
P. andrewsi	T.W.V.	G.B.R. and Samoa.	244	
P. suppressa, sp. n.			245	LI
P. annae, nom. nov.	H.M.B.	G.B.R. only.	246	LII
P. (Synaraea) vaughani sp. n.			247	LIII
P. (Synaraea) hawaiensis		Macclesfield Bank, Samoa, Hawaii.	247	
Alveopora irregularis, sp. n.			234	XLIX, L
A. mortenseni, sp. n.			235	XLIX
Stylaraea punctata		Red Sea.	236	L

* Not collected.—[A.K.T.]

	Other recorders from Gt. B. Reef.	Wider distribution.	Page.	Plate.
HYDROCORALLINAE				
[MILLEPORINA]				
Millepora tortuosa		Not Red Sea, nor E. of Fiji.	249	LIII
M. foveolata, sp. n.			249	LIII
ALCYONARIA				
[COENOTHECALIA]				
Heliopora coerulea		Not Red Sea; Indo-Pacific to Funafuti.	250	
Tubipora musica		Northern Red Sea, Indo-Pacific. but neither Samoa nor Tahaiti.	251	

Corals are so extraordinarily variable, not only in growth form but in what one would think were fundamental structures, such as the numbers of cycles of septa, as well as in details such as those of septal teething, that species have been found to run together, in some genera, in a wholesale fashion. I feel that it is now necessary to be on one's guard against applying results found in one genus to members of another without criticism or publication of proofs. One must be watchful for details, apparently trivial, such as in other groups are sound foundations for specific distinctions, and which, in some corals may be found constant. For example, as Vaughan shows repeatedly, septal toothing is often a vital distinction, while in other cases it is of no consequence, and may be due to mere lack of building power. (Crossland, 1931.)

In particular, growth form varies so greatly with conditions that many "species" are later found to be merely the effects of, *e.g.*, shallow water, sediment or surf. There has thus arisen a tendency to ignore form altogether as a specific distinction, action which, in many cases, may be premature. These ecologic variations have their limits for each species, and, until these limits are determined, it is not permissible to merge species on the ground that they differ in little but their growth form ; and the same applies to other variable characters. An extreme case is my new species *Montipora fossae* (p. 186), which hardly differs from *M. ramosa* except in being of decidedly different form. These forms and others may later be proved, by experiment and observation on the reef, to be only ecologic variations, but, until that is done, they must be kept apart. It is much easier for future workers if species are kept distinct until *proved* to be variations than if they are confused now and have to be sorted out later.

On the other hand I find, in this collection as elsewhere, cases of variation within one species which seem hardly believable, but which are clearly proved by the series examined.

Perhaps I may be allowed to add that I make new species with great reluctance.

In the following I have therefore given details of variation at the risk of being tedious, though using them for the creation of new names, or the resuscitation of old ones, as little as possible. My object is to give material upon which others may perhaps work, in cases where what we have is insufficient.

How far are the colours of living corals specific ? Most of the evidence is of astonishing variations without specific or even varietal differences, *e.g.*, the brilliant green discs of several Astrean species, the bright pink form of a species of *Pocillopora*, and local differences, such as the green-coloured species of *Stylophora* described by Gardiner, the green species of

Cyphastrea in this collection, *all* species being brown in the Red Sea. Among the Perforata the leafy *Montipora* of Tahaitian lagoons is usually violet or blue, but often may be pinkish or brown, while the *Acropora cytherea* nearby is distinguishable from the other stalked forms by its lilac colour. *Turbinaria* is a genus usually brightly coloured. *T. mesenterina*, in the Red Sea, is variable, but within the limits of yellow and yellow brown, while *T. peltata* of the Great Barrier Reef may be whitish or rose pink. More data are necessary, and it must not be assumed from the above that colour never has specific value, or varies without ecologic reason.

A difference between the continental reefs and those of the far oceanic islands is that in the latter, as in the Red Sea, the tide rises only about 18 inches at springs, so that corals are very rarely laid bare, and the wonderful photographs of coral beds taken by Saville Kent, Sewell and this Expedition are not to be had from these seas. More important is the fact that the barrier edge is always under the influence of the surf, whereas where there is a tide of several feet the surf's action is greatly lessened for the whole 24 hours over most of the month. Consequently the modifications in growth form induced by the surge in Tahaiti shown in the present writer's papers (1928, pls ii and iii; and 1939, pl. 12) are not found on the Great Barrier Reef to anything like the same extremes.

As species-work is the handmaid of ecology, I give reference to the ecological papers of this series whenever possible, *viz.*, Vol. III, No. 2, by T. A. Stephenson, Anne Stephenson, Geoffrey Tandy and Michael Spender, " The Structure and Ecology of Low Isles and other Reefs," 1931 ; and Vol. III, No. 10, S. Manton, " Ecological Surveys of Coral Reefs," 1935. Miss Manton's scale drawings of parts of the reefs are particularly valuable ; counting " heads " alone may be deceptive, *e.g.*, Mayor, on at least one occasion, found the number of " heads " greatest where the total growth was least.

My labour has been much lightened by Prof. Matthai, not only through the simplification made by his published works, but by his having named a large number of these specimens.

I have referred to published illustrations wherever I have found those which agree well with the specimens of this collection, since in many species the name alone gives little idea of which is meant of a series of variations. The naming of species in the ecological and other reports was, naturally, somewhat provisional, and the following emendations are necessary :

Names used in earlier reports of this series.		Names used in present report.
Pocillopora bulbosa	synonymous with	*Pocillopora damicornis.*
Galaxea musicalis	,, ,,	*Galaxea clavus.*
Leptastrea agassizi	,, ,,	*Leptastrea purpurea.*
Favia clouei	,, ,,	*Favia speciosa.*
Favia pallida	,, ,,	*Favia doreyensis.*
Favia pectinata	means	*Goniastrea pectinata.*
Favia acropora	synonymous with	*Favia stelligera.*
Favia vasta	,, ,,	*Favites virens.*
Goniastrea solida	for	*Goniastrea retiformis* var. *solida.*
Goniastrea K.5 and *Goniastrea* K.18		*Goniastrea mantonae* sp. n.
Fungia danai		Not found, probably *Fungia fungites.*
Psammacora gonagra	for	*Psammocora contigua.*
Doderleinia irregularis	,,	*Halomitra robusta.*
Dendrophyllia nigrescens	,,	*Dendrophyllia micranthus* var.

Names used in earlier reports of this series.		Names used in present report.
Astreopora ocellata	probably synonymous with	*Astreopora myriophthalma.*
Montipora ramosa		*Montipora fossae* sp. n.
Montipora foliosa		(?) *Several species.*
Acropora decipiens	for	*Acropora variabilis* and others.
Acropora hebes	includes	*Acropora intermedia.*
Acropora delicatula	for	*Acropora armata* and (?) others.
Acropora formosa		Not found in the collection.
Acropora loripes	for	*Acropora quelchi.*
Porites haddoni	,,	*Porites stephensoni* sp. n.

Acropora hyacinthus and *Acropora cytherea* are probably confused.

Among differences from other coral regions, besides details noted under the species and genera, such as the absence, from the Murray Island Collection, as well as this, of the semi-encrusting species of *Dendrophyllia*, usually so abundant, it is notable that large colonies seem to be rare or absent. True, S. Manton (1935, p. 297) refers to "huge" Montiporas and Acroporas at 16 feet and below on the windward side of the Low Isles reef, but gives no idea of what "huge" means. Compared with the very small colonies S. Manton had dealt with in shallow water they may have deserved this description without being so very big. Were they over 12 feet across ? In all the coral seas familiar to me, and from descriptions in the literature, corals of this size are exceptional, but those of six feet in diameter are not uncommon in most coral seas, in the genera *Porites* and *Acropora* especially, while Gardiner records quite large masses of Astreans, of species which are all quite small here, from many places in the Indo-Pacific. Eguchi (1938) records *Montipora foliosa* 3 meters across in Iwayama Bay, Palao Islands.

What is the present effect of all this growth, the balance between deposition and destruction ? Paradice was the first (1925) to give any details of reef structure in this region, and described the remarkable columnar rocks found on the lee sides of many reefs, of which he gives a sketch on p. 54, which may be compared with the scale section by Stephenson and others (1931) on p. 66. Thanks to the diving helmet we now have under-water details which were invisible to Paradice, given by Stephenson and others (1931) on Plate XVII and by S. Manton (1935) on Plate XII. In both cases we see that the rock masses are smooth and bare,* and such coral as now grows thereon had no part in their formation, is adding nothing to the bulk of either reef edge or pinnacle, and does not even add anything but sand to the deposit at the base of the rock. It is clear that the lee reef edge is under erosion, and the pinnacles are remnants of once existing reefs now removed.

To windward conditions are entirely different. Paradice, Stephenson and others all agree as to the steepness of the reef edge and abundance of coral growth, S. Manton especially referring to the abundance of "huge" colonies, but unfortunately she was unable to see the character of the precipitous part of the slope, 28 feet deep out of a total of 86 feet. Such a steep sometimes indicates erosion, but, at any rate in its upper part, the reef is clearly growing

* These edges are comparable to those of the Tahaitian lagoons, but there is much more coral below the level of Low Water Spring Tides here than in Tahaiti, where live coral was confined to the upper surfaces of the overhangs, which it did not, or only exceptionally, form.

Now to take the reef as a whole we have first Paradice's (1925) diagram on p. 53, which can be well compared with the aerial photograph* of Coates Reef given by Yonge in "A Year on the Great Barrier Reef," Plate XLI, opposite p. 137. (The diagrams and figures of Stephenson and others are essentially the same, but Coates Reef is the simpler case.) Both clearly show a solid growing edge of definite outline to windward, irregular growth overbalanced by destruction on the lee side. This definiteness and solidity are due to several factors :

(1) More rapid coral growth, which is generally found to be accompanied by decreased activity of destructive organisms.

(2) Growth of lithothamnionae, such as are abundant only among waves.

(3) The mechanical action of the waves, which drives fragments into all spaces between the larger corals and so consolidates the reef.

The reef is thus creeping to windward, like some of those in the Red Sea. (See Bertram, 1936, p. 1013).

Imagine such a reef in open water, and subject to winds from two directions. The photograph and diagram may then be duplicated, and fitted together like a pair of horse-shoes with the open ends together—a miniature atoll. It is also noted that the barrier edge, at least among and just outside the breakers, though cut by trenches, is smooth and has no vertical step nor outlying buttresses, in fact just like that of Tahaiti. The expedition had no opportunity of seeing the reef just outside the breakers, but this conclusion is safely drawn from the photographs of *regularly* breaking waves. The same applies to many of the Maldivan and Pacific reefs from examination of photographs by Agassiz, Gardiner and Sewell, while some of those given by Agassiz show quite a different type of edge, abruptly falling, like those of Napuka Atoll, part of the exposed shore reef of Tahaiti, and of Funafuti. Judging by Agassiz' photographs, *part* of the Funafuti reef edge is regular and smooth.

The formation of platforms in the moat, and in general beds of living coral on reef flats and the tops of the Paradice pillars, raises an interesting question which has not hitherto been considered, *viz.*, how can these living corals still exist seeing that the sea level has been nearly the same for the last few thousand years ? Why did not the whole surface become a platform of dead rock many years ago ? The answer evidently is that, in these areas, either the decay and removal of coral is going on as fast as its growth, or that there is an alternation of rock formation and decay in different areas, so that as fast as a platform appears in one place it is removed in another where coral growth is resumed. In short, the fate of the *whole* of the coral living on a reef flat is to be broken up into sand and mud, which is swept away into deeper water, where again, as Gardiner has shown, its fate is often further subdivision and finally solution. Permanent beds of living coral can exist only immediately along the edge of an outgrowing reef, where their foundations are being continually extended.

Here follows for cross reference an index to the corals mentioned by Dr. S. M. Manton (Mrs. J. P. Harding) in Vol. III, No. 10, of this series.

* The photograph of Coates Reef was first published by courtesy of the Royal Australian Navy as frontispiece to Prof. Richard's paper, "A geological reconnaissance in North Queensland," Trans. Roy. geol. Soc. Australasia, I, 1924.—[A.K.T.]

INDEX TO NAMES OF CORALS USED BY Dr. MANTON.

Sci. Rep. Gt. Barrier Reef Exped., III No. 10, 1935, Ecological Surveys of Coral Reefs.

(*In classificatory order.*)

Roman numerals refer to Plates.*

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* Dr. Manton's Plates 1–VIII are diagrams of the traverses; IX–XVI, pictorial diagrams of small areas.

† It is difficult to believe that these " species " can really be recognized on the reef.

[The following information has been supplied by Dr. S. M. Manton: " Identifications of the corals encountered on the detailed surveys were not made on field observations alone. Both living and cleaned corals were examined in the laboratory, and full use was made of existing monographs. Corals which did not correspond with anything in the monographs were given provisional names. When an observer becomes sufficiently accustomed to examining the corals of a limited region it is found that many forms are clearly recognizable in the field. Those about which any doubt was felt were brought back to the laboratory for examination. It may be noteworthy that certain distinctions recorded in the field on living Xenias were completely invisible after preservation, but subsequent examination of the spicules by Professor J. S. Hickson confirmed that these superficially similar forms were quite distinct species. However, two corals which appeared in life to be unlike, " K.18 " and " K.5", are both referred to the same species, *Goniastrea mantonae*, by Dr. Crossland."—A.K.T.]

G. retiformis, 285, 286, 288, 293, 294, 297, 305, 306, 307, VIII, XI, XII, XIV, XVI.
G. solida, 294.
G. K.5, 288, 294, 305, 306, VIII, XI, XII, XIV, XV, XVI.
G. K.18, 287, 293.

Astraeidae Maeandrinae
F. astraeiformis (see above).

Coeloria, 284, 294, 295, 303, 305, VIII, IX, XIV, XV.
C. daedalea, 288.

Platygyra phrygia, 284, 288, 295, 298, 305, VIII, IX, XI, XII, XV.

Lobophyllia, 289, 295, 298, 302, VII, VIII, XI, XII, XIII.

Symphyllia, 284, 295, 298, 302, III, VII, IX, XI, XII, XIII.

Hydnophora, 298, 305, VIII, XIV, XV.

Unclassified
Merulina ampliata, 289, XI.

Fungiidae, VII.
Fungia, 284, 290, 302, 303, 306, 307, XIII, XVI.
Herpetolitha, 303.
Halomitra, XIII.
Podobacia, XII.
Polyphyllia, 290.

[Thamnasteriidae]
Psammocora, 301, 302.
Ps. exesa, 295.
Ps. gonagra, 284, 288, III, IX.
Pavona, XI.

[Acroporidae]
Montipora, 288, 289, 294, 298, 302, 303, 304, III, VIII, XII, XIV.
M. foliosa, 293, 294, 295, 300, VII, IX, XI.
M. erythraea, 294, VII, XI.
M. ramosa, 284, 293, 294, 300, 301, 303, III, VII, IX, X, XIII.

Astreopora, 290, 302, IV, VIII, XI, XII.

Turbinaria, 289, 290, 295, 303, XII.

Acropora, 289, 294, 300, 302, 303, IV, VII, IX, X.
A. abrotanoides, 298, 302, 305, VIII.
A. decipiens, 297, 298, 302, 305, 307, VIII, XIV, XV.
A. delicatula, 295, 305, XV.
A. exilis, 287, 295, 296, IV, VII, VIII, XI.
A. formosa, 287, 295, VIII.
A. gemmifera, 287, 295, 298, 303, 304, 305, 307, VIII, XI, XII, XIV, XV, XVI.
A. hebes, 284, 293, 295, 300, 305, IV, VII, VIII, XI, XIV.
A. hyacinthus, 287, 295, 298, 305, VIII, XI, XII, XIV, XV, XVI.
A. loripes, 295.
A. palifera, 305, 306, XV, XVI.
A. polymorpha, 295, 296, 298, 303, IV, VII, VIII, XI, XII.
A. pulchra, 284, 293, 295, 302, 305, VII, XIV.
A. quelchi, 284, 287, 295, IV, VII, VIII, XI, XIV, XV, XVI.
A. rosaria, 287, 295, 305, VII, XIV.
A. squamosa, 284, 295, 297, IV, VII, VIII, XI.
A. variabilis, 287, XI, XII.

[Family CARYOPHYLLIIDAE.]

Sub-family CARYOPHYLLIINAE.*

My inclusion here of the genus *Trachyphyllia* is a consequence of my examination of the solitary corals of Prof. T. A. Stephenson's South African Ecological Survey. It is based on the fact that in the genera *Polycyathus*, *Paracyathus*, and *Caryophyllia* the " pali," upon which classification is based, are parts of the septa and *not* independent structures. The three genera form a series which show this very clearly. In *Polycyathus* the septal teeth are of the same form from the top of the wall to the middle of the columella, as is particularly well seen in a section of the calyx. In the next stage, *e.g.*, in *Paracyathus*, the lower parts of the septa are differentiated from the upper. This differentiation takes various forms : in *Paracyathus* the lower part is thickened and bears large, sometimes twisted teeth, the so-called pali ; in the adult *Trachyphyllia* it is entire, and broader than the slightly thinner upper and toothed part, but in young specimens its shortness suggests a palial lobe rather than a division of a septum. In this it resembles *Caryophyllia*, which has similar shortened lower portions, and in the common Mediterranean species, *C. cyathus*, this shortening has gone so far, and the notch between the two parts is so deep, as to excuse the idea of structures of independent origin. As this species was the first known, being obtained in quantity by the fishers of *Corallium rubrum*, this appearance of distinct pali was stretched to cover *Paracyathus* and *Polycyathus*, whereas morphologically the series had its starting-point in the opposite direction.

This division of the septa into two parts is found also in *Favites virens* (this report, p. 130), thus perhaps making a second connection with the Astraeidae.

Genus *Trachyphyllia*.

Trachyphyllia geoffroyi Aud.

1899. *Antillia sinuata* Gardiner, p. 167, pl. xx, figs. 26*a*, 26*b*.
1928. *T. geoffroyi* Matthai, p. 95, pl. 22, figs. 1–11 ; pl. 23, figs. 1, 2, 5 ; pl. 26, fig. 1 ; pl. 60, fig. 1 ; pl. 62, figs. 1–3, 7, 8, 11.
1936. *T. amarantum* Yabe, Sugiyama and Eguchi, p. 22, pl. xii, figs. 1–12.

* Crossland inserted in his MS. only two family and subfamily names. His descriptions of species were arranged in the same " classificatory order " as those in his "Index to Dr. Manton's Corals" (p. 99), where he had inserted six headings. These and fifteen similar new ones have been inserted in the text in square brackets. It was thought best to retain the Author's arrangement rather than to use the standard one of Vaughan and Wells (1943) published just after his death.—[A.K.T.]

Yabe, Sugiyama and Eguchi also refer to Wells' proposal to substitute *Manicina* for *Trachyphyllia*, and, quite rightly, reject it.

All the specimens were preserved in alcohol, and most remain so. Stns. 22 and 23 provided two specimens each ; Stn. 19 gave 21 specimens, ranging from 15 mm. to 65 mm.; Stn. 16 one of 13 mm. All are top-shaped, and only one, of 62 mm. has a second small mouth. The deeply constricted and meandroid, large forms which occupy most plates of illustrations are not represented here, so that, of the 36 illustrations cited above, three of Matthai's (pl. 22, figs. 2–4) and the two of Gardiner's, with Savigny's, are all that illustrate this series.

Gardiner's description and figures of his *Antillia sinuata* correspond very exactly with several of these specimens, which are " widely open, trumpet-shaped," and may or may not be " somewhat bent and twisted." The epitheca is thin, as in Gardiner's, in some specimens, thick and dense in others.

In view of these facts I do not regard it as proved that there is but one species of this genus, Matthai's series being, so far as his account goes, quite incomplete. There may be even three species, *T. sinuata* (Gard.) and *T. constricta* Brüg. as well as *T. geoffroyi*, but sufficient data have not yet been published for certainty. If this turns out to be so the present species is *T. sinuata* (Gard.).

The smallest specimen figured by Matthai (1928, pl. 22, fig. 1) is 45 mm. in longer diameter, a quite regular oval without constriction. The next to it is of the same size, but shows the beginning of a constriction. Neither shows the characteristic " palial lobes," and the calices appear shallow. In all but one of the Great Barrier specimens, even in the two of 12 and 15 mm., the palial lobes are conspicuous, clearly visible even while still covered by the flesh of the polyps, and the calices are deep, though *comparatively* shallow in some of those of medium size. Up to 37 mm. × 23 mm. only one specimen, of 30 mm., shows constriction, and that on only one side. The two smallest are circular, and there are none as large as Matthai's fig. 1, which has not become elongated and begun constriction. I therefore doubt whether Matthai's specimen is really the young of this species, since the present series is so complete.

The smallest known specimen is in fact a *Caryophyllia*, from which the adult form differentiates by regular steps ; it is not a larval or ancestral form. In this smallest specimen 5 cycles of septa are developed regularly, of which the first two bear the palial lobes, and are thickened near the columella, which they form by sending out trabeculae. The third cycle rarely reaches it, and more rarely takes part in its formation ; the fourth reaches about two-thirds of the way down the wall, and the fifth is short on one half of the calyx, rudimentary over the rest. Specimens 25 mm. in longer diameter are the same, but the third cycle regularly joins the columella. In larger specimens septa multiply, and those of the lower orders are also broadened below, at first to a smaller extent, then to equal those of the first two orders.

Distribution.—Northern Red Sea and Indian Ocean (rare in both) ; E. Australia and China seas, but no further east than the Philippines.

Heterocyathus aequicostatus M. E. and H.

1904(*a*). Gardiner, Marine Investigations in South Africa, III, 1905. (This paper published in Sept., 1904.)
1909. Harrison and Poole,* p. 898, pl. 85, figs. 1*a–f*.

Gardiner shows that there is only one species of this genus, the variation in which he

* See footnote, p. 103.

investigated by detailed examination of nearly 900 specimens. His plate illustrates 43 of them. Harrison considers that two species can be distinguished.

The Great Barrier specimens are only two, both young, from Linden Bank, Stn V. The larger is fairly closely represented by Gardiner's pl. iii, fig. 41, but the smaller, which has a disc measuring 6 mm. × 4 mm., has a ridge-shaped base pointed at the closed end, apparently enclosing a very small shell completely.

Distribution.—Gardiner's specimens were all from 40 to 90 fms., apparently all off the coast of Natal; Semper's from the Philippines in from 6 to 25 fms. I have dredged it from about 10 fms. near Wasin, Equatorial East Africa, and it is recorded also from Ceylon, Burma and the Persian Gulf.* Rehberg's specimens were from West Australia and S. China.

[Sub-family THECOCYATHINAE]

Genus *Thecocyathus.*

Gardiner (1938, p. 173) places this genus in the Flabellidae, as the polyp has little or no edge-zone.

Since the value of this feature in classification needs reinvestigation, and it is not known whether all the species of *Flabellum* are without edge zone,† and in view of the close likeness of *Thecocyathus* and *Paracyathus* in their septa, palial lobes and columella, I keep the genus in its old position for the present.

Thecocyathus minor Gard.

1899. Gardiner, p. 163, pl. xix, figs. 3*a–b*.

I have three specimens of this species from a mass of rotten shells bound together by lithothamnioneae, obviously dredged (but no data given). The B.M. number is 414.

The correspondence with Gardiner's description is very close, but I am able to add notes on variation.

The epitheca is thickly overgrown by nullipore almost to the edge of the calyx, so that no transverse or costal markings are visible. For "extremely granular sides" of the septa I should prefer to say septal sides with numerous spikes, which would become synapticula with a little more growth. These, with the black colour of the rest of the septa, which remains after boiling in soda, give this part of the coral a resemblance to *Ulastrea crispata*. As Gardiner found, the septal series are hard to see, and in my specimens the extra thickness and prominence of the primaries can only be made out sometimes.

The "very irregular arrangement of its pali" was noted by Gardiner as a peculiarity of the species, and this deserves further examination now that three specimens are available. The two divisions of the septal edges may or may not be clear, and are sometimes non-existent. The upper parts are nearly horizontal. and bear small blunt teeth, which increase in size and become flattened transversely to the septa on the nearly vertical part, and bear denticles. This enlargement amounts to great swellings in part of the circumference of one specimen, with or without a cut between them and the rest of the septum. In other

* In the typescript Crossland had entered the title of the paper as "Some corals of the Persian Gulf." The corals were collected in the Mergui Archipelago.—[A.K.T.]

† Fowler (1888); Moseley (1881), p. 164, pl. xvi, fig. 10.

parts of this same calyx the knob-like teeth pass into the columellar processes, while in other septa the teeth remain small, in marked contrast to the large knobs of the columella. In another specimen the first enlarged teeth may be high up the septum, with one or two others rather smaller below it projecting well from the septum, pali-fashion. In the third these teeth, which are not much thickened, are separated by deep vertical cuts from the upper nearly horizontal part of the septum, and so appear pillar-like. There are usually two of these teeth, but occasionally one or three, and the distance of the first vertical cut from the wall varies greatly.

Distribution.—Sandal Bay, 40 fms.; Lifu, Loyalty Is.; N.E. of New Caledonia, about 22° S.

[Sub-family EUSMILIINAE.]

Euphyllia glabrescens (Chamisso).

(Plate II, fig. 6.)

1899(*a*). *E. glabrescens* Cham. Gardiner, p. 735.
1904(*b*). *E. glabrescens* Gardiner, p. 759.
1911. *E. laxa* Gravier, p. 31, pl. 2, figs. 5–8.
1918. *E. glabrescens* (pars) Vaughan, p. 82, text-fig. 1, pl. 26.
1918. *E. glabrescens* Mayer, pl. 19.
1928. *E. glabrescens* Matthai, p. 174, pl. 42, fig. 5 ; pl. 44, fig. 4 ; pl. 62, fig. 9.

One fragment, " June Reef, outer Barrier, Nigger head, No. 431," with three elongated calices and one nearly round.

All the main septa being strongly exsert, generally 2 mm., and up to 2.5 mm., gives the specimen a very abnormal appearance, the level junction of the broad main septa with the delicate wall being one of the characteristic features of the genus. Of the 10 figures in which this point can be made out published by Vaughan, Matthai, Gravier, Faustino, Yabe, Sugiyama, Eguchi and Bedot, in seven there is no exsertion, in three a slight exsertion here and there. I was therefore inclined to make this specimen a separate variety until I saw Gardiner's remarks on his Rotuman and Maldivan specimens. In 1899 (p. 736) he gives an account of variations of growth-form which disposes of Gravier's *E. laxa*. " The septa vary up to 2 mm. in exsertness " " The colour of the polyps varies from green-yellow to olive-brown, always markedly greener towards the stomodaea." " Rotuma ; in pools of outer reef, very local in distribution, often forming large masses, 3–4 feet across." In 1904(*b*) (p. 759) he writes : " The specimens differ from the Rotuma ones in that the septa very seldom rise above the wall." The species " may generally be found in hollows towards the inner side of the reef-flat or in protected situations, where there is no sand or mud. . . . Where it occurs . . . it is exceedingly abundant, but is nowhere a reef-builder. Colour, dull green."

It may easily happen, especially in a species with so delicate a wall, that the wall does not keep pace with the upward growth of the septa, probably as a temporary growth stage. As, however, this striking and exceptional form has not been photographed I illustrate it in Plate II, fig.6, a nearly side view to show also the rather prominent costae.

I conclude that Low Isles is too muddy for this species.

Distribution : Gulf of Aden, but not the Red Sea ; Indian Ocean and Pacific as far east as Samoa only.

(?) *Euphyllia fimbriata* (Spengler).

A very small fragment from Batt Reef, B.M. 268, is all that represents this species, but its valley is only 8 mm. across. The fragment is too small to be worth further discussion.

Distribution : *E. fimbriata* has already been recorded six times from E. Australia. It occurs in the central Red Sea,* and there are numerous records from the Indo-Pacific, but it has not been found even so far east as Fiji.

Family Flabellidae.

The relationship between the genera *Flabellum* and *Euphyllia* is obviously close, so much so that Dana placed two species of *Flabellum* in the genus *Euphyllia*.† In 1904 Gardiner (p. 954, pl. 93, figs. 28, 29) described an elongated *Flabellum* with several stomodaea, *F. multifore*, which, in top view, resembles *E. fimbriata* so strikingly that Matthai (1928, p. 179) puts (?) *F. multifore* in the synonymy of *E. fimbriata*. There is in the Köbenhavn museum a specimen of a *Placotrochus* of about the same size as *F. multifore* which I hope to describe later, when this whole subject can be thoroughly discussed. Possibly *Coeloseris* Vaughan (or *Aplocoenia* M. E. and H.) may belong to this group. There has been much discussion about, and great importance attached to, the structure of the wall in this family. It is described as "epithecal," a very unsuitable term as the word means added *upon* the theca, whereas, as there is no edge zone in *Flabellum*,‡ the wall is deposited from the inside only, not from both sides as in most corals. It is therefore better described as a hemitheca. Two entirely distinct things have been confused under this name epitheca, apparently only because both result in dead-looking surfaces, (1) the hemitheca of the Flabellidae,§ and (2) the covering of the lower part of the skeletons in many corals, especially conspicuous in, *e.g.*, *Trachyphyllia* (or *Antillia* as it is called in the literature of this subject.) This is a generally dull-surfaced deposit upon a theca which has been made in the usual double way, and so is a real epitheca. It is secreted by the lower border of the edge zone in its retreat as the coral grows upwards.||

Von Koch (1886) is responsible for this confusion, the lack of logic in which was exposed by Fowler (1887 p. 15.) Von Koch gave importance to " dark lines " in the skeleton, but apparently knew nothing of the living polyp. It is von Koch, however, who has gained the attention of his successors.

Genus *Flabellum*.

Flabellum rubrum (Q. and G.).

1904. Gardiner, p. 125, pl. iv, figs. 22–34.

One specimen is present, dredged from Stn. XIV, 19 fms. near Lizard Island and named

* This is the first record from the Red Sea. I especially noticed it at Dongonab, being attracted by the difference between its polyps and those of *Lobophyllia*. The living colonies resemble each other, but the polyps of the former show their tentacles by day (or at least in the early morning) when those of the latter are retracted.

† Yonge (1930, p. 20) shows that *Euphyllia* has an edge-zone.

‡ See Yonge's figure (1930, text-fig. 1) of the expanded polyp of *F. rubrum*.

§ According to Fowler (1885, p. 586) *F. patagonicum* may have a retractile edge-zone and so a complete theca. *F. pavoninum* also has a smooth porcellaneous outer surface, but nothing is known of the living polyps of either form.

|| There is evidence to suggest that both hemi- and epitheca are physiological responses to conditions *e.g.*, sand rasp and burial, or the growth of organisms round the bases of fixed forms.

by Prof. Matthai. It resembles Gardiner's fig. 31, pl. iv, but has a third root, very short, 1 cm. up one side, and the coral is broken off at a level between the two longer roots.

Distribution: Indian Ocean, Maldives and south to Cape Colony. Of the eleven localities given by Gardiner, eight are east and north-east of Cape Agulhas, but four are not to be found on an ordinary good atlas; of the seven known localities five are off Natal, and from these 491 of the 584 specimens were obtained. Known also from the Philippines and Palao Islands in the Pacific, and as far south as New Zealand and the Bass Straits. Not recorded east of the Palao Is.

Flabellum vacuum, sp. n.

(Plate I, figs. 1, 3.)

Three specimens, dredged Stn. XVI.

	mm.	mm.	mm.	
Calices	45 × 28;	24 × 16;	13 × ?	(broken but nearly circular).
Heights	32	22	15	

The distinctive features of the species are:

Broadly oval calyx, nearly round in the youngest, with narrow septa, leaving the cup almost empty. Columella absent in young specimens, in the largest rudimentary, formed mostly of septal teeth. Whole corallum is light and delicate. There are 24 principal septa, between each pair of which are one smaller, running down the wall to the columella, one very small reaching but a small distance down the wall, and from two to six represented only by short ridges at the top of the wall. That is to say, there are three cycles of nearly equal septa, the fourth smaller but complete, the fifth rudimentary and the sixth both rudimentary and incomplete.

In the largest specimen* the costae of the first four cycles, with traces of the fifth, run down the outside of the calyx to its base as very low but distinct ridges, but they are only visible under a lens in the two smaller.

The septa and costae project above the edge of the wall at most 1 mm., but, as always in this genus, this projection carries a portion of the wall with it, so differing from the exsertion of the septa of other corals. In the smaller specimens the fifth cycle of septa is often, and the sixth is always, absent.

The species comes nearest to *F. stabile* Marenzeller, (1904, p. 273, taf. xvii, figs. 12*a*, 12*b*), but this is an Atlantic deep-water form, and, among other differences, much coarser in structure.

[Family Seriatoporidae.]

Genus *Seriatopora*.

Stephenson and others (1931) refer to the genus on pp. 67, 86 and 88.

Characteristic of seaward slopes and anchorage at Low Isles, of Yonge Reef and the reef patch off Lizard Island, *i.e.*, wherever water is clear.

S. Manton refers to the genus on pp. 295, 298, 306 and 307, and on pls. vii, viii and xvi. It occurs on seaward slope of Traverse II beyond 364 feet; on the windward slope in the third 100 feet, anchorage of Yonge Reef. Pl. xvi shows some fair-sized colonies,

* Selected as Holotype.—[A.K.T.]

the largest 20 cm. in diameter, in contrast to the exceptionally small colonies brought home (7 cm. in diameter, and one colony 13 cm. long but of stunted growth).

Seriatopora hystrix Dana.

Samples 37, 281, 195, 196 and 353 have been named by Matthai. These, like No. 440, are small but of normal growth. The spirit specimens are branches of larger colonies with crab galls. B.M. 276, 13 cm. in longer diameter, is abnormally flattened in shape, with frequent dichotomies and very short end-twigs. B.M. 388, " stout pink *Seriatopora* nigger head, Undine Reef Y," is comparable to Marenzeller's pl. 29, fig. 115, which he shows to be a thickened pathologic form.

Distribution : Recorded from Murray Island by Vaughan and common through the Indo-Pacific as far as Fiji ; but the genus does not extend to Samoa, Tahaiti, or Hawaii. It may be the same as *S. angulata* Klz. of the Red Sea, but the material present is not sufficient for settling the question ; and, though Marenzeller has made a very full examination of this species, his figures are spoiled by being so roughly printed.

Genus *Stylophora.*

Only six small pieces of this genus have been brought home, one of which may be a nearly complete, though very small colony.

Stephenson and others (1931) refer to the genus on pp. 86 and 88 as characteristic of seaward slopes and anchorage, and of Yonge Reef and Lizard Island, in all three cases accompanied by *Seriatopora* and *Pocillopora.*

S. Manton refers to the genus and to *S. pistillata* on pp. 289, 295, 298, 302, 307, and plates iv, vii, viii, xi, xvi, on the steeper part of the seaward slope of Traverse I small colonies of 3 to 6 inches, which, like *Goniopora* and *Turbinaria,* are able to form normally shaped colonies in spite of the mud. Also on the seaward slope of Traverse II and the third 100 feet of Traverse III, but in shallower water on the windward side and accompanied by *Pocillopora* and *Seriatopora.* It appears to be one of the less abundant corals in this region, and the colonies are generally small.

The genus is distributed from the Red Sea (where it is abundant) to Murray and Fanning Islands and Fiji. It is not recorded from Samoa or Hawaii, and in Tahaiti occurs only as small thin crusts resembling Klunzinger's (1879) *S. armata* (taf. viii, fig. 12). While it seems to accompany *Pocillopora* in local distribution it is absent from the regions in which the latter especially flourishes.

Stylophora pistillata (Esper).

S. digitata Klz., Marenzeller, 1906, p. 77.

Marenzeller gives no reasons for considering this species identical with *digitata* and most of Klunzinger's species, but the chances are that he is right. Specimen No. 2 consists of nearly straight, roughly cylindrical branches, and, as is often the case in the others the columella is not stylar. No. 311 (Lizard Island, A reef) is bushy, and with more flattened branches than Nos. 3 and 1, but is clearly the same species, probably grown in rougher water. The growth forms due to varied conditions shown by Klunzinger and Marenzeller are, in short, here represented.

The best illustrations of the normal form of this species are those given by Savigny on pl. 4 (Polypes), figs. 3 (1) to 3 (5), Klunzinger coming second, but his specimens are somewhat stunted, as he collected at Qoseir in roughish water.

Distribution : The species is abundant throughout the Red Sea, occurring even off the muddy beach at Suez, the Indian Ocean, Pacific to Fanning Island, but not to Tahaiti or Hawaii.

Stylophora septata Gardiner.

(Plate II, fig 5.)

Gardiner, 1898, p. 996, pl. lxii, fig. 1.

I refer specimen 369 to this species with some hesitation; I have seen nothing else like it in nature or the literature.

Unfortunately the specimen is but a fragment, measuring 75 mm. across and 60 mm. high. It has the growth form usual in specimens of several species grown in rough water, as were all four on Gardiner's plate lxii. The weight of this example strikes one as unusual as soon as it is handled. To the naked eye the closeness of the calices and their large broad hoods are conspicuous. Even on the upper ends of the branches there are stout walls between the calices, perhaps more so than in Gardiner's specimen, but this crowding of calices and thinning of their walls and coenenchyma always varies greatly with conditions of growth. The obtuse broad lips projecting 1 mm. over the mouths of the calices, often so developed as to resemble a downwardly directed tube, with striae outside so continuous and prominent as to resemble costae, are remarkable features. (Plate II, fig. 5.) The coenenchyme between is covered with scattered small pointed spines. The calices of the ends of the branches are deep, and open, the primary septa being thin, secondaries rudimentary, and the columellar style low down in the calyx. The top of one branch is intermediate between these conditions and those of the calices of the sides. These, the normal calices of the colony, are remarkable for the thickness and roughness of the primary septa, usually as thick as the spaces between them are broad, often thicker; they reach nearly to the centre of the calyx, but the columellar style is, more often than not, invisible, though it sometimes appears as a small point near the surface. Secondary septa are present and distinct, but much shorter and thinner than the primary. This specimen came from the anchorage zone of June Reef; Gardiner's from Rotuma, outer reef.

Gardiner remarks, " This species is evidently very closely allied to *S. digitata*, having almost precisely the same mode of growth, and may perhaps be only a variety of it due to a very slow growth owing to its position on the reef, or some other cause. However, the presence of 12 distinct septa in nearly all the calices and the very obtuse lip are constant features of difference." I should add " long " to " obtuse," and observe that the growth form is common to all species grown in rough water. If this were merely a rough water form of *S. pistillata* (*S. digitata*) it would be similar to the *S. mordax* Dana described by Vaughan (1918), p. 81, pl. 25, and by him considered as probably a growth form of this species, but this is quite distinct from *S. septata.*

Genus *Pocillopora.*

I have made notes on the Family Seriatoporidae and the genus *Pocillipora* in my account of the corals of the Natal Coast (1948, pp. 179, 183). The results are briefly as follows: (1) The distinctions between the genera *Pocillopora*, *Stylophora* and *Seriatopora*, though so clear in most cases, all have connections through species which show one or other of the characteristic features. (2) The variation in the species, especially of *Pocillopora*, is enormous (see, *e.g.*, Vaughan, 1918, pl. 21) and the clue to it has not yet been discovered, nor can be without observation and experiment on the reef, as well as in a marine laboratory. (3) It is probable that such work would bring down the number of species in this genus to about six, but if Vaughan's work on *P. caespitosa—bulbosa—damicornis*, etc., applies to other species it might be even smaller. Gardiner wrote in 1898 (p. 942), " The complete absence of verrucae on the tops of the branches and their incrassate (*i.e.*, thickened) form in such a species as *P. grandis* [*i.e.*, *P. eydouxi*] are due to the ends of the branches having reached the low-tide level, and, being unable to grow further upwards, increasing in both thickness and breadth. Although this is by far the most common species of Madreporaria on the reef at Funafuti, I never found any of its branches with their summits dead, even though they reach almost invariably to the low-tide level." This is exactly what I found in Tahaiti, except that I should write " genus " for " species of Madreporaria." I conclude, therefore, that the presence or absence of verrucae, close crowded thin-walled calices or those of more normal type on the ends of the branches, as well as the exact shape of the branches, are not of specific value, so that I am confirmed in thinking, *e.g.*, Hoffmeister's *P. setchelli* from Tahaiti (1929, p. 359), of which he gives three figures, of growth form only, to be only a surf-flood variety of some other species such as *P. verrucosa*. Gardiner further gives the colour of the living colonies as " usually green or pink when the polyps are expanded, but if retracted are nearly colourless." Apparently there is an extraordinary variation in colours with locality, as in some other corals. I have seen a green *Pocillopora* only once, a very dark green, in the southern Marquesas. In these islands, and Tahaiti and the Red Sea, the colour, polyps expanded or not, is, with one exception, brown ; in *P. eydouxi* dark almost chocolate, ends of branches pink or white ; a yellower and lighter brown, with yellowish ends of the branches in *P. verrucosa* ; and a quite light yellow brown in *P. damicornis*. The exception is that *P. verrucosa* is sometimes bright red, the reason for which is unknown.

I give a table of the common Indo-Pacific species, but, as I said, we have not the data for a useful discussion of synonymy. Gardiner wrote (1897, p. 942) : " In the collections there are over 50 specimens . . . and in addition I have examined a very large number in the British Museum . . . and I am doubtful whether all these so-called species should not rather be described as varieties of one species, the characters of which would be the characters of the whole genus."

TABLE OF COMMON INDO-PACIFIC SPECIES OF *Pocillopora*.

T. W. Vaughan (1907) p. 100 (1918) p. 78, writes "*P. damicornis, danae, verrucosa, meandrina,* and *elegans* form a series so indistinctly broken that one is led to suspect that they are really continuous. It is probable that *P. brevicornis* and *P. lobifera* are a part of the same series."

A. Septa and columella rudimentary or obsolete (except on basal expansions, and in the varieties *laysanensis* and *stylophoroides* of *P. cespitosa* (Vaughan, 1907, pp. 88, 89)).

(1) Small clumps, not exceeding 15 cm. in diameter : *cespitosa—bulbosa—damicornis ;* almost certainly one species.

(2) Clumps exceed 18 cm., septa as spines, no columella, branches subterete : *P. danae.* Branches flat : *P. verrucosa, P. meandrina, P. elegans ;* all very close, if not identical.

B. Septa and columella well developed, large clumps, big *flat* branches (almost always) ; *P. eydouxi* and *P. woodjonesi.*

These two species differ in ornamentation of spicules and details of columella and septa.

I much regret that I can obtain no specimens from Ghardaqa which might help to decide whether Klunzinger's species, *favosa* and *hemprichi* are the same as *danae—damicornis—verrucosa*, as seems very likely. This would give a distribution of these species from the extremes of the Indo-Pacific, from the Red Sea to the Marquesas and Hawaii. *P. eydouxi* I have not seen in the northern Red Sea.

Pocillopora damicornis (Pallas) Dana.

The names *damicornis, cespitosa, bulbosa* and *acuta* are discussed at length by Vaughan (1918, p. 75) and by Hoffmeister (1925, p. 15).

Stephenson and others (1931) record the species *P. damicornis* from a series of habitats where coral growth is unexpected and much restricted, for example the sandy pool in the mangrove swamp, in the mangrove park, sometimes on mangrove roots and on the reef flat. It is one of the most abundant in the moat and the barren sandy flat of Batt Reef, " low massive species " being found near the edge. In Tahaiti it is common close inshore, even right at the foot of the beach at Pa'ea. It is this species which is generally found as young colonies, *e.g.*, on floating logs (Wood Jones), chains of buoys, a wire-fence, pearl oysters, and tiles (Crossland, 1928), and a coco-nut (in the Kóbenhavn museum); other coral larvae settling much more rarely, if ever, on artificial substrata.

S. Manton distinguishes between *P. damicornis* (called *bulbosa* in her paper) and *P. danae*, probably including all the thicker-stemmed varieties of the former in the latter species if the two are really distinct. Her references bring out the fact that the thin-stemmed *P. damicornis* is " extremely resistant to exposure, and to a wide range of conditions," as we have learned from Stephenson and others. She also shows how, when conditions improve, *e.g.*, in deeper water, or on windward or outer reefs, the change to *P. danae* or *P. verrucosa* takes place. *P. eydouxi* is less accommodating, being confined to outer regions and windward slopes, and corresponding with a more distinct specific differentiation. The following 8 of the 10 specimens have been named *damicornis* by Matthai: No. 111, " Prob. moat form " ; No. 446 ; No. 21 ; " P. 51 " ; " P. 40," " Batt Reef, wave zone " ; No. 324 ; No. 374 ; " June Reef, Int. Mad. Zone " ; No. 325, " Lizard Island, A Reef " ; the other two by me, *viz.*, No. 386, " Outer Barrier June Reef, Nigger Head " ; and (no number), " Low Island, ordinary moat *Pocillopora*." Of these No. 111 and (no number) are good examples of the *bulbosa* form ; " P. 40 " and No. 325 are thick, branched and grade into *P. danae* ; Nos. 374 and 324 are small, about 6 cm. diameter, with close short branches, obviously stunted ; while the Batt Reef wave zone fragments, " P. 40," show no sign of stunting. No two specimens are alike ; the collection is an excellent series of the variation of this strange species, but, as all have been already illustrated, especially by T. W. Vaughan in 1907 and 1918, there is no need to publish more.

Distribution: The species is abundant from Singapore to Fanning Island in the Central Pacific, Tahaiti, and Hawaii. From the Indian Ocean Vaughan records it from Cocos-Keeling, but Prof. Stephenson's collections enable me to add Natal and Mauritius. It is not recorded from Equatorial East Africa or the Red Sea, unless Klunzinger's *P. favosa* is an extreme variation.

Pocillopora danae Verrill.

S. Manton refers to this species on pp. 288, 298, 306, and on pls. viii, xiv, xv, xvi. It is hardly possible to distinguish *P. danae* from thick specimens of *P. damicornis* on the reef. For instance the reference on p. 288 might be read, "Thin stemmed *P. damicornis* occurs in scattered colonies (2 to 12 inches), but beyond 420 feet in the deeper water the branches thicken"; or on p. 298 on the seaward slope of Traverse III might read "as in the deeper waters of Traverse 1 on the lee side *P. damicornis* here grows with thicker branches, like those of *P. danae*."

Only one fragment, 8 cm. in diameter × 6 cm. high, is thus labelled by Matthai. It corresponds better with Vaughan's (1918, pl. 22, fig. 2) Verrill's type of the species, than with the figures of his specimen from Murray Island. It corresponds well also with Hoffmeister's (1929, pl. 2, fig. 2) a specimen from Tahaiti.

Specimens 325 and "P. 40," both labelled *P. damicornis* by Matthai, an identification with which I agree, form an interesting series with *P. danae*. The first is a rather coarsely branched *P. damicornis* without any doubt, much like Vaughan's (1918, pl. 21, fig. 2), while "P. 40," being from the wave zone of Batt Reef, is partly the same, partly with thicker branches not distinguishable from those of *P. danae*. I therefore think it very likely that this species is, in fact, a variety of *P. damicornis*, as does Vaughan, but I cannot dogmatize without further evidence.

The species is recorded also by Thiel from Banda, but not by Umbgrove from Java or by Yabe, Sugiyama and Eguchi from Japanese seas. Faustino (1927) mentions it from the Philippines, but his figure (pl. 13, fig. 3) is the same as that already given by Vaughan (1918) in pl. 22, fig. 1*a*. Gardiner collected it from Funafuti and Fiji, but gives no figure. It is thus found throughout the Pacific as far east as Tahaiti. It has not hitherto been recorded from the Indian Ocean, but two of the specimens of *P. damicornis* in Prof. T. A. Stephenson's collection from Natal are much like the intermediates mentioned above. In the Universitetets zoologisk Museum, Kóbenhavn there are 6 good-sized and complete specimens from Mauritius (labelled *P. frondosa*, n. sp. by Lütken, but no description was published) which clearly belong to *P. danae*, and resemble Vaughan's figure of Verrill's type, with rather long irregular verrucae, often a little swollen at their ends. The growth forms are an interesting series, from very loose and irregular to compact. I hope to publish illustrations in the future.

Prof. T. A. Stephenson's collection from Mauritius also contains a small specimen (No. 206) clearly belonging to this species or variety.

We thus extend its distribution from the southern Indian Ocean as far as Fiji and Tahaiti. It is not recorded from the Red Sea or tropical East Africa, and figures of *P. favosa* Klz. do not resemble it.

Pocillopora verrucosa (Ell. and Sol.).

Manton, 1935, pp. 297, 304, 305, 306, pls. viii, xiv, xv, xvi.

Manton (1935) says: "On the first 100 feet of the Seaward Slope [Traverse III to windward, corals] resemble those present on the leeward side . . . with the addition of large and small massive species of *Pocillopora* (*P. verrucosa* and *P. eydouxi*) and *Acropora decipiens*. These corals do not occur elsewhere on Low Isles, and are characteristic of the exposed outer ridge and reef crest of outer barrier reefs such as Yonge Reef." This corresponds with my own experience, but pls. viii to xvi indicate that it is nowhere as abundant as in Tahaiti, though recorded as frequent on Yonge Reef.

The collection consists of one specimen and two fragments, all named by Matthai, *viz.*, 332 Outer Barrier, Ribbon Reef, Inner moat; 342 from the same, but the outer moat; and 74, a large branch, dividing dichotomously so that the upper surface has 24 endings. Also a small scrap, 285, with one of another species too small for identification. The specimens are typical, and call for no comment.

Distribution: Red Sea; probably Mauritius; Cocos Keeling in the Indian Ocean; throughout the Pacific to the Marquesas and Hawaii; represented in the latter by "the closely related, if not identical, *P. meandrina* Dana" (Vaughan, 1918, p. 78).

Pocillopora eydouxi M. E. and H.

(Plate I, fig. 2.)

The synonymy is given by Vaughan (1918) and Umbgrove (1939). Note Umbgrove's remarks on Thiel's new species *P. symmetrica*, an example of founding a new species on one broken scrap, which, in all corals, but especially in such a genus as this, is a proceeding which should rarely be attempted.

S. Manton refers to the species on pp. 297, 298, 305 and 307, and on pls. viii and xv.

The species is characteristic of clear water on exposed reefs.* It is, in almost all cases, recognizable at once on the reefs by its large size and flat branches, the only species with which it might be confused being *P. elegans, grandis and elongata*, three species of Dana which Gardiner gives as synonyms, and *P. woodjonesi* Vaughan, which is well distinguished by its large frosted spicules and inconspicuous columella. The colour of *P. eydouxi* is a cool brown with the ends of the branches pinkish or white.

Its broad-ended branches and comparatively cellular structure make it possible for storms to break up the colonies, but, at the same time, the coarse gravel thus produced is very resistant, so that it is a particularly important reef and beach builder. I have published (1928*a*, p. 582) photographs of reef islets composed entirely or largely of this species.

The present collection contains three specimens and four fragments, all but one named by Matthai (this one is quite typical). Nos. 269, 367, 268, and 274 are from June Reef, of the outer barrier series; 402 and "P. 50" from Low Isles, the former from outside the rampart; the latter, from the seaward slope, is the "tip of a long flattened branch similar to those of specimen 364." There is no note for 364.

Three very distinct forms are present:

A. The normal form with broad-ended branches, of which there are the three fragments "P. 50," 402 and 367. They are the triangular tops of branches: the last is prolonged below into a flattened but narrow stem, 20 mm. × 27 mm. None of them reach sufficiently near the base to show the typical calices with thick septa of Vaughan's figure.

From the literature, and from my own observations in Tahaiti, this is the normal and abundant form; perhaps this is why these few scraps were considered sufficient to represent it? The other specimens, much larger, are rare varieties, and, I suppose, were specially selected.

B. Two large parts of colonies, Nos. 268 and 274, both from June Reef, consisting of a number of nearly cylindrical branches, springing from common

* Wood Jones (1907; 1910) says, "Inhabits only the still deep water of the lagoon." This is contrary to Gardiner's, Manton's Umbgrove's and my experience, in four widely separated regions.

stems, the whole measuring 30 cm. high, by a maximum diameter of 21 cm., and 27 cm. × 21 cm., there is also an isolated branch 16 cm. long with 4 branchlets above. This form has been recorded only by Yabe, Sugiyama and Eguchi (1936), pls. ii, iv, fig. 2, v and vii, fig. 6, from the Marshall Islands.

These three specimens differ from the others of the Barrier collections and from that of Yabe, Sugiyama and Eguchi in the irregularity of their verrucae, which in all three show a tendency to grow out into branches, the beginnings of such a curious growth as that shown by Gardiner (1897) in pl. lvii, fig. 3, under the name *P. grandis*.

C. No. 269, of which the base is unfortunately missing, consists of five broad thick roughly triangular lobes, connected by broad bases, as shown on Plate I. The largest, which is incomplete, is 13 cm. wide, and 18 cm. high. The next largest, which is complete, is 15·5 cm. wide and 10 cm. high. Thickness of the largest, across the broken edge, 6 mm. at the top, 18 mm. near the base, the common base of the whole being 32 mm. thick. All surfaces, except the upper edges, are covered with rather closely placed smallish verrucae, remarkable for their regularity of shape and distribution.

I have carefully cleaned the specimens, and examined the calicinal characters and spicules, as a result of which I endorse Matthai's identification of these three remarkably different forms with the single species *P. eydouxi*. At the same time some ecological information about them is much to be desired, since calicinal characters alone are not certainly specific in this genus. The variation of these characters has not yet been described, though referred to by Umbgrove.

The few figures given, by Milne Edwards and Haime, Vaughan, and Yabe, Sugiyama and Eguchi, all show the calices on the flat surfaces between the verrucae, and I may say at once that these are far more variable than those on the verrucae themselves, which are, however, owing to their position and delicacy, difficult to photograph. Such regular and thick septa and columella as Vaughan shows (1918, pl. 24, fig. 2*a*) are only found on the lower part of the branches, 15 cm. at least below the ends, higher up they become more delicate and more variable, the septa varying in both breadth and number. As this collection contains only upper ends of branches in most cases, these typical calices are present only in the two larger specimens Nos. 268 and 274, *i.e.*, those with cylindrical branches.

Thus, the two short branches of set A have, on the flat surfaces septa 0 to 6 or 8 in number, narrow and thin ; near the upper edge generally only 0 or 2 or 3, or calices completely empty ; columella either detached or joined to one or a pair of directive septa. In B.M. 402 [no Expedition number] columella is small and detached, often only traces of it visible. In No. 367, which is 14 cm. long, triangular end part 7 cm. long by 9·5 cm. broad, calices of the lower part of the stem like Vaughan's figure, but septa and columella are delicate, and columellae all detached. Half-way up the stem the septa appear as two series by the narrowing of half of them, and one or a pair of directives are developed, but they do not unite with the columellae. On the upper triangular part calices very degenerate and shallow, and much of the coenenchyma is smooth.

On the other hand, the calices of the verrucae almost always have 10 to 12 septa clearly seen, and the columella is detached, or joins a single directive, except close to the top of the branch where the septa are mere lines of little spines and the columella is absent. In No. 367 there are 12 septa and detached columella everywhere, but calices very delicate near the top of the branch.

Form B with cylindrical branches: No. 364, a single branch 16 cm. long. Irregular verrucae, as in the two larger specimens. Near base, 6 very small delicate septa and prominent columella, but septa often absent, or nearly so. Columella may broaden, and join the septum on its upper side. In the middle the same, but a complete cycle of septa is rare, and columella usually attached to one directive. On the upper part of the stem are 12 septa, columella attached to one or two directives, or these may come close to the columella without attachment. No. 268, 21 cm. long, near base 6 to 12 rather delicate septa, in middle 6 to 12 as above sometimes very distinct, sometimes almost absent; columella also absent sometimes.

In the two large specimens the basal parts, where the verrucae become low and rounded, calices exactly like Vaughan's figure, others at the same level have only one series of septa which is often incomplete, and, in places, the calices are almost empty. On the other hand, calices on the verrucae show little variation and are as in the A specimens.

Form C: The foliose specimen is only 16 cm. high, so none of Vaughan's regular calices are present on the smooth part, and the septa are very irregular, with a distinct, even massive columella on one side of a branch, which may be absent altogether on the other. Directive septa rare; higher up many calices practically empty.

Again, calices on the verrucae with 12 delicate septa and distinct, though slender columella, which may be detached, or joined to one directive.

Distribution: Widely distributed in the Pacific; numerous records from Java to Tahaiti, the Marquesas and Hawaii (Vaughan, 1907, under the name *P. modumanensis*); but the only record from the Indian Ocean is from Cocos Keeling Atoll. I have no specimens from Mauritius, and there is no record from the Red Sea. Curiously Faustino does not mention it from the Philippines.

[Family Astraeidae: species with distinct calices and cyclic septa.]

Genus *Leptastrea.*

Stephenson and others (1931) give four references to the genus: swamp passages on roots, etc., the reef flat and mangrove park; the anchorage; Batt Reef; and dredged at Stn. 27.

S. Manton records tiny colonies of *L. roissyana* in the moat, becoming larger in the deeper part, on the descent of the seaward slope (scarce and small).

Also on Traverse II. On Traverse III larger specimens, *L. ehrenbergana* (identified from a boat). On p. 300 is a note on the wide range of conditions the species will tolerate. It occurs also on the crest of Yonge Reef in the form *ehrenbergana* (as on the barrier edge in Tahaiti), and on Batt Reef. After my experience in Tahaiti and the Red Sea I am unable to divide this genus into the species *ehrenbergana*, *roissyana* or *transversa*, since all grade into, and are all derived, by simplification, from *L. purpurea*, which is the prior name (Crossland, 1931 and 1935). However, I retain the names *purpurea*, *ehrenbergana transversa* and *bottae* as a matter of convenience, and for reference to the ecological papers. Like Vaughan, I prefer the name *transversa* Klz. to *roissyana* M. E. and H., since it is far from certain what the latter is, though Vaughan shows (p. 92) that it is near to the form *purpurea*. Klunzinger's illustration, fortunately a photographic print, shows an extreme form, but this grades into more ordinary forms not only in Tahaiti but also here, in spec. D.8.E., in which typical " transverse " calices occur here and there.

Leptastrea purpurea Dana.

(Plate I, fig. 5 ; Plate III, fig. 3.)

1918. Vaughan, p. 91, pl. 30, figs. 1, 1*a* (showing Dana's type).

This is the form from which the others are derived. A typical example was brought from Low Isles by Mr. G. W. Otter, and two very small fragments are labelled " T.1. moat " ; it is much more rare than its derivatives, and I have not seen it in Tahaiti or in the Red Sea, though there some *ehrenbergana* specimens approach it.

I include here a very curious specimen, No. B.M. 420, dredged from Stn. 27, which is unlike any other specimen or figure I have seen, though nearest to Vaughan's figure of Dana's type (1918, pl. 30, fig. 1*a*). The coral forms a crust, 10 mm. and more thick, on a dead *Favia*, the living area rounded-triangular, 7 cm. across the base × 7 cm. base to apex. The surface is undulating, but remarkable in this genus for its smoothness. The calices are very shallow, being filled in, except just over and near the columella, by the thick, and for the most part, horizontal septa ; their inner sides are nearly vertical. Consequently to the naked eye the coral resembles a *Siderastrea*, the characters of *Leptastrea* appearing only under a lens. All the septa have rough sides and denticulate margins ; they are in 4 cycles, primaries prominent and very thick, only the last cycle thin, so that the calices are almost filled up, the loculi being exceptionally narrow. Columella solid, sometimes oval or round, sometimes compressed, bearing small but distinct tubercles, which may be in a round or oval group or in rows, often a single row, according to the shape of the columella.

Leptastrea ehrenbergana M. E. and H.

Two specimens, one a mere scrap, the other 14 cm. × 10 cm. × 7 cm., showing much less irregularity of shape, and even of calices, than those of the Tahaitian barrier. In the small piece from Batt Reef the roughness of the sides and the granulations of the septa vary remarkably, in some cases being very marked, in others almost smoothed out. Some septa in the larger specimen from the moat at Low Isles, are clearly " swollen in the calyx " ; in the smaller they are " swollen in the theca," as Vaughan remarks of Matthai's pl. 17, fig. 6 (1914). I have a note that this distinction between " species " was not made out in my 50 Tahaitian specimens.

Leptastrea transversa Klz.

(Plate LIV, figs. 1–3.)

Specimen 227 is remarkable for its round, separated calices in which cyclical arrangement of the septa can hardly be seen, and, in short, the specimen would appear to be an *Orbicella* or *Favia*. It grows as a crust over a dead *Favia*, 0 to 25 mm. thick, and 11 cm. × 13 cm. in area, and almost quite smooth. Multiplication by budding cannot be made out on the main area. However, the following features indicate an abnormal specimen of *Leptastrea transversa ;* smooth intercalicinal grooves, over which the costae do not meet, smoothness of the upper part of the septa, and the way they run over the tops of the columellae, and make a bilateral symmetry, as in fig. 2, on Plate LIV. The columella itself bears tubercles, quite characteristic of *Leptastrea*, and is often compressed, but how disguised are the *Leptastrea* characters is shown by the photographs on Plate LIV.

I take it that the main area of the specimen was in nature a vertical face, probably crowded by other corals, and the edge turned over the block of *Favia* is the upper horizontal surface, growing in somewhat more normal conditions. Here the smoothness of the side area is less marked, budding is frequent, the walls are thin, so calices polygonal, the intercorallite grooves mere notches in the costae, columellae often non-existent, septa thin and smooth on sides and edges, or granulated on both, with small teeth only near the columella.

Leptastrea bottae M. E. and H.

(Plate I, fig. 4 ; Plate II, figs. 2, 3.)

1879. *L. inaequalis* Klunzinger, Taf. v, fig. 6.
1914. *L. solida* Matthai, p. 69, pl. 18, fig. 5.
1918. *L. bottae* Vaughan, p. 94, pl. 31, figs. 3 and 4.
1936. *L. bottae* Yabe, Sugiyama and Eguchi, p. 27, pl. 30, fig. 1.

I agree with Vaughan that Matthai preferred the name *solida* to *bottae* on insufficient grounds. Yabe, Sugiyama and Eguchi are the only later authors to mention the species ; they give no reference to Matthai or reasons for preferring the name *bottae*.

The present specimen, No. 407, resembles Klunzinger's (1879*a*, taf. v) fig. 6, and Matthai's (1914, pl. 18) fig. 5. In the small crowded calices of the more usual size, only the six thick primary septa reach the columella, or the secondaries may reach it deep down in the calyx, but generally they are small ; tertiaries are just visible or are absent, but their costae, low and rounded like those of the other series, are generally present. Columella greatly reduced, but may bear vertical points, and septa often bear paliform lobes. As seems to be usual in this species, giant calices are present ; in these, numerous septa reach the tuberculated columella, which seems to block the bottom of the theca. Comparison with the other species, and with an intermediate specimen in the Kôbenhavn museum, indicates that these " giant " calices are, in fact, nearer to the normal form, the more numerous and smaller being the farthest from the ancestral type.

A longitudinal section of this species has not yet been figured ; it is remarkable for beams* connecting the thecal walls, some solid, some hollow. I give a photograph on Plate II of a broken, *not* cut and ground section, broken sections being generally the more instructive, and, indeed, a cut and ground section might not show these curious structures. Compare Milne Edwards and Haimes' (1848) pl. 9, fig. 3*a* (for *Phymastrea valenciennesii*).

Leptastrea pruinosa,† sp. n.

(Plate III, fig. 1.)

The minute specimen,‡ B.M. 414 (part), has no locality, but its being on a fragment of Lithothamnia suggests that it was dredged. It consists of 6 full-sized calices and 6 small, forming a crust 15 mm. × 7 mm.

* Visible also at surface.—[A.K.T.]

† Latin, *pruina*, a white frost, referring to the spinules on the septa.

‡ This holotype now bears B.M. Register No. 1934.5.14.630. It appears possible that it may have been separated from 1934.5.14.414, *Acropora squamosa*. This came from Lizard Id., A. Reef, and is marked α396.—[A.K.T.]

Calices are between round and polygonal (see Plate III) the larger 4 mm. to 5 mm. across. Lines between them quite smooth. Septa, but not walls, exsert to about 0·5 mm. They are decidedly thick over the walls, thinner in the calices, where they appear much thicker than they really are through the number of square-ended spinules they bear on their sides. In some cases these meet over the top of the septum, forming a little transverse lappet, but in others the thin edge of the septum, finely toothed and bearing only minute lateral spinules, projects above the part thickened by the massive spinules. These are smaller or absent also over the walls. At the edges of the crust the septa project as costae, smooth or very lightly spinulose.

Septa in three cycles, with traces of a fourth, as thin short septa or mere platelets on the walls.

The columella is small, almost rudimentary, the tubercles of the upper surface 3 to 6 in number, spinulose like the innermost teeth of the septa ; this makes another difference from other species.

I have long hesitated to describe so small a corallum of a genus in which all the species so grade into each other, but it is very clearly different from any other specimen of any species of the genus.

Genus *Cyphastrea*.

The genus is of universal distribution, but it is interesting to find that the ratio of the species is different in different regions. Here we have 10 specimens presumably taken at random, of which 8 are *C. chalcidicum* and 1 each *C. serailia* and *C. microphthalma*. Contrast the northern Red Sea where all these three species are common, but *C. microphthalma* decidedly the most abundant. Gardiner found it not abundant in the Maldives, but his collection contains 2 of *C. serailia*, 4 of *C. chalcidicum*, and only 3 of *C. microphthalma*.

It has not been recorded from the Great Barrier before, but it is evidently common, since Stephenson and others give five references, finding it on roots, etc., in passages in the mangrove swamp, scattered small colonies in the mangrove park and *Thalamita* flat, as well as on the seaward slopes and the anchorage. It is also recorded from Yonge and Batt reefs. S. Manton refers to it on six pages and in two diagrams.

There is a good deal of variation in all these specimens, but not the extremes found in Forskaal's collection. (Crossland, 1941.)

Cyphastrea chalcidicum (Forsk.).

The 8 specimens are divisible into two sets, without intermediates.

A. Humpy, rough with projecting thecae, such as shown by Matthai (1914), pl. 13, fig. 7 (for *M. microphthalma*), or pl. 38, fig. 5 (for *C. serailia*).

B. Smooth, thecae hardly projecting, with appearance of lines between the calices, like Matthai's pl. 14, fig. 1, for this species, or pl. 13, fig. 8 (for *C. serailia*).

Set A are numbers 285, 44, 5, and B.M. 375. The last specimen is from Batt Reef, S.W. side of S.E. corner, wave zone. This specimen is unattached, and growing on all sides, so cannot have been exposed to very heavy waves. Set B are 198, 17, and 43. The last is the largest specimen, 15 cm. × 10 cm. × 7 cm. high.

Distribution: Northern Red Sea, through the Indian Ocean to the Philippines. Not recorded from Fiji or Samoa, and does not occur in Tahaiti. *C. ocellina*, the only species in Hawaii, is very close to this, but Vaughan says it is not identical, so that records of *C. chalcidicum* from Hawaii must be received with caution.

Cyphastrea serailia (Forsk.).

A small irregular colony 7 cm. × 5 cm. × 2 cm., encrusting an irregular calcareous mass of uncertain origin.

This species and the preceding are often scarcely separable, but this specimen is clearly differentiated by its rather thick spiny septa, with costae of the first two orders not nearly so prominent as in *C. chalcidicum*, and those of the third nearly equalling them.

Inner moat, June reef, No. 415, B.M. 393.

Distribution: From the northern Red Sea, through the Indian Ocean to Murray Island and the Philippines. Not recorded from Samoa. Does not occur in Tahaiti.

Cyphastrea microphthalma (Lamk.).

A single quite typical specimen, with thick spiny septa, etc.

Half the area is dead, the interior extremely rotten, possibly in accordance with the fact that it was dredged from Stn. XXIV.

Distribution: From the northern Red Sea to Tahaiti, where it is the only species, and shows reduced growth.

Genus *Echinopora*.

I follow Matthai, and others, in placing *Echinopora* in a division of the Astraeidae, near *Cyphastrea* (indeed *Echinopora* is almost a *Cyphastrea* enlarged) and leave *Echinophyllia* in the Fungiidae. Horst (1921, p. 29) says: "Verrill places the genus *Mycedium* in the family Echinoporidae and he is right in my opinion." Umbgrove (1939) follows Yabe, Sugiyama and Eguchi (1936, p. 48) in making a family Echinoporidae to include this genus with *Mycedium* and *Echinophyllia* (under the name *Oxyphyllia*). I do not propose to discuss this arrangement in detail, since the fact that *Echinopora* has a cyclical arrangement of the septa and the other genera have not is against any near relationship. Also, as pointed out, if the leafy *Echinopora* must join the leafy Fungiidae, then so must also the solid *Cyphastrea*.

Stephenson, Stephenson, Tandy and Spender refer to the genus on pp. 67, 86, 87. They found species at Low Isles, on the seaward slopes and in the anchorage, on vertical or overhanging surfaces below low water. Also on Yonge Reef and Lizard Island, in the latter among other delicate forms on and between larger coral masses (*Porites*) in some depth of water on the edge of the reef.

S. Manton (p. 295, pls. xi and xii) found *E. lamellosa* and another coarser species (? No. 420 below) infrequently in calm water on the seaward slopes of Traverse II, not far from the reef edge, and (pl. xii) on a coral head in water about 9 feet deep. The contrast with the occurrence of *E. gemmacea* at Ghardaqa in the Red Sea is marked, as this, in the encrusting form, is abundant on the surface of the harbour reefs.

Distribution: The genus does not occur in Tahaiti, nor is it recorded by Hoffmeister from Samoa, though Verrill says his *E. elegans* (*E. lamellosa*) is from Samoa.

Echinopora lamellosa (Esper).

E. elegans and *E. concinna* Verrill, 1901. Tr. Conn. Acad. Arts. Sci. vol. 11, pp. 138–39, pl. 29, figs. 3, 4.

All the 9 pieces of encrusting or free *Echinopora* have been given this name by Matthai, in spite of very great differences. To the naked eye they fall clearly into two sets: (1) Six pieces; the surfaces and calices have a soft appearance owing to the number of delicate spines borne in rows on the peritheca, costae, and exsert ends of the septa. These can hardly be shown in a photograph, certainly not in one taken vertically to the surface. (2) Three pieces, of much coarser surface, in which the peritheca bears few and stoutish spines, but is covered with low ridges, while the exsertions of the septa bear coarse teeth.

The coarser form comes near to *E. hirsutissima*, but, as noted above, these species of *Echinopora* all have members connecting with the others. After working on the genus in the Red Sea I find it impossible to decide whether all the forms there found should be placed in *E. gemmacea*, as Matthai considers, or whether, for instance, Klunzinger's *E. carduus* may not be distinct. Meanwhile I believe that the four species *gemmacea*, *lamellosa*, *hirsutissima* and *horrida* are distinct, though I am not, in every case, able to separate them with confidence. Such scraps as those before me, or the small pieces seen by other authors, are of little help, and a series of large complete colonies is necessary, examined on the reef as well as in the laboratory ashore.

Nevertheless the variations among the six more or less typical *E. lamellosa* are so curious as to deserve mention.

No. 125: Surface nearly flat, very finely "woolly" with spinules. Calices with openings 3 mm.; if projecting at all only 1 to 2 mm., usually less, and many are completely immersed; these low walls are thick and rounded; base larger than the opening. In many of them the larger part of the exsert portion of the septa, within the notch, lies inside the calyx instead of being over the edge, so these appear like huge pali; the true pali, much smaller, can often be seen within these.

No. 27 resembles 125 but is a thin plate much crinkled, and, on the ridges, calices project to 1 mm.

No. 456: Very finely "woolly." Calices much larger than in the others, *viz.*, 5 mm. across. Septa all thin, though primaries less so than secondaries, and these than tertiaries; only slightly exsert, and extending horizontally inwards as far as the edge of the columella, to which they drop vertically 1 mm. or less, hence to the naked eye the calices look like truncated solid cylinders.

No. 38: Lamina thinner than the preceding, spinules thicker and coarser. Calices 3 mm. across, slightly more at bases. Primary septa very thick and rough, secondaries less so, tertiaries thin and nearly smooth.

No. 24: Lamina thin and deeply folded, forming in one part a flattened column which, with a little further flattening and fusion, would make a two-sided plate. Calices widely spaced, projecting about 0·5 mm., diameter generally only 2 mm., and, therefore, the tertiaries small and their cycle incomplete. Sides of septa and top of columella spinulose as usual. Primary septa thicker than secondaries.

No. 8 closely resembles No. 24.

Of the second set, No. 420 is a thick and heavy crust, the peritheca being quite solid, 20 to 25 mm. thick, with a thin free expansion at one end; the attached thicker part bears what may be described as narrow humps or incipient branches, very like those figured by me in 1935 (pl. ii, fig. 3) which is indeed a very similar specimen in shape as well as surface. Apparently the characters of the calices were also similar, as I have a note that they considerably resemble those of *E. lamellosa*, though typical *E. lamellosa*, with the characteristic folded margins, does not occur in the Red Sea. Peritheca with low rounded ridges, spines few, low and blunt, but spinulose. Calices comparatively large, 4 mm., round or slightly oval. Thecal walls project at most 0·5 mm. but primary and secondary septa exsert 1 mm. above that. Loculi between septa distinct and deep, thus differing much from preceding set of specimens, since, in spite of the large size of the calices, the secondary septa are thin and the tertiaries rudimentary. Columella well developed, dense, one-third of the diameter of calyx, with upstanding trabecular ends. Pali small and not easily distinguished from the trabecular ends on columella.

The calices are the same on the humps as between them and on the flat expansion. Specimen 25 is a fragment of the edge of a thin plate, thinner than the expanded part of No. 420. Neither of these are at all folded. It is very like the preceding, but the primary septa are little, if at all, thicker than the secondary, and both are much less exsert.

No. 422 is a solid-walled heavy tube, like part of Dana's (1848) fig. 4, pl. 17, * at the thicker broken end 20 mm. across, the irregular cavity being 7 mm. × 5 mm. Maximum external diameter of tube is about half-way up, 32 mm. At the top (the tube is 80 mm. long) the walls thin out to a sharp edge, enclosing a cavity roughly oval, 15 mm. × 6 mm. Calices, septa and perithecal spines like 420, but the spinulae on the sides of the septa are very fine. There are two similar but smaller bulbous tubes with the first set of specimens, resembling them in, *e.g.*, well-marked ridges on the peritheca.

Distribution: Not in the Red Sea, but Indian and Pacific Oceans as far as the Philippines and Fiji.

Echinopora horrida Dana.

(Plate IV, fig. 3.)

Umbgrove, 1939, p. 39, pls. vii and viii.

Sample No. 26, No. B.M. 285, and a number of fragments are labelled *E. gemmacea* by Matthai. I have already recorded the difficulty of dividing the species of this genus, while still believing them to be distinct; to quote Umbgrove (1939, p. 39), " if they are it seems to me that the branched type described here is closely allied to *E. gemmacea*. It may be that it is nothing but a variety or a growth form of that species. Since I have no convincing proof for this opinion I maintain the name *E. horrida* Dana. . . . The question can be settled only by growth experiments on the living reef. I collected no specimens resembling *Echinopora fruticulosa* Ehrb. as figured by Klunzinger in his plate 6 fig. 4, and by Crossland (*Proc. Zool. Soc. London*, 1935, pl. iii), all the specimens from the Bay of Batavia having branchlets with a laciniate and alate apex." With this I agree entirely only adding that nothing comparable to this form has been seen among the many specimens of *E. fruticulosa* I have seen in the Red Sea, and that a careful, special search of the reefs of Malaysia or the Great Barrier Reef might settle the relationships of *E. horrida* to, *e.g.*, *E. lamellosa* and *E. hirsutissima* independently of growth experiments;

* Crossland had omitted the date and numbers in his typescript. This is the only figure by Dana of which I know that matches the specimen.—[A.K.T.]

but relationship to *E. gemmacea* is ruled out by the distinctiveness of the fruticulose form of that species. All the published figures of *E. horrida* show that while *E. gemmacea*, and probably the other species have quite distinct fruticulose forms, *E. horrida* has generally no such distinction, all specimens but this of the Great Barrier Reef being mixed lamellate and branched.

The specimen illustrated on Plate IV is quite clearly the same as that on Umbgrove's pl. vii, the only difference being in the absence of expansions above noted, the proportionally few laciniate branches and the great development of heavy branches with conical thecae. Of the former types most have evidently been broken off.

It seems likely that these heavy conical calices have a physiological origin, since strikingly similar forms are found on the lower branches of *Oculina* spp. from Bermuda, as shown by Verrill, (1901), pl. xxxii. Nothing similar has been seen in any specimens of *E. gemmacea*, fruticulose or otherwise.

I quote Umbgrove again: " From the facts mentioned here it is evident that there is no reason to follow Wells in his instituting a new generic name for *E. horrida*."

Distribution: Malaysia, Philippines, Fiji.

[Family Oculinidae.]

Genus *Madrepora*.

Vaughan, 1907, p. 80.

The use of this name for an Oculinid, for which Verrill is responsible, is a regrettable example of legalism *versus* common sense, but it is too late now to go back to the old well-established nomenclature.

Vaughan (p. 82) gives his researches into the meanings of *Amphihelia*, *Diplohelia* and so on, and ends: " However, I believe that pointing out the tremendous confusion of Duncan's work, and by attaching a name to something definite, a start may be made to unravelling the tangle of the *Amphiheliae* (*Madreporidae*) *striatae*." To go back into this ancient jungle would be merely obstructive, and it is to be hoped that Vaughan's " name for something definite " will not be disturbed, but, under the present legal anarchy, anything may happen to any name.

Madrepora kauaiensis Vaughan.

Vaughan, 1907, p. 81, pl. viii, figs. 1, 2–2*a* and 3.

Three little fragments of thin twigs were dredged from Stn. XV. They correspond exactly with the thin branches of Vaughan's Hawaiian specimen except that the costal striations of the stems are, in places, less prominent. The species is clearly distinct from Moseley's two from the East Indian Archipelago and the Philippines.

All Moseley's and Vaughan's specimens are from deep water; this is the only record from comparatively shallow water.

Distribution: Hawaii, 5 " Mabahiss " Stations in Indian Ocean.

Genus *Galaxea*.

Stephenson and others (1931) refer to the genus on pp. 44, 67, 86, 87 and 90.

One of the corals mentioned as characteristic of the reef flat, of the seaward slopes and anchorage; conspicuous on Yonge Reef, the fringing reefs of Lizard Island and on Batt Reef.

S. Manton refers to the genus on pp. 289, 295, 300, 302, 303, and in pls. xi, xiii, xvi. Species occur on deeper parts of the moat and are dominant on the deeper parts of seaward slopes on Traverses I and II. Here specimens attain a size of over 10 inches. Compare the Red Sea where cushions 4 to 6 in. across are not separate colonies but the tops of columns forming very large masses below. Apparently such masses do not occur in the Great Barrier region. The colonies shown on the plates are minute.

[*Galaxea fascicularis* (Linn.)].

The four specimens, only one of which [*G. musicalis*] is more than a scrap, have been labelled *G. fascicularis* (Linn.) and *G. musicalis* (Linn.) by Matthai.

[*Galaxea clavus* Dana].

On this latter name Vaughan (1918, p. 100) remarks : " Regarding the name *musicalis* which Milne Edwards and Haine applied to the species and attribute with a query to Linnaeus, it is not known, and probably never will be known, what species Linnaeus meant. Because of this uncertainty the name *clavus* proposed by Dana, concerning which there is no doubt, should be applied." My recent work on Forskaal's corals, and other species of the genus in Kóbenhavn Museum, make me share to the full Vaughan's doubt as to the propriety of following either Linnaeus or Milne Edwards and Haime, and I therefore regard *clavus* as the first real name for this species.

In my edition of Forskaal's work I have shown how certain characters usually taken as diagnostic are only characteristic of stages of growth, and especially of dwarf specimens from the reef flat. Such are a continuous peritheca with comparatively thick-walled vesicles, the divergence of calices and their narrowing to their bases. These two last can only be found near the base of a new column, or when new buds arise, and the amount of the projection of the calices may depend on the rate of growth of the peritheca at the time. The number of septal cycles naturally varies with the size and development of the calyx ; there may be five in *G. fascicularis,* but often only three, with or without an incomplete fourth. The thickening of the septa in the walls is not a constant difference, though well marked in some specimens of *G. clavus, e.g.*, Matthai (1914, pl. xvi, fig. 2).

The distinctions between the species are (1) their growth forms, (2) the sizes of the calices, (3) the columellae. The growth forms are cushions in *G. fascicularis,* but, except in very shallow water, these cushions are the tops of *contiguous* columns, which therefore never bear polyps on their sides, whereas in *G. clavus* the columns are free, and bear polyps on all sides. This difference is quite real, since free columns have never been seen in the Red Sea, where I have seen many hundreds of specimens of *G. fascicularis,* both living and semi-fossil. It is in the latter, of course, that the internal arrangement of big colonies is easily seen to be an agglomeration of columns. The sizes of the calices grade into one another, as would be expected, *e.g.*, specimen 188 T 1, labelled *G. musicalis* by Matthai, has *occasional* calices as large as the average of No. 40, *G. fascicularis*. The third distinction is given by Matthai as " columella poorly developed " and " columella distinct " for the two species. Milne Edwards and Haime say " columelle nulle " for the synonymous *G. irregularis*. Defining a columella as a structure formed by outgrowths from the inner margins of the septa, then, *though the septa meet centrally*, there is, in *G. fascicularis*, as a rule no columella at all, at most a mere rudiment through which the septa pass, whereas in *G. clavus*, though small, it is distinct.

Vaughan (1918), p. 99, remarks: "Although large colonies [of *G. clavus*] usually form ascending columns, they do not invariably do so. There is in the U.S. National Museum a colony 15·5 × 18·5 cm. in diameter at the base, which has a nodulate upper surface, but there are no columns." Naturally columns will not be formed in shallow water, and it is from reef pools that so much of our material comes. Specimen 188 of this collection is incomplete, but measures 14 cm. × 9 cm. × 5 cm. thick, is almost quite flat, sloping down round the sides; it is from shallow water. S. Manton (p. 288), writing on Traverse I, finds *G. musicalis*, 3 to 7 inches across, which becomes large and abundant beyond 886 feet, and after 945 feet the large-polyped *G. fascicularis* is usual (see graph 29), but apparently all specimens are really extremely small.

Distribution: *G. fascicularis*, the only species in the Red Sea, so far as is yet known, extends through the Indian Ocean and Pacific as far out as Samoa. *G. clavus*, Indian Ocean and Pacific as far east as Fiji, but not in Samoa, nor Tahaiti, nor in the Red Sea.

Acrohelia horrescens (Dana).

Acrhelia horrescens Yonge, 1930, vol. i, No. 2, p. 17.

This is one of the species which are common in certain places, absent or rare in others of the same district. It is not in the collections from Low Isles or the vicinity, but both Mayor and Yonge found it in the Murray Islands, and Yonge in the Capricorns; it is common in Iwayama Bay, Palao Islands. Umbgrove (1939) also writes (p. 12): "Thus, *e.g.*, not a single specimen of *Acrohelia horrescens* was found in the Bay of Batavia although this species abounds on the Togian reefs." On p. 14 he gives a long list of corals from Amboina (not only Bedot's collection) from which *A. horrescens* is absent.

It is close to the genus *Galaxea*, and, judging from certain specimens of a second species of the genus dredged by Dr. Mortensen off Banda, the two genera may be really identical. This view is supported by Yonge's remark, "The structure and behaviour of the polyp is identical with that of *Galaxea* and description is therefore unnecessary, particularly in view of the possibility that this genus should properly be placed in the Orbicellidae." I adhere to Matthai's division of the Astraeidae, which includes *Orbicella*, though I do not follow him in merging the genus with *Favia*, since, as I have shown, there is the closest relationship between *Orbicella* and *Favia*. *Acrohelia* should join the Astraeidae beside *Galaxea*.

Distribution: Malay region and as far east as Fiji.

[Sub-family Montastreinae.]

Genus *Orbicella*.

I have no hesitation in following Gardiner and Vaughan, and in fact all authors but Matthai, in keeping this genus distinct from *Favia*. Not only are the round calices accompanied by intercalicinal budding sufficient grounds for doing so, but Matthai is hasty in inferring that cyclical arrangement of the septa is absent in the species which he removes to *Favia*. As Vaughan notes in 1914 and C. Crossland in 1931, cyclical arrangement is often to be made out, and, in some specimens, is the rule. It is clear in some calices of Klunzinger's *O. laxa* (one of the species removed to *Favia* by Matthai), but this is only one example, and I particularly refer to my *F. ingolfi* of Tahaiti, and the wish expressed in 1931 and 1935 that its polyps, which are preserved in the British Museum, might be sectioned. Other examples are given under *O. vacua* sp. n., below.

I find the four Indo-Pacific species difficult to define, and I am uncertain whether Matthai's *F. laxa* is really the same as Klunzinger's *O. laxa* (see note on p.125). In Tahaiti the three species, *versipora*, *wakayana* (*i.e.*, *curta*) and *solida* definitely do merge, but, as I showed in 1935 for other species, this does not *necessarily* apply to other regions than Tahaiti.

Gardiner (1904(*b*), p. 774) writes, " I must still assert my inability to find characters which clearly separate *Plesiastraea* and *Leptastraea* from this genus (*P.Z.S.* 1899, p. 751)." A case of a very striking resemblance of a specimen of *Leptastrea* to *Orbicella versipora* has been given on p. 31. Note also the strong probability that *O. mammillosa* Klz. is a form of *Echinopora gemmacea.* At the same time the facts that cyclical arrangement of septa is not universal, and that budding may be accompanied by fission, show the close relationship to *Favia*, and that the two divisions of the Astraeidae as tabulated by Matthai are not hard and fast.

The following are the species of this genus in the Indo-Pacific area : *O. curta, O. ingolfi*, and *O. vacua* n. sp. ; while the following may all be synonymous with *O. curta, viz., O. versipora, O. laxa* and *O. solida.*

Orbicella curta Dana.

1899. Gardiner, *Orbicella wakayana*, p. 753, pl. 49, fig. 2.
1914. Matthai, G., *Favia wakayana*, p. 104, pl. 25, fig. 4.
1918. Vaughan, T. W., *Orbicella curta*, p. 86, pl. 28, figs. 2 to 5.
1931. Crossland, C., *Favia versipora*, p. 384, pls. 15 to 19.

Matthai, examining Gardiner's collections in 1914, decides that four of his species of *Orbicella* are the same as his *Favia wakayana.* He remarks that " it is likely that the present species may have been previously recorded by Dana, but this point cannot be settled till Dana's Astraeid types are examined." This was done by Vaughan in 1918, who shows that this species is Dana's *O. curta* and *O. coronata,* the former name taking precedence, and publishes photographs of both types.

Specimen 401 is labelled " ? *Favia wakayana* " by Matthai but I see no need for the ? mark. The scrap labelled "*Orbicella* A, Nigger Head, Undine Reef," but not numbered, is the same species.

From S. Manton's reference, p. 305, pls. xiv and xv, the species is rare on Low Isles, more common on the outer reefs.

Distribution : If distinct from *O. versipora,* Pacific Ocean only, but as far east as the Tuamotu Atolls, *i.e.*, the limit of the Indo-Pacific area.

Orbicella vacua sp. n.
(Plate II, fig. 1, 4 ; Plate III, fig. 2.)

Three small specimens I am unable to place in any known species. They are sample numbers 399 (5)* ; 400, " Favia 2. Orbicella B," from reef crest, June Reef ; and 433,

* This probably means " Favia 5."—[A.K.T.]

"outer barrier, June Reef, Nigger Head." The first two are small crusts, the third a portion of a solid cushion at least 75 mm. thick.

This species resembles *O. curta* strongly at first sight, having similar exsert septa and costae bearing the rather characteristic transverse lappets. Usually the walls project more, and the costae are more prominent, but in much of the area of No. 399 they are no more so than in most specimens of *O. curta*. All the septa are narrow, and descend vertically into a deep calyx, and there are no traces of pali—hence the specific name. The Tahaitian specimens of *O. curta* usually lack pali (Crossland, 1931, p, 384, pls. 15 to 19), only traces being found in a few calices of 8 specimens out of 60, but this is the result of degeneration, as shown by the long teeth of the lower parts of the septa and the loosely made columella. In *O. vacua* the upper parts of the septa are merely spinulose, the lower either entire or with short blunt teeth, which abruptly merge into the solidly made columella, on which only the points of the trabeculae are usually visible, the heavy beams being often fused together.

No. 433 is labelled ? *Favia laxa* (Klunzinger) by Matthai but the specimen differs from this species as much as it does from *O. curta*. In fact *Orbicella laxa* Klz. and *O. curta* are almost certainly the same. I presume that Klunzinger's and Matthai's species are the same, though Klunzinger (1879*a*, p. 50) says "Knospung fast immer extra-calicinal," while Matthai (p. 100) says "multiplication by equal or subequal fission." I also find several calices in Klunzinger's photograph showing distinct cycles of septa, which are not to be seen in Matthai's, but this is not even a specific difference in either *O. curta* or *O. vacua*. Klunzinger describes the calices as 8–10 mm. in diameter, but they average 6 mm. with a maximum of 8 mm. in the photograph, as in Matthai's. They may be oval in Klunzinger's species, but not as often, nor so greatly, compressed as in Matthai's. Marenzeller gave the name *O. laxa* to several large specimens from the Red Sea, but neither he nor Matthai describe them.

The contrast with *O. curta*, normal or Tahaitian, is complete.

Multiplication, in these three specimens, is by extracalicinal budding alone, and all calices are round except a few in depressions in 399.

In No. 433 four cycles of septa are seen in a number of calices with almost diagrammatic clearness ; in 399 they are less evident, all the larger septa are alike and all reach the columella, except occasionally one joins another. The quaternaries are very small, sometimes only their costae present, alternating with the others as in *Favia*.

Owing to these differences these three specimens *together* must be regarded as the syntypes* of the species. They must not be separated.

[Family Astraeidae : Species Without Cyclical Septa.]

Favia favus (Forsk).

1901. *F. affinis* Marenzeller, p. 119.
1906. *F. savignyi* Marenzeller, p. 82, pl. 25.
1914. *Favia favus* Matthai, p. 79 (with synonymy), pls. 21, 22, 36.

Six specimens are definitely given this name by Matthai, *viz.*, samples 3, 134, 149,

* Crossland wrote "type." But in accordance with the recommendations on International Rules of Nomenclature, B.M. Register No. 129, is hereby designated holotype, and Nos. 370, 396 paratypes: Crossland (1941, p. 10) remarked that such a proceeding, *i.e.*, designation of "type and cotypes" (as he called them), though scientifically absurd, had its practical use.—[A.K.T.]

160, 169, 170, and two more marked with a query. Of these latter I find No. 150 indistinguishable except that the number of septa continuous over the walls is greater than usual, and No. 410 I propose to treat as a distinct variety, var. *crassidens*.

S. Manton refers to it on pp. 285, 286, 288, 294, 298, and 306, and on plates viii, ix, xi, xii and xvi, from which I conclude that the species is one of the commonest of the Faviidae on the Great Barrier Reef as it is throughout the Red Sea. On Traverse I, were numerous small colonies, 2 to 7 inches across; in deeper parts, between 888 and 1014 feet, the commonest species occurring at the rate of 10 per square yard. In all these shallows the specimens are small, in the deeper water, according to the plates, it is rare and smaller than most other Faviidae; on the inner part of Yonge Reef one irregular colony of 27 cm. is shown. In the Red Sea I do not remember any very large specimens, and the abundance of specimens in museums I believe to be due to this habit of forming small, nicely rounded growths in shallows.

On p. 306 S. Manton writes, "Fungias and *F. favus* are more particular in habitat, and occur here and on coral heads and leeward slopes and moats of Low Isles, but are not frequent on other parts of Yonge Reef."

The specimens are matched by published figures as follows:

No. 149: Matthai, G., 1914, pl. 20, fig. 6, "Red Sea, typical form"; pl. 22, fig. 3, Forskaal's type, typical: and fig. 5, his type of *M. cavernosa.*

No. 150: As above, but there are frequent meetings of septa over walls.

No. 170: A mere scrap, like above but distorted.

No. 160: As No. 150.

No. 169 is intermediate between typical forms and that shown in Matthai, 1914, pl. 21, fig. 1.

No. 134: Marenzeller (1906), pl. 25, fig. 86.

No. 3: Matthai (1914), pl. 21, fig. 1; and Marenzeller (1906) pl. 25, fig. 84.

Distribution: Common in the Red Sea, including the northern part; recorded from all over the Indian Ocean. Pacific records are few, Tongatabu; Philippines and Samoa; and now the Great Barrier Reef, but not from Murray Island. It does not occur in Tahaiti, but a specimen from the Tuamotu Atolls in the Museum at Papeete is probably of this species.

Favia favus var. *crassidens* var. n.

(Plate XIV, fig. 5.)

Specimen No. 410, though heavy for its size, is remarkable for the thickness of its septa rather than of its walls, in fact the calices are near together in comparison with Matthai's (1914) var. 2, figured on pl. 20, fig. 4, or pl. 21, fig. 3; or by Marenzeller (1906), pl. 25, fig. 88. Prominence of a few septa is common in this species, and is shown in Matthai (1914), pl. 21, fig. 3, pl. 22, fig. 1, and, in some degree in Nos. 149 and 134 of the present collection; but the state of these prominent thickened and exsert septa, as shown on pl. xiv, fig. 5, is unique. To this photograph I refer for numbers and measurements.

It is regretted that the specimen should be only a small part of a colony.

Favia valenciennesi M. E. and H.

1914. *Favia bertholleti* (Val.) Matthai, p. 94, pl. 22, fig. 7; pl. 23, figs. 4, 6; pl. 24, fig. 1.
1918. *Favia valenciennesi* Vaughan, note 2, p. 100.
1924. *F. valenciennesi* Matthai, G., p. 14, pl. 4, fig. 1; pl. 11, fig. 2.

Specimen 163 is given the name *bertholleti* by Matthai, with a ? mark on his pencilled label. The species is difficult to define, as shown by the number of photographs given above, and by the fact that Matthai (1914) shows on pl. 22, fig. 7, one of Forskaal's types of *F. favus*, " ? *F. bertholleti* (Val.) . . . perhaps only a thin-walled *F. favus*."

S. Manton does not mention the species; it is evidently rare on the Great Barrier. This specimen shows the same change from moderately deep calices on one side of the colony to very shallow ones on the other that was seen in a specimen of *F. doreyensis*, but in this case the whole colony was alive and apparently healthy when collected. This difference is common between the upper and lower parts of many corals, though not often so marked. Intercorallite grooves are not present, this being var. 1, the light form. It is very like Matthai's (1914) pl. 23, fig 6, but the calices are usually rounder.

Distribution: Red Sea and Indian Ocean. The present record from the Great Barrier Reef is the first from the Pacific.

Favia doreyensis M. E. and H.

1914. Matthai, G., *F. doreyensis*, M. E. and H., p. 84, pls. 9, 22, 32.
1918. Vaughan, T., W. *F. pallida* Dana, p. 105, pl. 38, figs. 1–7.
1924. Matthai, G., *F. doreyensis*, p. 11.

Matthai's reason for not adopting Dana's name in 1924 is apparently that Vaughan includes *F. hululensis* Gard. in *F. pallida*, which species Matthai considers should be kept distinct. The species *hululensis* is not present here.

The species is peculiar in having round separated calices which divide very unequally and yet produce smooth colonies.

One specimen, No. 154, calls for remark; it is an oval mass, 12 cm. × 8·5 cm. × 6 cm. high, somewhat hollow underneath. About half of it is dead; along the growing inturned edge it has the characters of *F. doreyensis*, but, as we pass over the upper surface (probably the vertical surface in life) calices become more and more shallow, their edges less and less distinct, until, over the dead half of the colony, the thecae are quite superficial and widely separated, the result being almost exactly like a figure of *F. favosa* given by Matthai (1924), pl. 2, fig. 8. Doubtless the same causes, position in the colony and mud or crowding, has had the same effect on these two so different corals, and on the specimen of *F. valenciensii* referred to above.

S. Manton refers to this species on pp. 285, 288, 294 and 297, and on pls. viii, ix and xiii. It is of wide local distribution, but infrequent, and, like all the Low Isles Faviidae, very small.

Distribution: Indian Ocean, Pacific to Philippines, Fiji, and Samoa, but not from the Red Sea or Gulf of Aden.

Favia speciosa Dana.

1914. *Favia clouei* (Val.) Matthai, p. 89; pl. 10, fig. 6; pl. 23, figs. 1, 2, 5; pl. 34, fig. 1.
1918. *Favia speciosa* (Dana) Vaughan, p. 103, pl. 36, figs. 1, 2, 2*a*, 3, 4, 4*a*; pl. 37, figs. 1 to 4*a*.
1924. *Favia speciosa* (Dana) Matthai, p. 12, pl. 1, figs. 3, 5, 8*; pl. 11, fig. 3.

Matthai adopts Vaughan's correction of the name *clouei* to *speciosa* in 1924, but labels the four present specimens as *F. clouei*.

* As this plate is printed upside down figs. 3, 5, 8 of the 'explanation of plate' appear as figs. 7, 5, 2 on the plate itself.

To *F. clouei* S. Manton refers on pp. 285, 288, 298, 302 and 305 ; and on pls. iii, viii, xii and xiv. On Traverse I there was one in the moat and a few on the deeper part of the seaward slope. On Traverse III (to windward), on the third 100 feet of the slope, "the deeper water Favias of Traverse 1 continue or appear for the first time," *F. clouei* being one now to appear. On p. 302 Manton says, "The deeper water *F. vasta*, [*i.e.*, *F. virens*] *F. clouei*, [*i.e.*, *F. speciosa*] *Astreopora*† and *Lobophyllia* have larger polyps than the species found in shallow water" and withstand mud better.

This species has been thoroughly illustrated, as shown by the references above, to which many others may be added including Yabe, Sugiyama and Eguchi.

No. 159 is very like Dana's type of *Astrea pandanus* figured by Vaughan, T. W. (1918), Pls. 36 and 37, and some of its calices low down on one side resemble both fig. 4*a* on pl. 36 and the whole of the flat specimen dredged at Stn. XXIV. This leads on to No. 215, a distorted scrap from "Detailed survey 1. *Favia* from scanty corals, weed zone, deep water."

Nos. B.M. 419, 418 and 609 dredged at Stn. XXIV, with perfectly flat calices, marked off by thin polygonal lines, may be this species, but certainty is not possible.

Distribution: Northern Red Sea through the Indian and Pacific Oceans as far as Fiji and Fanning Islands, but not found in Samoa or Tahaiti.

Favia stelligera Dana.

F. acropora Matthai, 1914, p. 102.

One portion labelled "No. 49, *F. acropora*" by Matthai, represents this species. The names *acropora* and *lobata* have the advantage of being descriptive ; in Matthai's list of 14 references the former is used six times, the latter five times, but Dana is not referred to. In 1918 Vaughan states that the earlier authors' descriptions are not identifiable, and have led to error, so that this name is not available for any coral. He therefore substitutes Dana's name *stelligera*, remarking that Klunzinger's pl. 3, fig. 9, of *F. lobata* might almost have been made from Dana's type.

S. Manton refers once, on p. 289, to the occurrence of this species on the seaward slope of Traverse 1. As the species is so conspicuous in life, the columnar growths, which are thicker above, and the small calices making it one of the few Astreans certainly recognizable at sight, I conclude that it is rare in the Great Barrier Region. It is not recorded from Murray Island.

Distribution: From the northern Red Sea, where it may form large masses, to Tahaiti.

Favites halicora (Ehrb.).

1914. *Favia halicora* (Ehrb.) Matthai, p. 106, pl. 26, figs. 3, 5–7.
1918. *Favites halicora* (Ehrb.) Vaughan, p. 110, pl. 41, figs. 1, 2 and 3.
1924. *Favia halicora* (Ehrb.) Matthai, G., p. 17, pl. 1, figs. 4 and 6.*

S. Manton refers to this species on pp. 285, 288, 294, 298 and 306 ; and on pls. viii, ix, xv and xvi. It is generally distributed, as very small colonies, on shallows both at Low Isles and Yonge Reef. In the latter locality it grows larger, but nothing of any size is shown on the plates.

† Not true of Astreopora.—[C.C.]

* As this plate has been printed upside down figs. 4 and 6 of "Explanation of Plate I" are really figs. 6 and 4 on the plate.

Four small specimens and a scrap are labelled "*Favia halicora*" by Matthai. The last, 425, is too small for certain identification. 173 is thin walled, 162 and 180 are decidedly thick walled, and 229 is intermediate. Grooving between the calices is strongly marked in 162 but hardly at all in 180, though both are thick walled.

For distinction from allied species, *e.g.*, *F. abdita*, see Vaughan (1918), pp. 101, 110.

For the relationship between thin and thick walls compare Matthai's two figures in 1924, which are taken from the same specimen, and illustrate the variation with position mentioned above in the cases of *e.g.*, *F. doreyensis*, *F. virens* and *F. valenciennesi*.

Distribution : From the northern Red Sea through the Indian Ocean, including the Natal coast ; the Pacific, including Murray Islands, Fanning and Samoa, but not Tahaiti.

Favites abdita Ell. and Sol.

Of this generally common species only two small pieces are present, but S. Manton refers to it on six pages and six plates.

The great likeness of some specimens of *F. flexuosa* to some of *F. abdita* is commented upon on p. 46, and by Yabe, Sugiyama and Eguchi, while Vaughan, 1918, p. 111, remarks : "Some specimens of *F. halicora* have a most perplexing resemblance to some specimens of *F. abdita* (compare pl. 40, fig 4, with plate 41, fig. 2), as Matthai has pointed out. Usually the prominent septal dentitions just within the calices of the former are a good discriminating character."

S. Manton refers to the species on pp. 288, 294, 298, 305 and 307, and on pls. viii, ix, xii xiv and xvi.

The specimens noted are quite minute, 1 to 7 inches across, except one shown on pl. xii. This was growing on a pinnacle of dead coral which may be described as small, being 36 cm. across. It is common in shallow water on the two leeward traverses, but not to windward. On Yonge Reef it is found frequently on the inner parts and occurs also on the reef crest, where the colonies are very small. It is thus one of the species "able to exist under very variable conditions," but *not* able to grow to full size anywhere in the areas seen. Compare this observation with that of Gardiner (1899, p. 758). In Rotuma (?) "these three species" (all are *F. abdita*, *fide* Matthai) "live on the extreme breaking edge of the reef, and are exposed at spring tides for two or three hours to the sun. though constantly wetted by the spray. They form also large spreading masses as deep as can be seen outside the reef." In 1905, p. 787, of *P. fusco-viridis* Gardiner says, "Very common on lagoon shoals and outer slope, often forming immense masses both at Minikoi and in the Maldives." In the Red Sea large specimens occur off a reef edge about Lat. 21° N., but at Ghardaqa in the North it, with *F. halicora*, is one of the corals which are found as small scattered colonies on the outer part of the shore reef-flat. Large colonies have not been found there.

The two specimens are of the blunt-walled variety. Among the numerous illustrations published they are matched by Vaughan's (1918) pl. 40, fig. 3, which shows Dana's type of *A. fusco-viridis*, and fig. 5, one of the specimens from Murray Island ; and by Matthai's (1914) pl. 29, figs. 3 and 4. For illustrations of the more typical growth form see Bedot (1907), pl. 30, fig. 150 (under the name *P. robusta*), and Matthai (1914), pl. 35, fig. 2. Matthai (1924, pl. iv, fig. 2) shows a curiously branched form from somewhere in the Indian Ocean, which is matched by two in the Kóbenhavn Museum from Singapore, in which hillocks become vertical branches.

Distribution : The whole Indo-Pacific, including the Red Sea, Mauritius and Natal; but not east of the Fiji Islands.

Favites virens Dana.

(Plate VI, figs. 1, 2.)

1914. *Favia vasta* (Klz.) Matthai, G., p. 108, pl. 27, figs. 3, 5, 6.
1918. *Favites virens* (Dana) Vaughan, p. 111, pl. 41, figs. 4, 5.
1924. *Favia vasta* (Klz.) Matthai, p. 18, pl. 1, fig. 7* ; Pl. 11, fig. 1.
1936. *Favites flexuosa* (Dana) Yabe, Sugiyama and Eguchi, p. 32, pl. 20, fig. 1.

S. Manton refers to this species on five pages and on three plates, using Matthai's name, *Favia vasta*.

In 1924 Matthai lists Vaughan's name *virens* as a synonym, but gives no reason against its adoption, though Vaughan's reasons appear conclusive ; they depend upon Matthai's identification of Klunzinger's *Goniastrea halicora* with his *F. vasta*, with which, after deliberation, I agree. I therefore follow Vaughan in adopting Dana's name. *Favites flexuosa* Dana is raised to a distinct species by Yabe, Sugiyama and Eguchi, though it is given as a synonym of *F. abdita* by Vaughan. While agreeing with the Japanese authors in its distinctness from *abdita*, the seven specimens before me bring *flexuosa* clearly into the range of *F. virens*. The distinctions from *F. abdita* are, however, much less than the resemblances. Yabe, Sugiyama and Eguchi give (1) broader, stouter, and more numerous septa ; (2) broader walls, rounded above ; (3) larger calices. (1) is merely a consequence of the much larger calices, and, in fact, *F. virens* is only a large form of *F. abdita*, except that in the former, when septa meet over walls generally the short meet the short, while as a rule the short meet the long in *F. abdita*. The difference between short and long septa is much more marked in *F. virens*, the former being decidedly thinner, and extending only a short way down the wall. These small differences suffice to divide the species unless intermediates are found.

Just as in *F. abdita* there are two very well marked forms (1) with thin walls and calices as almost regular pentagons ; (2) with thicker, rounded walls and calices, therefore rounded pentagons or almost oval. The latter are the *F. flexuosa* of Dana and of Yabe, Sugiyama and Eguchi.

I regard the columella as a distinctive feature, which is shared with *F. abdita*, and illustrate it on Plate VI, fig. 1. It is compact and clearly defined ; the trabeculae are delicate and expand into lappets at their ends, the edges of which are spinulose ; these have no resemblance to septal teeth, with which their connection is found only after careful examination. The septa round the columella end in a vertical drop, forming a little pit floored by the top of the columella. Klunzinger's description as " grob trabekular " is thus misleading, as apparently the coarseness refers to the little lappets, not to the columella itself. A lens shows at once that the " *Goniastrea halicora* " figured contradicts the definition of the genus in having a well-developed compact columella. I much doubt whether his var. *superficialis*, with its rudimentary columella, formed of ordinary septal teeth, can be the same species. There is nothing like it in the series before me.

Each long septum is divided into two parts, the upper narrow, with fine teeth (*i.e.*,

* As this plate has been printed upside down fig. 7 of " Explanation of Plate I " is really fig. 3 on the plate.

in proportion to the size of the calyx), the lower broader and thicker, with coarser teeth. This lower part, to the naked eye, simulates a crown of pali.

The series before me could not have been better selected to illustrate the variation from an *abdita*-like form to the very different *flexuosa*. The points in which the specimens differ are (1) size, (2) depth, (3) walls, thin and sharp or rounded, (4) presence or absence, and depth of grooves between the calices.

(1) Diameters of calices : Specimens 174 and 167 have small shallow calices, like those of *abdita*, but with some larger than are to be found in the latter, *viz.*, 15 mm. in longer diameter. The average and maximum sizes in the other specimens are 15 mm. and 20 mm., but there are only two calices of 20 mm. on one side of the colony. In No. 114 the average and maximum sizes are 20 mm. and 23 mm. In another specimen,* 20 mm. and (one) 22 mm.. In No. W.2, 20 mm. and 24 mm. (this is the typical *flexuosa*, almost exactly like Yabe, Sugiyama and Eguchi's fig. 1, pl. 20), and lastly a specimen* with all calices about 15 mm. in diameter.

(2) Depths of calices : in the first two specimens the calices are shallow, especially in the thick-walled No. 167, but in both as usual in all corals, the calices are much deeper on the summits of the dome-shaped colonies. In the third, No. 115, the calices are shallow at one end, 7 mm. deep at the other. No. 114 is similar, but has far larger calices (6 and 7 mm.). In No. 152, all calices are equally deep. In W.2 all are deep, and in 145 the calices are smaller but about 10 mm. deep.

(3) Walls thin and sharp in only the first of the series, and on the flatter part of the fourth. This specimen is particularly interesting, since fairly sharp-walled calices occupy most of the surface, thick walls round the deeper calices which are marked off by grooves. The fifth and seventh of the series have all the calices separated by grooves, in the latter quite deeply, but in the sixth, No. W.2, there are few traces of grooves, *i.e.*, it is a perfect example of *F. flexuosa*.

Illustrations of specimens matching those of this series are provided as follows :

(1) No. 174, Klunzinger (1879*a*), pl. iv, fig. 2 (*Goniastrea halicora*).

(4) No. 114, the part without grooves between the calices, Vaughan, T. W. (1918), pl. 41, fig. 5 ; Faustino (1937), pl. 28, fig. 2 ; Mayor (1918), pl. 16, fig. 28.

(6) No. W.2 (*F. flexuosa*), Vaughan, T. W. (1918), pl. 40, fig. 2 ; Yabe, Sugiyama and Eguchi (1936), pl. 20, fig. 1.

Of the remainder of this series Nos. 114, 115 (the upper part) are illustrated on Plate VI, figs. 1 to 2.

The first is remarkable in that the calices are marked off partly by notches in the septa over the walls, in the usual way, and partly by laminae between the septa parallel to the walls.

It is to be remarked that the series would have been even more instructive had larger and more complete colonies been brought home, or, from really large masses several samples been taken with notes on their positions. At the same time I note from S. Manton's account that, although the colonies belong to a large number of species the colonies are all small—very small compared with those I know in the Red Sea, and those described by

* There are seven specimens : Nos. 114, 115, 145, 152, 167, 174, W.2. Crossland did not mention the number of this specimen in his typescript.—[A.K.T.]

Gardiner in the Indian Ocean and Pacific. There are few coral species in which the specific features are constant over any large area of a colony, and lateral crusts are generally abnormal.

Distribution : From the northern Red Sea (where it attains a considerable size) to the Pacific, but not further east than Samoa.

Favites aspera Verrill.

(Plate V, figs. 1, 2.)

1868. *Goniastrea aspera* Verrill, p. 32.
1904(*b*). *Favia parvimurata* Gardiner, p. 771, pl. 62, fig. 25.
1914. ? *Favia parvimurata* Gard., Matthai, p. 113.
? 1918. *Acanthastrea hemprichii* Vaughan, p. 101.
1927. *Goniastrea aspera* Verrill, Faustino, p. 141, pl. 33, figs. 1 and 2.
1936. *Goniastrea aspera* Yabe, Sugiyama and Eguchi, p. 35, pl. xxiv, fig. 3.
1938. *Goniastrea aspera* Eguchi, p. 350.
1939. *Favites aspera* (Verrill) Umbgrove, p. 30, pl. iii, fig. 3 ; pl. v, fig. 1.

Two specimens of widely different appearance are present, No. 155 being labelled *Favia parvimurata*, the other No. 166, ? *Favia bertholleti*, both by Matthai. This latter specimen fits no description or figure of that species, but does connect the heavier No. 155 with the lightly built *F. aspera*, from which it differs only in having smaller and simpler upwardly directed teeth on the exsert parts of the septa.

Gardiner's original description fits specimen No. 155 better than does Matthai's, which is abbreviated and omits the important fact that the walls are not only peculiarly delicate but sometimes incomplete, and dismisses the lower septal teeth, carefully described by Gardiner, mere as a conspicuous pali crown. These two points are important also in connection with the much lighter form of No. 166, which is figured with 155 on Plate V, the differences from Gardiner's specimen being all due to general lightness of build, *e.g.*, the relative inconspicuousness of the lower teeth of the septa and of the toothing of their upper parts. As might be expected, the walls in this example are quite often incomplete, though never wholly missing, and without interrupting the sequence of the septa. The columella is loose, though essentially as in No. 155. For septal numbers, measurements, etc., I refer to the photograph.

A complete description of the species can be had by combining the accounts of Gardiner, Faustino (who copies that of Verrill, with notes by Vaughan) and Umbgrove.

Vaughan (1918), p. 114, says : " I doubt *G. aspera* really being a *Goniastrea*. Besides having roughly and irregularly dentate septa, the intercorallite walls are often slit, making a combination of characters suggesting affinity with the *Coeloria* group of *Meandra*."

Distribution : Maldives, Malaysia, Japan (Yabe, Sugiyama and Eguchi), Southern Philippines and the Great Barrier Reef. Always rare.

Genus *Goniastrea*.

The genus is abundant at Low Isles and elsewhere on the Great Barrier, and apparently in many places in the Indo-Pacific it is the commonest of all the Faviidae. The smooth rounded shape and nearly white colour of the commoner species make them conspicuous.

Stephenson and others include it in *Favia*, but S. Manton gives four page references to the genus on four pages and to the several species on numerous pages and plates. At

Hope Reef Hedley and Taylor found it, with *Porites*, dominating the edge of the reef. This genus has evolved a completely meandrine form, *G. benhami* Vaughan, noted on p. 136 and figured on Plate VIII, which offers a curious ecological contrast to what we may call the meandrine form of *Favia, i.e., Coeloria*, in that, while the latter is a more successful species, both in number of specimens and especially in size of colonies than the original form with simple calices, the former is a rarity and always small. Similarly in *Lobophyllia* it is the simple form which is so important in the Red Sea and elsewhere, the meandrine forms being unimportant. Many species have been attributed to *Goniastrea* which are so ill described that even their generic position is uncertain. Some of these are tabulated by Matthai (1914, p. 116). It does not seem to me possible, however, to make *G. seychellensis* Klz. identical with ? *F. favus* (Forsk.). Quelch's species are not certainly identifiable, but his *G. incrustans* has been redescribed by Matthai (1924), p. 21, pl. ii, fig. 4; pl. xi, fig. 4. It is very close to *G. pectinata*. *G. lacera* Verrill is a *Favites*.*

I therefore list only the following 6 species as certainly known:

1. *G. retiformis* (*G. solida* or *G. parvistella*).
2. *G. pectinata* (*G. planulata*).
3. *G. incrustans*.
4. *G. mantonae*, n. sp.
5. *G. benhami* Vaughan.
6. *G. seychellensis*.

Of these it is barely possible that *incrustans, mantonae, benhami*, are varieties of *pectinata*.

The mode of division of calices is rarely given by authors, but, judging from the specimens before me and the numerous figures published, the "subequal division" of Vaughan's definition is the rule in all but *G. mantonae*. I tabulate the species as follows:

A. *No tendency to meander:*
  (1) Multiplication by subequal fission. Calices up to 4 mm. wide . . . . 1. *G. retiformis*.
  (2) Multiplication by marginal fission. Calices up to 10 mm. wide . . . . 2. *G. mantonae*.
B. *Occasional short meanders:*
  (1) Calices up to 7 mm. wide; meanders rarely over 12 mm. Palial lobes large . . . . . { 3. *G. pectinata*. 4. *G. incrustans*.
  (2) Calices 10 mm. wide; meanders up to 25 mm. long. Palial lobes poorly developed . . . . 5. *G. seychellensis*.
C. Meanders frequent, 6 to 9 mm. wide, 30 mm. to 44 mm. long 6. *G. benhami*.

Goniastrea retiformis (Lamk.).

1914. *G. retiformis* Matthai, p. 118, pl. 31 figs. 1–5; pl. 33, fig 3; pl. 38, figs 2 and 4.
1914. *G. solida* Matthai, p. 117, pl 28, figs 3 and 4; pl. 31, fig. 1; pl. 33, fig. 4; pl. 38, fig. 3.
1918. *G. retiformis* Vaughan, p. 114 [pl. 15, fig. 24; pl. 16, fig. 25; both of Dr. Mayer's article (1918.)]
1918. *G. parvistella* Vaughan, p. 114, pl. 44, figs. 2, 2*a*.
1925. *G. retiformis* Hoffmeister, p. 26.

* Crossland had added, "and is described as such on p. — of this report." I am unable to trace this reference.—[A.K.T.]

The typical and commonest form, with its small, sharp-walled calices, is one of the most easily recognizable of all corals, but its variation is extensive and gives puzzling cases.

The history of the species is as follows: Matthai (1914, p. 118) includes in his synonymy-list 7 references under the name *retiformis*, 3 under *solida* and 5 under other names, which means that both Milne Edwards and Haime and Gardiner are unable to distinguish these two species. On the same page, but under *G. solida*, he says that of the five specimens which Milne Edwards and Haime refer to *G. solida*, two belong to *G. retiformis*. Of the 19 "Pola" specimens at Vienna, all referred to *G. favus* by Marenzeller, he says that ten are undoubtedly *G. retiformis* and that the remaining ones may be assigned to *G. solida*. No. 15918 (*solida*), Matthai says, has corallites showing a meandering tendency. By definition above this is not *solida*, but probably *planulata*. Also I consider that Matthai's (1914) fig. 1 on pl. 30 is of *G. solida* according to the text on p. 117, but *G. retiformis* according to the text on p. 118, and the explanation of the plates on p. 139.

In 1918 Vaughan says that the name *solida* is inappropriate, and substitutes *G. parvistella* Dana since Matthai took it from Forskaal, whose *Madrepora solida* is a *Porites*, as discovered by Marenzeller. Since Forskaal says the species is the building material of considerable towns there was hardly need to wait for Marenzeller to know that it is a *Porites*! Matthai, however, distinctly writes "non *Madrepora solida* Forsk.," so the objection does not hold.

The above prepares us for Hoffmeister's finding that, in his Samoan specimens, "the main difference that I am able to make out in all these specimens is in the thickness of the walls. The Samoan specimens, however, show walls as thin as those in typical *G. retiformis* in some parts of the corallum, and, in other parts, are as thick as those of Dana's type of *G. parvistella*." "I have examined very carefully all of the specimens in the U.S. National Museum, including those in the Samoan Collection, and have compared them with Dana's type of *G. parvistella* and with Matthai's description and figures of *G. solida* and *G. retiformis*." Hoffmeister therefore concludes that the species are the same. Umbgrove (1939, p. 32) agrees, and "will describe transitional forms from Togian reefs."

Finally in 1934 Matthai labelled two specimens of the Great Barrier Reef Collection, No. 142 ? *G. solida*, and No. B.M. 183 from Batt Reef as *G. retiformis*. The two are exactly alike, except that the latter is somewhat more solid. In both, pali may or may not be divided by a deep notch from the septa, the sides and edges of which are spinulose, very much so in the "solida" specimen, the columella degenerate and often fused.

It is clear that this species is an excellent subject for ecological work on the reefs, the easier as the species is so common. For the present the species name is *retiformis*, with variety *solida*.

The other two specimens, No. 226 T. 1 moat and No. 177, are typical, and are matched by numerous figures by several authors. No. 142 B.M. 185 is best matched by Matthai's pl. 31, fig. 1; and No. B.M. 183 by Mayer's (1918) pl. 15, fig. 24. S. Manton refers to this species on pp. 285, 286, 288, 293, 294, 305 and 307, and on plates viii, xi, xii, xiv and xvi. On Traverse I it is one of the most abundant corals in the moat; at about 830 feet the rocks dip below low water, and this species appears with *F. favus*, *F. astraeiformis* and *Acropora* spp. On the seaward slope between 846 and 930 feet it is more abundant than the other Faviidae, which become more numerous as the water deepens.

On the seaward slope, as on Traverse II, are the largest specimens, as well as most numerous species, up to 16 inches across—quite a large coral for Low Isles. Pl. viii shows its extension from lowest tide level to 8 feet below, but it extends no further. On Yonge Reef it occurs both on the crest, pl. xiv showing one flat-topped colony 18 × 11 inches, and in the anchorage zone, where pl. xvi shows one 32 × 18 inches, thus showing that it is tolerant of very variable conditions. Only one specimen of the *solida* form is recorded, 3 inches in diameter on the seaward slope of Traverse II.

It is abundant, and much larger in the Maldives. Gardiner (1904*b*, p. 772) writes : " This golden-green species is common on the outer slope, occasionally occurs on the reef-flat in small heads, and is abundant in the lagoon, both at Minikoi and in the Maldives. It often forms immense masses, which on the shallow flat behind the boulder zone die in the centre but spread linearly, the blocks in growth resembling massive Porites." I have not seen this golden-green colour in the Red Sea, where it is very light brown or almost white.

Distribution : Vaughan says, " One of the best known Pacific and Indian Ocean corals." Common, often abundant, from the northern Red Sea to Fiji and Samoa, but not in Tahaiti.

2. *Goniastrea pectinata* (Ehr.).

1892. *Coeloria australiensis* Rehberg, Abh. Naturwiss. Verein Hamborg, pp. 1–50, pls. i–iv.
1914. *Goniastrea pectinata* Matthai, p. 120, pl. 28, fig. 6 ; pl. 37, fig. 1.
1914. *Goniastrea planulata* Matthai, p. 121, pl. 28, fig. 5 ; pl. 31, figs. 7 and 8.
1918. *G. pectinata* and *planulata* Vaughan, pp. 114 and 116 ; pls. 42 and 43 ; [pl. 15 of Dr. Mayer's article (1918)].

The two species recognized by both Matthai and Vaughan differ only in the thickness of their walls. The two works quoted may be consulted for the difficulties both these highly experienced men have had in separating the species, which I will not repeat in full, but, as one example, on p. 115 Vaughan says " Dr. Mayer obtained 20 other specimens of *Gonistrea pectinata* on the Murray Island reef. The variation is simply bewildering . . . The principal variation is in the character of the wall between adjacent corallites and in the depth of the calices." These characters vary with position on the colony in the usual way, but the means also vary from colony to colony. There is no difference in the present collection between some of the specimens labelled *pectinata* by Matthai, and those he has labelled *planulata ;* all the specimens can be arranged in a continuous series.

Matthai labelled the specimens as follows :

(1) As " *G. pectinata.*" No. 224 O. T.1 Moat ; and the following unnumbered from Batt Reef ; B.M. No. 171, Patch 1, square 4 ; B.M. No. 172, Patch 1, square ? ; B.M. No. 175, square 3 ; B.M. No. 176, Patch 1, square 9. The following are marked with a query : Nos. 153, 146 and B.M. 88, locality 2. These last three specimens have very thin walls, slightly larger and deeper calices, and narrow septa, but do not differ from No. 224 preceding, which is not so queried. I do not share Prof. Matthai's hesitation. His identification of B.M. No. 88 with *Coeloria australiensis* is not queried ; the ? is to *Goniastrea* sp. There is no difference between it and Nos. 153, 146 and others.

(2) As " *G. planulata.*" From Batt Reef, Patch 1, square ? ; B.M. No. 178, a half dead scrap ; B.M. No. 179, similar ; B.M. No. 180, fragment of a small but living colony ;

B.M. No. 181, showing some marginal fission. The last-mentioned is a whole colony, though very small (7 cm. in diameter × 7 cm. in height), and columnar in shape. Walls thin to very thin, calices low down the sides generally, but not always, thicker walled and shallow. It combines the characters of *G. planulata* and *G. pectinata.*

S. Manton refers to *G. pectinata* on pp. 284, 285, 287, 293, 294, 300 and 302, and on pls. iii and x. As she does not refer to *G. planulata* I presume it is included in *G. pectinata.* It is found in very small colonies, 1 to 4 inches across, in shallow parts of Traverse I, as far as 620 feet (see pl. iii, graph 22) and is one of the more abundant corals (1 to 7 inches across) in the moat, but is absent from deeper water. It occurs also on the inshore part of Traverse II, but is again absent from the seaward slope. It is found to remove sediment, both sand and mud, with relative ease, which probably accounts for its successful growth in shallow water. Pl. X shows only two little growths, $4\frac{1}{2}$ inches across, in the moat.

On this part of the Great Barrier the species is very much less common than is *G. retiformis.* Gardiner did not find it in the Pacific Islands he visited, and it is somewhat rare in the Maldives, though it is common at the Murray Islands and Samoa.

Distribution : Red Sea, Indo-Pacific to Samoa, but not to Tahaiti ; and apparently absent from some islands west of Samoa.

4. *Goniastrea benhami* Vaughan.

(Plate VIII, fig. 2.)

1917. Vaughan, p. 277, pl. xviii, figs. 1, 2, 2*a* ; pl. xix, figs. 1, 1*a* ; pl. xx, fig. 1.
1918. Vaughan, p. 116.

One small specimen, No. 51, of this rare species is in the present collection, and another was brought to me by Mr. G. W. Otter.

Vaughan published 6 figures in the Trans. New Zealand Inst. As this publication may not be always accessible, I publish another, but do not repeat Vaughan's description except to quote " except that it has meandroid calicinal valleys it bears a considerable resemblance to some specimens of *G. pectinata.*" I also remark that, in this specimen, valleys are meandroid in all parts of the colony. They are up to 30 mm. long, with 4 or 5 centres.

Distribution : Kermadec Islands, Formosa, and now the Great Barrier Reef.

Goniastrea mantonae, sp. n.

= Goniastrea K.5 and K.18 Manton (1935).

(Plate VII, figs. 1 and 2.)

The only three fair-sized specimens of this species are here assembled. They are labelled by Prof. Matthai only as *Goniastrea* sp., their numbers being : sample 120, B.M. 186, T.2 shallow (*Goniastrea* K.5, Manton) ; 128, B.M. 404, T.2 shallow ; 179, B.M. 187 (*Goniastrea* K.18, Manton). They were labelled by letter and number because Dr. Manton could not identify them with any known species.

The first is apparently half a regular hemisphere, 12 cm. in diameter, 6 cm. thick. No. 128 is a whole colony, a crust 0 to 5 cm. thick, growing over some other Faviid. No. 179 is a nearly regular low dome, 12 cm. across by 5 cm. high. All were in good condition and active growth.

I am fortunate in having three good specimens on which to found a new species, but, as in most coral genera, and especially in this, a dozen would have been none too many.

Definition : As *G. pectinata*, but (1) calices are larger, the largest in K.18 being 10 mm. × 9 mm., 11 mm. × 7 mm., 12 mm. × 10 mm. ; in No. 128 the largest are 10 mm. × 7 mm., 9 mm. × 5 mm., 11 mm. × 7 mm. ; and in K5. are 9 mm. × 9 mm., 10 mm. × 9 mm., and 12 mm. × 7 mm. ; the depths are in proportion as in *G. pectinata*. (2) There is no trace of meanders. (3) Fission is always marginal. Palial lobes always distinct, but not thicker than the upper halves of the septa. While the latter are finely denticulate the former bear small teeth ; notch between palial lobe and upper part of septum horizontal, or extends downwards a little way. Columella deep below palial lobes, of very fine, often indistinct, trabeculae.

In No. 128 the intermediate septa are rudimentary and often absent ; in K.5 small but generally present ; in K.18 longer and always present. Edges of septa strongly denticulate in all three, sides roughly granulate in K.5 and No. 128, nearly smooth in K.18. K.5 has thicker walls and septa than the other two, and, as usual, the walls are still thicker and calices shallower near the base.

The thicker-walled K.5 is shown on Plate VII, fig. 1. The general likeness to *G. pectinata* is obvious, but the marginal fission and absence of meanders are equally distinct.

Owing to differences between the specimens all three must be regarded as syntypes.* They cannot be considered apart.

S. Manton refers to this species on pp. 287, 288, 293, 294, 305 and 306, and on Plates viii, xi, xii, xiv, xv and xvi. On both Traverses I and II it is present in the moat and on the shallower part of the seaward slope, much as *G. pectinata*. On Yonge Reef both on the crest and on the inner part, where it is frequent. It thus endures a wide range of conditions, though it never extends much below low water. Manton's plates also show a wide local distribution, though it is never abundant. Pls. xv and xvi show larger specimens, up to 34 cm. across, the examination of which would have made my definition of the species much more complete and safe.

[Family Astraeidae : Meandroid species.]

Genus *Cynarina* Brüggemann.

1877. Revision of the Recent Solitary Mussaceae. Annals and Mag. Nat. Hist., Ser. IV, XX, p. 305.

A genus with only one species, known only from the Gulf of Suez, where it was found by Savigny and later by MacAndrew. Now a single specimen from the Great Barrier Reef. It is distinguished from *Sclerophyllia margariticola* Klz., also from the Red Sea, by its narrow base and thin septa, among other things.

Cynarina savignyi Brügg.

(Plate IV, figs. 1, 2.)

1826. *Caryophyllia carduus* Audouin, p. 233.
1827. (*Caryophyllia carduus*) Savigny, pl. 4, fig. 2 (1–3).
1877. *Cynarina savigny* Brüggemann, p. 305.

* Crossland wrote " form the type." In accordance with the International Rules B.M. Reg. No. 187 is here designated holotype, and Nos. 186 and 404 paratypes. [See also footnote, p. 125.—A.K.T.]

The single specimen, No. B.M. 492, is the largest yet found, being 4½ cm. over the long diameter of the calyx, and 5 cm. high, Brüggemann's largest being 3½ cm. × 4 cm., a little larger than Savigny's.

Savigny's figures are perfectly reliable, but Brüggemann remarks, as I have had to do, that his "figure was either mistaken" (I suppose misunderstood is meant) "or overlooked by subsequent authors." However, I refigure the larger specimen before me, as Brüggemann's is the only account between 1826 and the present day.

I agree with Brüggemann in substituting *savignyi* for Audouin's name *carduus*, since apparently that was given under the mistaken idea that the species is the young of a *Lobophyllia*, and *carduus* has been given to several species in this family, mostly badly described.

The most remarkable features of the species are the thin septa (*cf. Sclerophyllia margariticola* Klz. and *Mussa* (*Lithophyllia*) *lacrymalis* M. E. and H. which are probably the same) and the large columella made of closely packed thin lappets (see Plate VII, fig. 2). These features also make it impossible to be a young form of any species of *Lobophyllia.* True, in this specimen there are about 12 (many are broken) more exsert, more coarsely toothed septa, but these are not greatly thicker than the others, and almost all septa, even the thinnest and narrowest, reach and contribute to, the columella. Details can be obtained from the photograph. The toothing of the larger septa, especially their exsert parts, is very coarse—sinuous or lobed might better describe them. The smaller have more numerous, but still rounded teeth.

In contrast with Savigny's figures, and presumably Brüggemann's specimens also, only one constriction is at all deep, but three are distinct, and two more above these can be seen faintly. The theca and epitheca are so reduced in the upper part that it is full of squarish holes between the septo-costae and dissepiments : these are to be attributed to age and have no morphological significance. Endothecal dissepiments make the cup very shallow, but, as they slope inwards, it is 5 mm. deep over the columella.

Genus *Lithophyllia.*

1857. Milne Edwards and Haime, p. 290.
1877. *Scolymia* Brüggemann, p. 301.
1899. *Lithophyllia* Gardiner, p. 166.

The adoption of Haime's name *Scolymia* by Brüggeman in spite of Milne Edward's and Haime's statement that it had not been published, is unjustified.

Lithophyllia vitiensis (Brüggemann).

(Plate IX, fig. 4.)

Scolymia vitiensis Brüggemann, *l. c.*, p. 304.
Lithophyllia vitiensis Gardiner, p. 166.

One specimen corresponding very well with Brüggemann's from Fiji, dredged at Stn. XXIV, B.M. Reg. No. 1934.5.14.410*c*. It has not been figured hitherto. It measures 36 mm. × 25 mm., the type being 40 mm. in larger diameter. The substratum is an extremely rotten fragment of shell with a nullipore on it, the growth of which quite obscures the base, but the corallum appears to be 7 mm. high on one side and 3 mm. on the other. It is thus much more squat as well as more oval than the type.

Brüggeman says " no distinct epitheca." In this specimen it is distinct, but only like a thin, shrivelled-looking membrane, so thin that the low costae are clearly seen ; it reaches nearly to the top of the wall. Septal granulations not visible unless suitably lighted, when they become quite distinct. The 5th cycle is incomplete, probably owing to the distortion of the specimen and its smaller size. The columella is peculiar, and as Brüggemann describes it, " very dense, with subimbricate surface, the trabeculae being enlarged to horizontal, somewhat crimpled lamellae." I hope the figure on Plate IX will explain this somewhat peculiar arrangement. I add that the surfaces of the lamellae are dotted with small granules like those on the septa, and that the circular columella is quite small in comparison with the area of the quite flat theca.

Recorded Distribution : From Fiji before 1877 ; Loyalty Islands by Willey before 1899 ; the only previous records.

Genus *Caulastrea.*

For the relationships of this genus, which has special morphological interest, see Matthai (1928), pp. 11, 13, 14, 17 and 272. Briefly it is a primitive member of the *Mussa* group, the Indo-Pacific representative of the Atlantic *Protomussa.*

Caulastrea simplex sp. n.

(Plate III, figs. 4, 4a.)

A single specimen, dredged from Stn. XVI, of a small solitary coral, 12 mm. high and 8 mm. in diameter, belongs to this genus. It is not a young specimen of any compound species, since the eversion of most of the septa over the top of the calyx indicates that it is fully grown.

Its form is turbinolid, with a bent base, but this may be accidental, and due to the shape of the shell fragments to which it is attached. The upper part is nearly cylindrical, capped by the large exsertions of the septa, which exsertions add 2 mm. to the height given above. These eversions are continued to the base as distinct but narrow costae, all of nearly the same size, widely apart. They correspond to the first three cycles of septa, and bear, like them, triangular teeth, but much smaller and more rarely. The calyx opening is quite circular, and 3 mm. deep to the columella, *i.e.*, 5 mm. from the top of the larger septa. The septal series are consequently regular, the first two alike, the third narrower, especially below, where it does not reach the columella, and the fourth is rudimentary.

The septal exsertions and their teeth are more like those of *e.g.*, *Lobophyllia* than those of the other species, the teeth being broad and blunt, the largest at the outer angle of the exsertion ; but the teeth of the costae are small and far apart. These are shown on Plate III, fig. 5, but those of the interior of the calyx cannot be well shown. As the calyx is deep and the septa are narrow, the greater part of their edge is nearly vertical ; this part bears three or four broad blunt teeth, narrower and sharper on the 3rd order. All these teeth, like the septal edge and exsertions, are granular, the sides being smooth until examined in a carefully adjusted light. The outgrowths which form the small and rather loose columella are smooth and flattened.

The differences between this and the other species of the genus are considerable enough, and the fact that this is a solitary coral might be taken as reason for the creation of a new genus. This is not necessary, however, since the differences are of degree rather than kind, and the solitary habit is not, of itself, a generic character.

Caulastrea simplex is also not unlike *Parasmilia centralis* M. E. and H. from the upper chalk (1850, p. 47, pl. viii, figs. 1, 1*a–c*). It differs mainly in the toothing of the septa, those of *Parasmilia* being entire as in other Eusmiliidae.

Caulastrea furcata Dana.

1928. Matthai, p. 273; pl. 44, fig. 5*b* and 6; pl. 45, fig. 3; pl. 61, fig. 3; pl. 62, figs. 6 and 12.

This species was dredged from Stn. XVIII and XXI. There is no particular difference between the sets of specimens, or between them and Matthai's complete description and figures, except that these are more loosely branched, and the edge-zone extends well down the stems.

Distribution: Already known from the Great Barrier Reef, but other records are confined to the Pacific, between the China Sea, Fiji and Tongatabu.

Genus *Acanthastrea* M. E. and H.

1914. Matthai, *Favia*, p. 77.
1918. Vaughan, *Acanthastrea*, p. 101, p. 125, pls. 50, 51.
1924. Matthai, p. 37, pl. 3, figs. 2 and 3; pl. 5, fig. 1.
1931. Crossland [*Favia hemprichii*], p. 387, pl. 21.

The genus is defined by its possession of teeth or spines on the upper parts of the septa, especially over the walls. This definition is insufficient without the distinction between, *e.g.*, teeth which are the result of reduced growth and those due to added growth. As more pertinent examples than those I gave in 1931 of the former, I cite those on the upper edges of interthecal costae in *Favia dipsacea*, Aud. and Sav., rediscovered on the coast of Natal by Prof. T. A. Stephenson and his colleagues. Their existence, combined I suppose with distrust of Savigny's very excellent figure, has caused this species to be included in this genus. Similarly *F. parvimurata* Gard. is given as a possible synonym by Vaughan, and definitely by Thiel, though the teeth on its exsert septa are of the most ordinary sort. (See illustrations and references under *Favites aspera* on p. 132.) The spines of *Acanthastrea* are very different, and quite a special growth, with triangular bases and thinner prolongations with spinulose ends. Many of them are hollow, and all the longer ones are removed by handling before the specimens reach museums, leaving traces, when hollow, as little holes that appear in illustrations as small black dots. To show a complete specimen, with the fullest development of the spines, I had one photographed in Tahaiti, which is shown in the above quoted paper.

The relationships of the genus have been somewhat confused. Matthai in 1914 brings the two species he describes under *Favia.* Vaughan in 1918 separates Matthai's species into *Acanthastrea*, which, from the position in which he places the species he describes, he evidently regards as far removed from *Favia. Favia complanata*, superficially resembling an *Acanthastrea* until its spines are examined, he rightly places in *Favites*, and near to *F. abdita.*

The septa being the foundation of an *Astraeid* skeleton, from which both theca and columella are directly derived, I follow Vaughan in attaching great importance to their characters. I therefore, like Vaughan, regard this genus as quite distinct from *Favia* and allied to *Lobophyllia* (*Mussa*) and beg the reader to refer to Vaughan (1918), pl. 50, on which figs. 1*b* and 2 bring out the relationship in a striking way. In 1924 Matthai, pl. 5, fig. 1, and pl. 3, figs. 2 and 3, shows a specimen of a species with huge calices, which, he names "*Acanthastrea* or *Mussa* sp.," which is certainly of this genus, differing mainly from *A. echinata* in the size of its calices, the formation of short valleys being a common occurrence in the smaller species (Matthai, 1914, p. 111 ; Crossland, 1931, p. 287.) My *Symphyllia simplex* from Natal is similar, but not identical, and might equally well have been placed in *Acanthastrea*.

Acanthastrea echinata Dana, 1846.

(Plate VIII, figs. 1 and 3 ; Plate IX, figs. 1, 2.)

1879*a*. *Prionastrea spinosa* Klunzinger, p. 39, taf. 4, fig. 7.
1914. *Favia hemprichii* Matthai, p. 110, pl. 27, figs. 1, 2 ; pl. 36, fig. 3.
1914. *Favia hirsuta* Matthai, p. 100, pl. 24, figs. 7, 8.
1918. *Acanthastrea echinata* Vaughan, p. 125, pls. 50 and 51.
1931. *Favia hemprichii* Crossland, p. 387, pl. 21.

The name *hemprichii* is due to Ehrenberg, whose description is *nul** ; then to Milne Edwards and Haime, who describe as Ehrenberg's something which is both unidentifiable and not an *Acanthastrea* ; and finally Matthai in 1914 publishes an unsatisfactory photograph of Ehrenberg's type, with which he identifies his species " with some hesitation." To me this hesitation amounts to extreme doubt, and I therefore regard *hemprichii* as a *nomen nudum* still. I regard both Matthai's names as the same, and take Dana's *Acanthastrea echinata* as the earliest name available. Fortunately, Vaughan has made this safe by his description and figures of Dana's type, without which it was confused with any Faviid having teeth on the exsertions of the septa.

I have carefully tabulated the characters given by Matthai for his two species, and find that there is no valid distinction. The two specimens before me are illustrated on Plate VIII, figs. 1, 3, and are seen to differ very greatly in appearance, but this is almost entirely due to the differing thicknesses of the walls, with which go polygonal calices in the one, and almost round in the other, but it is a commonplace that such differences are not specific. In both specimens the septa are thin ; the characteristic thickening over the walls is but slight in No. 151, fairly well marked in No. 144, but in neither so strongly marked as in 1, *e.g.*, Dana's type.

The columella is generally neglected in descriptions, and I am uncertain what weight should be given to its details. Such figures of this species as show it appear to give an ordinary trabecular arrangement with simple teeth, Matthai says, " pointing upwards " ; neither of these specimens is of this type. In No. 114 they are of the *F. abdita* type, figured, for *F. virens*, on Plate VI. But in No. 151 they are quite peculiar, made of greatly thickened, blunt, smooth septal teeth pointing level to the centre. As the uppermost of these highly modified teeth do not reach the centre, the columella is hollow on the top. A very few, minute, spinulose projections do occur in some calices, so that possibly the structure is not so far removed from that of No. 144 as seems at first to be the case. However I illustrate both on Plates VIII and IX.

* Dr. Crossland's meaning is not clear. At the bottom of p. 96 (Ehrenberg, 1834) appears : " 9. A. Hemprichii E." At the top of p. 97 is a 6-line description. Perhaps Crossland missed the latter.—[A.K.T.]

No. 151, "*hirsuta*" is very well matched by Klunzinger's taf. 4, fig. 7, as *Prionastrea spinosa* (which Matthai makes the same as *F. hemprichii*). The columella is visible, with a lens, in two calices ; it is of thick beams, probably like this Great Barrier specimen. The only other figures at all like our specimen are Matthai's (1914) pl. 27, fig. 1 (*F. hemprichii*), and Vaughan's (1918) pl. 51, fig. 2 (*A. echinata*), from Murray Island. As for No. 144, there is nothing quite like it in the literature, and I therefore illustrate it on Plate IX, fig. 2.

Distribution : From the northern Red Sea, through the Indian Ocean as far as Tahaiti. Always rare.

Genus *Lobophyllia.*

Stephenson and others mention the genus on pp. 67, 86 and 88 as one of the animals characteristic of the seaward slopes and anchorage at Low Isles, of Yonge Reef, and of the reef patch at Lizard Island.

S. Manton refers to the genus on pp. 289, 295, 298 and 302, and on pls. vii, viii, xi, xii and xiii.

On Traverse 1 the genus is met with in colonies of 2 to 12 in. occasionally in the moat, and on the seaward slope. On the windward traverse it occurs only rarely between "distances" 700 and 760 feet in water 8 to 10 feet deep. The plates of drawings show only rare and insignificant scraps. This is in very great contrast to the Red Sea, where, in both northern and central sections, numerous colonies of *L. corymbosa* make masses up to 10 feet high and 20 across ; but the other two species, so far as I know, are smaller, though not at all uncommon. (Crossland, 1935, p. 502, and 1939, p. 515.) The Great Barrier conditions recall those of Tahaiti as far as this species is concerned. The only other reference to "enormous colonies" is by Umbgrove (1939, p. 37) quoting Vervey, in the Bay of Batavia.

The variation of the three species was worked out by me in Tahaiti (1931, pp. 373 to 380, and table on pl. 22), and though it is possible that variation is at a maximum in that far oceanic island, the present collection, like all the literature, shows an astounding amount of variation.

Lobophyllia corymbosa (Forsk.).

(Plate IX, fig. 3.)

For synonymy see Matthai (1928), p. 210, and pls. 25–27, 47,* 57, 58, 60, 62, 64, 68, 71.

The species is the only one of the three which is certainly definable.

The collection contains one specimen and 6 fragments. No. 110 is a regular dome 20 cm. in diameter. It resembles Matthai's (1928) pl. 68, fig. 1, "side view of Dana's type of *Mussa cactus*," the calices of which are shown on pl. 26, fig. 4, which is very near to Forskaal's type, pl. 71, figs. 5 and 6. Dana's type seems to be about the same size as No. 110, and apparently is the largest specimen to which Matthai had access, though he saw 106 specimens at the British Museum (Natural History), and 30 abroad, of which only 50 had a maximum diameter of 20 cm.

No. 447 is remarkable for the thickness and exsertion of its septa, up to 6 mm., including the teeth. The upright teeth on the exsert parts of the septa often number three to five,

* Pl. 47, fig. 8, is named *Lobophyllia costata* Dana. Crossland may have included it in error.—[A.K.T.]

and the upper costal teeth are unusually prominent in this, unlike any illustration I know of this species, except Crossland's (1931) pl. xii, fig. 23. It is near to Matthai's (1928) pl. xxv, fig. 6, "probably Milne Edwards' and Haime's type of *Mussa fistulosa*," or to pl. 27, fig. 1, "probably Milne Edwards' and Haime's syntype of *Mussa aspera*." It is more like the former in that the septal teeth, where broken, are seen to be hollow. The columella is very small in No. 447, as in both these type-specimens. As I wish to show the septal teeth and "eversion" of the exsert parts of the septa the illustration on Plate IX is taken a little obliquely.

Distribution : Northern Red Sea, through the Indian Ocean, including Mauritius and Rodriguez, and Pacific out as far as Tahaiti.

Lobophyllia hemprichii (Ehr.).

(Plate X, figs. 1 and 2 ; Plate XXX, figs. 1 and 2.)

Two specimens are labelled *L. costata* by Matthai, viz., No. 255, a half dead scrap, and No. 94, a well-preserved specimen 19 cm. across and 10 cm. high. A third specimen, B.M. 380 " "*Lobophyllia* ? Stn. No. 2 Low Island" is very like No. 94, but is only part of a colony ; its differences will be given later. All three specimens are alike in the breadth of continuous valleys, and in the remarkable long, *tapering* teeth of the exsert parts of the septa. There are usually three of nearly equal length (5 mm. up to 8 mm. ; one is vertical, the other two point inwards and outwards at an angle (Plate X, fig. 2).

The fourth specimen, No. 450, is labelled *L. hemprichii*, with which I agree. I cannot, however, agree that any of the preceding correspond with Matthai's definition of *costata*, since the wide valleys, 25 to 30 mm., are continuous. In No. 94 they are 15 to 20 mm. deep ; in B.M. 380 shallower, but 13 to 17 mm. I have described the variation of the species *costata* and *hemprichii* in Tahaiti (1931, p. 379, table on pl. 22), showing a difference between the species in spite of overlapping.

B.M. 380 and No. 94 differ greatly in the parts of the septa within the calices. In No. 94 there are 4 main septa per cm., of which one is generally thin, narrow, with fine teeth, and only two large teeth above the wall. The tertiary rudimentary, very finely toothed ; intermediates alternate regularly, so adding 4 to the total number of septa per cm. In B.M. 380 there are $3\frac{1}{2}$ large septa per cm., all alike, and the intermediates are quite rudimentary ; the lower teeth of the main septa are only 1 to 3, small and triangular in this specimen, but up to 7 small sharp teeth in No. 94, but parts of No. 94 approach B.M. 380 in condition of the larger septa, and No. 255 is intermediate. The following published figures of Matthai (1928) match these two specimens : pl. 28, fig. 6. A specimen from Torres Straits ; its valleys are narrower and teeth shorter. Pl. 29, fig. 4, Milne Edwards' and Haime's *Mussa echinata*, is similar, but its valleys are only 20 mm. wide, and apparently all the longest teeth are broken off. Pl. 66, fig. 2, Ehrenberg's type of *Manicina hemprichii*, valleys 25 to 30 mm., wide and teeth *occasionally* prominent. All the above are named *L. hemprichii* by Matthai.

The specimens also match Faustino's (1927, pl. 39, fig. 2, *Mussa cristata* Ehr.). Milne Edwards and Haime, in describing the species specially mention these peculiar teeth, but they are blunter than in our specimens. This specimen is called *costata* by Matthai. As these teeth are not well shown in any of these pictures, and I feel that I must offer evidence in support of my disagreement with Matthai, I give illustrations on Plate X, figs. 1 and 2. In order to show the septal teeth the views are rather oblique.

No. 450 is entirely different in the structure of the exsert parts of the septa, and therefore differs from the first three in appearance as much as any two distinct species could. The columellae also are larger and more closely compacted, and are joined by from two to five lamellae. The tips of almost all the upper teeth are broken off,* but they seem to be only elongated triangles, not spikes, as in the preceding. They are hollow. Of these comparatively small and uniform teeth (Plate X, fig. 1) there are five on the upper edge of the septum, but as this edge forms a regular rounded arch, with no boundaries between inner, upper and costal parts, the number cannot be counted exactly. At the inner angle, or a little below it, is an extra large tooth, and below it one to three rather smaller ; on septa of the second order these are sometimes followed by three or four small thin sharp teeth. Septa of the third order are very small, but bear teeth above, and below are sinuous, or bear one or two small teeth low down.

This form somewhat resembles Yabe, Sugiyama and Eguchi's (1936) pl. 32, fig. 1 (*L. hemprichii*), but the differences are considerable enough to warrant another illustration.

Distribution : Red Sea, Pacific to Tahaiti, but the only Indian Ocean record is a doubtful one by Gravier from the Gulf of Aden.

Genus *Symphyllia.*

Stephenson and others refer to the genus on pp. 67, 80, 86, 88 and 90 as one of those characteristic of the seaward slope and anchorage at Low Isles ; at Three Isles it forms, with *Favia* and *Porites*, flat-topped platforms in a pool between the mangrove swamp and shingle spit ; it is found also on Yonge Reef and the reef patch at Lizard Island and on Batt Reef. It is thus widely distributed, but never seems to have been conspicuous.

S. Manton refers to the genus on pp. 284, 285 and 302, and on plates iii, vii, ix, xii and xiii.

Small specimens, 3–8 inches, are found in the deeper parts of the moat, on the inner side of the seaward slope of Traverses I and II (Graphs 28 and 56 on pls. iii and vii). On p. 302 the genus is mentioned as being one of those which, having large polyps, can easily remove both mud and sand. Pl. ix shows two very small growths in the western moat, but on the other plates examples of from 23 cm. to 32 cm. in diameter are shown. The genus (or species—there is only one common) is common and widely distributed at Low Isles, but is not flourishing, which may be connected with the lightness of the specimens collected.

Distribution : Indian and Pacific Oceans, as far east as Samoa ; not found in the Red Sea (unless Klunzinger's *Isophyllia erythraea* is a simple form of this genus), nor in Tahaiti.

Symphyllia recta Dana.

(Plate XI, figs. 2 and 3.)

Symphyllia sinuosa Q. and G. All authors up to Vaughan (1918).
1918. *S. nobilis* Dana ; Vaughan, p. 124.

* Collectors should remember that, though stony and heavy, corals are delicate objects and need as careful handling and packing as other specimens. Most collectors should also remember that they do not know which specimens are of value and which are good for nothing but road material, but for ecological purposes all are of equal value.

1918. *S. nobilis* Mayer, pl. 17, fig. 35.
1924. *S. sinuosa* Matthai, p. 31.
1928. *S. recta* Dana. Matthai, p. 227 ; pl. 30, figs. 1–6 ; pl. 31, figs. 1, 2 ; pl. 48, figs. 4–6 ; pl. 57, figs. 1*a*–*b*.
1932 to 1936. Yabe, Sugiyama and Eguchi, alternate between *S. nobilis* and *S. recta*.

Synonymy : This species has been known as *S. sinuosa* by all authors up to 1918, and at least Milne Edwards and Haime's description and figure were adequate as far as they went. It is very unfortunate that Dana's greatly damaged and now quite worthless specimens were preserved and used as a basis for the resuscitation of his names *nobilis* and *recta*. The result is not only that a well-known name is altered, with no advantage to anyone, but certain loss, and even experts like Vaughan, Matthai and Yabe, Sugiyama and Eguchi cannot agree which name to use, but also that, instead of the identification of later specimens depending upon Dana's types it is those types which are only recognizable from later specimens and the work done upon them. Dana's samples should have been ignored.

What Ellis and Solander and Lamarck meant by their descriptions is of no interest to any practical zoologist now. It is only by assuming that our present classification cannot be upset by the ecological research which is so badly needed that Dana's names and types can have any validity.

The following specimens are labelled *S. recta* by Matthai, viz., Nos. 13, 95, 112 and 209. Three specimens, B.M. 365, B.M. 367 and B.M. 405, are not named, except " Symphyllia gonad species." All are of the " thin variety " of Matthai except No. 209, which approaches the " thick variety " in having its main septa as much as 1 mm. thick. The three " gonad species " examples have particularly thin walls and septa, which latter therefore appear much less crowded than in the others, though there are 8 to the cm. in both cases.

No. 13 is interesting as being a young specimen, 5 cm. in diameter, 4 cm. high, attached by its whole under-surface and with no radial arrangement of the valleys, and so distinct from *S. radians*. No. 95 is small and somewhat deformed. It has several monostomodaeal calices, most of the others being di- and tri-stomodaeal. Its septa are 0·75 mm. thick, in places 1 mm., and therefore appear crowded, though there are only 8 or 9 to 1 cm., as usual. The larger teeth have been broken off, but appear to have been short, giving the walls an evenly rounded appearance. There are no grooves.

The following figures match these specimens :

No. 97, Matthai (1928), pl. 30, fig. 4, " from Chagos " ; Bedot (1907), pl. 21.

No. 112 and B.M. 367, Matthai (1928), pl. 30, fig. 1, of Q. and G's. type ; Bedot (1907) pl. 22 (but the inner septal teeth are less prominent).

No. 209 is the only example of the thick variety, in which I place it because of its wider valleys and having three or four smaller septa between the larger, instead of the simple alternation of the other samples, and its large triangular irregular teeth, but in spite of the fact that its teeth are only 1 mm. thick instead of the 2–2·5 mm. of the definition. It is very like Matthai's (1928) pl. 30, fig. 5, but as it is part of a larger colony its valleys appear longer. This figure is labelled " thick variety," though its septa are only 1 mm. thick. Gardiner's (1899*a*) pl. 48, fig. 1, also affords an illustration.

Nos. B.M. 405 and B.M. 365 have thinner walls and septa than any illustration published, but they grade in with B.M. 367 and No. 112, of which figures are given by Matthai and Bedot. Their upwardly pointed triangular teeth within the calyx are prominent, much larger than those on the walls, columellae well developed, compact, of thin rather broad lappets as in *Lobophyllia* ; septa 8 or 9 to the cm., larger and smaller alternating. I give a rather oblique view on Plate XI, figs. 2, 3, to show these features.

Generally these thin forms are the less abundant. Gardiner's Maldivan and Rotuman examples are all thick, the former, of which three good illustrations are given, having the main septa 2 mm. and over in thickness. He is the only author, except those of the Great Barrier Reef Expedition Reports, who gives notes on size and habitat ; as the contrast with Low Isles is marked I quote him. Writing (1899, p. 739) of Rotuma, he says : " The species in the living condition is of a green colour, brown round the peristome. The colonies form great hemispherical masses, 2–3 feet across, and are very common in the outer half of the boat-channel. The species is noticeably resistant to the action of the sun, parts of the colonies at spring tides being uncovered for 2–3 hours. Massive colonies, too, which have died in the centre and been hollowed out, are rare." Again (1904*b*, p. 761) he says : " The species is fairly common on the lagoon shoals and reefs of the Maldives. I have also seen it on the outer slope, and it is not improbably in places an important reef-builder . . . Colour of the Minikoi specimen . . . a large mass several feet in diameter, in central upper part of the colony, over walls transparent, peristome very light green dotted with dark green, edge of stomodoeum white, and at sides, over walls very dark green, peristome white slate, edge of stomodoeum white."

Distribution : Indo-Pacific as far east as Samoa, whence Mayer obtained one small specimen. It does not occur in the Red Sea or in Tahaiti.

Symphyllia radians M. E. and H.

One specimen, labelled " Low Isles W. moat," B.M. 366, is quite typical in having a central stalk and radial valleys, but the septa are divided by grooves over the walls, generally just visible, but in two places 2 mm. wide. Principal septa 4 to 1 cm., as in Matthai's definition, but there are generally three principal marginal teeth, often four, and the columellae are compact, made of thin broad lamellae, usually rounded.

Matthai (1928) gives 5 figures, of which pl. 54, fig. 7, from Tizard bank, resembles this specimen fairly closely. Pl. 58, the underside of Dana's *Mussa crispa*, shows a central stalk with the rest completely free, but in this specimen growths and secondary attachments hide perhaps a third of the surface. In Bedot's specimen, pl. 19, attachments seem to have covered most of the underside, and it is otherwise unlike the Gt. Barrier example.

Distribution : Indian Ocean, but not east of Rotuma and Tongatabu in the Pacific. Rather strangely there are already four records from the Great Barrier Reef.

Genus *Oulophyllia.*

The two species of this genus were placed in *Coeloria* by Gardiner in 1904, an arrangement with which I have every sympathy, the present tendency to make numbers of genera with one to three species each being very inconvenient. Of the differences from *Coeloria* given by Matthai (1928), p. 256, the first, wider and deeper valleys, and second, septa narrower and thinner, are not generic ; while the third, a tendency to form palial lobes, is quite rudimentary ; and the fourth, distinctness of the columellar centres, is not complete, septal trabeculae occurring frequently between centres. As Matthai remarks, description of the polyps is needed, and it is very likely that the structure of the living and expanded polyps alone would settle the relationships of this genus to both *Coeloria* and *Tridacophyllia*.

Oulophyllia crispa (Lamarck).

1904. *Coeloria cooperi* Gard., p. 762, pl. lx, fig. 9.
1928. *Oulophyllia crispa* Matthai, p. 257 ; pl. 19, figs. 1, 2 ; pl. 25, fig. 2 ; pl. 71, figs. 1 and 3.

The first adequate figure is that by Gardiner in 1904. Rehberg's figure of his *U. maxima* is only a drawing, not very distinct. His types are photographed by Matthai (1928), pl. 71, figs. 1 and 3.

The present collection contains only one specimen, No. 52, a regular dome 12 cm. across × 7 cm. high.

Distribution : Gulf of Aden, E. and W. of Indian Ocean, Singapore to Palau and Caroline Islands, and Bismarck Archipelago. Now Great Barrier Reef.

Genus *Coeloria*.

From S. Manton and Stephenson and others, we find that the genus is common on the Great Barrier, but inconspicuous. It appears, too, that *C. daedalea* is much more common than *C. lamellina*. Compare Gardiner's (1899*a*, p. 740) description of its occurrence in the South Pacific : " The genus is very abundant on the lagoon-shoals at Funafuti, where it forms large, spreading masses, which vary in colour from brown to green. It is also found sparingly on the leeward reefs at Funafuti and Rotuma, but it cannot apparently withstand the force of heavy breakers." Of *C. daedalea* he writes : " Common in the boat-channel, where it forms large spreading masses, 3–5 feet in diameter, small colonies only being found on the reef." In the Maldives, says Gardiner (1904*b*, p. 761) " the genus is the most abundant of all Astraeids on the reef-flat and outside the edge of the reef to 5 *f*., where the immediate force of the breakers is felt. It also occurs abundantly on the outer slope down to 15 *f*., and one specimen comes from 28 *f*. . . . Colour, generally some shade of green." It is very remarkable that the above notes refer only to *C. dacdalea*, *C. lamellina* being absent. In Gardiner's collections from the central part of the Indian Ocean, Matthai (1928) records only two specimens from Chagos.

Coeloria astraeiformis (M. E. and H.).

1879*a*. *Coeloria esperi* Klünzinger, p. 19, pl. 2, fig. 6.
1899*a*. *Coeloria astræiformis* Gardiner, p. 743, pl. 46, fig. 4.
1918. *Mœandra astreiformis* Vaughan, p. 120.
1918. *Mœandra astreiformis* Mayer, pl. 14, fig. 19.
1925. *Maeandra esperi* Hoffmeister, p. 29.
1928. *Favia astraeiformis* Matthai, p. 278 ; pl. 44, figs. 2*a*, 2*b* ; pl. 45, fig. 1.

One specimen, No. 230, T1 moat, names *Favia astraeiformis* by Matthai, while Nos. 143 and 148 are given a ? mark. Whether this mark refers to the genus or the species is not indicated ; probably to both, as the distinction from some specimens which Prof. Matthai has labelled *C. daedalea*, Nos. 168 and B.M. 78, are, if any, very slight.

All authors but Matthai place this species in either *Coeloria* or *Maeandra*, which means simply that the gradation with *Favia* is complete. I therefore follow the majority.

As regards *C. esperi*, Gardiner (1899*a*) thinks it very probably the same as *C. daedalea*, and Matthai in 1928 was definitely of this opinion. Vaughan (1918), p. 120, says it must be the same species as *C. astreiformis*, but Hoffmeister's (1925) Samoan specimen of *C. esperi* " agrees with Klunzinger's (1879*a*) description and figure (p. 19, pl. 2, fig. 6) very well," and therefore cannot be *C. astraeiformis* as Klunzinger's species is the same as *C. daedalea.*

The species is rare. S. Manton refers to it on 6 pages and 5 plates, but only once refers to *C. daedalea.* As a large number of the latter species was collected I assume that this means that the two cannot be distinguished on the reef.

Distribution : Milne Edwards and Haime record it from the Red Sea, where neither Klunzinger nor I have seen it. It has been found in widely separated places, in the Indian Ocean only by Gardiner. As far east as Fiji ; it is not recorded from Samoa.

Coeloria daedalea (Ell. and Sol.).

(Plate XI, fig. 1 ; Plate XII, fig. 2.)

1936. *Coeloria rustica* Dana, Wells, p. 104.

The fact that Forskaal's *Madrepora daedalea* is an *Alveopora* has given the opportunity to Wells to change the well-established name *C. daedalea* to Dana's *C. rustica.* He is followed, quite uncritically, by Yabe, Sugiyama and Eguchi in 1936, and by Umbgrove in 1939.*

Matthai (1928, p. 24) gives 33 references between the years 1786 and 1927 almost all using *C. daedalea* for this well-known coral. Further references extend to 1935, making the period of unanimity 148 years. Wells' proposed change cannot be too strongly repudiated. (1) It is a defiance of the rules of nomenclature, which state that no change is to be made if greater confusion than uniformity results. Does Prof. Wells really wish to save us from confusing a species of *Coeloria* with one of *Alveopora* ? (2) Such changes bring the rules into contempt. (3) It depreciates the work of men who have made real additions to our knowledge of the species in favour of two bare records of local distribution. (4) It assumes that zoological nomenclature is the affair of a few museum experts only.

I may also point out that " Madrepora," as Forskaal uses it, is not a genus but a rough division of the corals, as he himself definitely says.

Of the 12 specimens from the Great Barrier seven deserve notice, viz., the two already mentioned, Nos. 168 and B.M. 78, which are not really distinguishable from *C. astraeiformis;* three with remarkably thick walls, one with a lamellar columella, and one with remarkably shallow valleys. The remainder, Nos. 140, 147, 176, 219 and 321, fall within the normal variation of the species given by Matthai (1928, pp. 24–37).

Specimen No. 147, which is 17 cm. long and 10·5 cm. high, consists of two areas with the usual meanders and sharp walls, the longest valley 28 mm. in length, most shorter, and between them an area 8 cm. × 5 cm. on which the walls are still thinner and the calices mostly single, as in *C. astraeiformis.* Another similar but smaller area is near one end. They are but slightly depressed. They are on the side of the corallum, the top of which is dead in the centre.

* Dana's type is figured by Matthai (1928), pl. vi, figs. 7 and 8. It is a beach pebble, so worn that even such authorities as Matthai and Vaughan do not agree whether it represents the present species or *C. lamellina* (Matthai, 1928, p. 29). It is therefore absurd, whether legal or not, to make such a defective specimen the type of an important species.

The longest valley is in No. 140, and is 50 mm. long, measured in a straight line. The specimens have been named by Matthai, but No. 54 with a ? mark, which it owes to its shallow valleys, 1–2 mm. deep and 4 mm. wide, and rather broad, rather thick septa, many of which slope inwards before dropping nearly vertically to the narrow columella, features which give the colony a very distinctive appearance. The specimen is a living area of a dead hemisphere, the dead parts partly overgrown by nullipore and filamentous weed. Most of the dead area has been broken away, but in what remains along one side can be made out the higher thinner walls and narrower septa of more normal form. There is nothing like it in Matthai's 18 figures, but, as it is clearly morbid, I do not illustrate it.

No. 138 is a thin crust growing over dead *Porites* (?) illustrated on Plate XII, fig. 1. It is somewhat similar to the last but has thicker walls, but though the valleys are equally shallow, 1·75 mm. × 4 mm. wide, they are more open at the bottom. The most interesting peculiarity is the almost plate-like columella, like the figure Matthai (1928) gives on pl. vi fig. 1, " showing variation towards the *Platygyra* facies," but there is no reference to this remarkable fact in the text, under either genus. Gardiner (1904*b*, p. 762) writes (under *C. sinensis*, which is most probably a synonym of *C. daedalea*) : " When a valley is very shallow, owing to boring organisms underneath or other causes, the *columella* may approach in appearance the condition in Leptoria . . ." This specimen is free from parasites, but whatever other causes have induced growth as a crust about 8 mm. thick, a form strange to this genus, it does indicate the close relationship to *Leptoria* (*Platygyra*). Such a columella is also shown by Yabe, Sugiyama and Eguchi's (1936) pl. xxi, fig. 10, of a curious humpy growth of " *C. rustica*," but, as usual with these authors, the phenomenon receives no notice in the text. No. 321 is similar, and has been labelled " *Platygyra B* " by the collector, but the columella has nowhere the regularity of typical *Leptoria*.

The thick-walled specimens also are not figured by Matthai or other authors, nor is anything like them found in his table of variations on pp. 34 and 35, all the specimens considered having sharp-edged walls, generally perforated. The valleys are deep and open. Their peculiarities are due to morbid deposits of endotheca, which not only swell the walls but make irregular floorings among the very loose columellar trabeculae ; or these may be absent, or represented only by long straight septal teeth. In the small scrap, No. 175, where walls are more normal the morbid deposition is less. It is similar to that found by me in Tahaitian specimens of *Acanthastrea echinata* (or *Favia hemprichii*) (1931, p. 387).

Distribution : Many records from the Indian Ocean and Pacific as far as Samoa. It does not occur in Tahaiti, but Agassiz collected a specimen in the Paumotu Atolls, further east (*cf. Favia favus* above). In the Red Sea it is rare ; it was collected by Klunzinger (*C. esperi*) and Milne Edwards and Haime record it. The only specimen I have seen is semi-fossil, at Ghardaqa. Contrast *C. lamellina.*

Coeloria lamellina (Ell. and Sol.).

There are four specimens showing the usual great variation, numbered 61, 259, 261 and 371.

Stephenson and others only refer to the presence of the genus in the fauna ; it is found everywhere, but the coralla noted by S. Manton are only 2–9 inches across, except one shown on pl. xv, the outer moat of Yonge Reef, which is 66 × 45 cm., but is a mere flat cake growing in only a foot of water. The big conspicuous domes and cylinders of the Red Sea are nowhere noted.

No. 61 is a peculiar growth, 19 × 13 × 10 cm. high, which stood out bracket fashion from a vertical face to which it was attached by a narrow stem of ? *Porites* ; the top is killed by exposure at low tide. The sides, both sloping and vertical, show long, nearly straight valleys with bulging areas at the edge with the usual meanders. On the sloping or outer side are thicker rounded walls and somewhat lamellar columellae. The colour of this species in the Red Sea is a particularly bright brown.

Distribution : Abundant in the Red Sea, from which Matthai had 29 specimens, where it forms colonies up to 2 metres each way. Elsewhere it seems to be small and rare, especially in the Indian Ocean, but seems to be more common in the Pacific, where it extends to Samoa and Fanning Island.

Genus *Leptoria.*

1834. *Maeandra* (*Platygyra, pars*) Ehrenberg, *non Platygyra* Vaughan, 1901 ; *nec Platygyra* Brüggemann, 1879.
1848–1857. *Leptoria* Milne Edwards and Haime.
1879*a*. *Leptoria* Klunzinger, p. 13.
1899*a*. *Leptoria* Gardiner, p. 739.
1904*b*. *Leptoria* Gardiner, p. 764.
1918. *Leptoria* Vaughan, p. 117.
1924. *Leptoria* Matthai, p. 25.
1925. *Leptoria* Hoffmeister, p. 27.
1927. *Leptoria* Faustino, p. 141.
1928. *Platygyra* Matthai, p. 109.
1936*a*. *Platygyra* Wells, p. 124.
1936. *Platygyra* Yabe, Sugiyama and Eguchi, p. 38.
1939. *Platygyra* Umbgrove, p. 33.

The genus having been known as *Leptoria* for 80 years, Matthai's unravelling of Ehrenberg's mistakes is nothing but a misfortune, a contravention of the rule that no change is to be made if greater confusion than uniformity will result. Matthai's discussion of Ehrenberg's confusion is a good example of the useless labour a rabbinical adherence to the rule of priority imposes upon men whose time is far too valuable for such rooting in old, and in this case, useless books.

I therefore return to the older name, and bring my work into line with that of the eminent workers of the past.

Matthai (1928), p. 112, writes : " *Platygyra* further differs from *Coeloria* inasmuch as the corallum usually grows to a larger size, is heavy . . ."

I find no record of the size to which *Leptoria* may grow except my own note of a specimen 2 or 3 feet across at Umm Qama'r, off Ghardaqa, which is much larger than numerous other specimens seen in that neighbourhood, on the *outer* reefs, and is trifling compared to numerous specimens of *Coeloria lamellina.* It is certainly heavy in comparison with *C. lamellina*, which, when dry, floats quite buoyantly. S. Manton's largest specimen (pl. xv) is 45 × 36 cm.

Leptoria phrygia (Ell. and Sol.).

Four specimens are present, all labelled as *Platygyra phrygia* by Matthai. In some specimens the distinction from *L. gracilis* is very vague, as I found was the case in the Red Sea. The specimens are numbered 10, 328 June Reef, 42 and 443.

Under the name *Platygyra* Stephenson and others give references to it on pp. 67, 86 and 88, as one of the animals characteristic of the seaward slopes and anchorage, of Yonge Reef and the reef patch at Lizard Island. S. Manton refers to it on 5 pages and 5 plates. Colonies 3–5 inches across occur in the moat, but are more frequent and larger between 860 and 960 feet on Traverse I, but it is infrequent on the seaward slope of Traverse II. It does not penetrate into deeper water on the windward side (Graph, pl. viii). It is mentioned as occurring in the moat of Yonge Reef. The plates show only rare small specimens, except the one on pl. xv mentioned above ; it is evidently of no reef-building value here, or, apparently, elsewhere.

Distribution : Northern Red Sea, Indian Ocean, including Mauritius, and Pacific as far E. as Samoa.

Genus *Hydnophora.*

Hydnophora microconos (Lamk.).

One smooth little knob, No. 423, is all that represents the genus here, with a small specimen brought to me at Tahaiti by Mr. G. W. Otter, though there are a number of Australian records for *H. exesa* and *H. contignatio.* It is, however, possible that these species are not distinct.

This specimen is matched by Matthai's (1928), pl. xvii, fig. 1, for its general appearance and the monticles, but none of his enlarged figures show a similar thick and continuous columella, though fig. 7 on pl. xvi comes near. Vaughan's (1918) pl. 47, figs. 3 and 3*a* are similar.

Local distribution as in the preceding species, appearing also as one of the massive corals of the outer moat of Yonge Reef. S. Manton (1935, pl. xiv), shows only two tiny colonies on the crest, and pl. xv three in the moat of Yonge Reef.

Distribution : Northern Red Sea, throughout the Indian and Pacific Oceans as far E. as Samoa.

[Family Merulinidae.]

Genus *Merulina.*

Stephenson and others mention the genus as one which, on the seaward slopes and the anchorage, are characteristic of vertical or overhanging surfaces. It was also found on the Reef Patch at Lizard Island. S. Manton refers to it on p. 289 as occasional in the moat, and shows a fan-shaped colony, 18 cm. across, on the seaward slope of Traverse 1 on pl. xi.

Merulina ampliata (Ell. and Sol.).

Two small specimens and four scraps are labelled by Matthai, and No. 349 is well matched by Matthai (1928) on pl. xiii, figs. 1*a*, 1*b*, and B.M. No. 296 by pl. 59, fig. 4 (Dana's example of *M. ampliata*), except that the little knobby branches of the latter, which rise from the centre of the colony, are more marked in the Great Barrier Reef specimen, as are the deep radial wrinkles of the underside.

In a number of specimens in the Kóbenhavn Museum these curious knobby branches grow into large clusters, such as I have not seen illustrated, the nearest approach being Yabe, Sugiyama and Eguchi (1936), pl. 29, fig. 3. Thiel, pl. vii, figures a fairly large colony with numerous central branches, but of quite different form. I hope to discuss these Kóbenhavn specimens in a later work.

Specimen B.M. 296 is clearly Horst's *M. vaughani*, but Matthai (1928), pp. 130–131, pl. xiii, figs. 1–8, shows that the species grade into each other in respect to the sharpness or roundness of the ridges.

In such a variable genus, and in all genera in which branches rise from a basal plate, only whole, or nearly whole, coralla are really worth examination. If no basal plate is accessible, as in some large specimens of this genus, or, *e.g.*, *Echinopora gemmacea*, the collector should note the fact. Gardiner notes huge colonies, such as no one else has seen, apparently without branches, " off the outer slope at Goidu (Maldives) this or a similar species is very abundant, forming foliaceous colonies two or three yards across and high."

Distribution : Red Sea (in the North a small scrap, probably semi-fossil), Maldives, common in Malaysia, several records from the Great Barrier Reef, and as far E. as Samoa.

[Family Fungiidae.]

Fungia echinata (Pallas).

No. B.M. 280 has no Expedition label or note of locality. It is part of a large specimen, apparently the half ; the piece is 15 cm. long × 13 cm. broad ; the whole would therefore be nearly as big as Döderlein's largest from Singapore.

Boschma in 1925 describes the difference between this species and *Herpetolitha simplex* Gard. In this specimen there is a tendency for the central groove to divide, it does not run out to the end of the calyx, all septa have well granulated sides, and the larger have well granulated teeth. The costal spines are conspicuously thick, of irregular length, spinulose, the costae themselves, though crowded, conspicuous from the edge to the centre, being clearly separated by deep slits, which, near the edge, make minute perforations. I find no figure exactly like this, Döderlein's taf. x, fig. 2*a*, being nearest, but the spines are considerably smaller than in the Great Barrier Reef specimen. There are some large specimens in the Kóbenhavn Museum from Singapore which are exactly like this of the Great Barrier Reef. Among them is one 39 cm. × 18·5 cm., apparently the largest recorded (*cf.* Döderlein, p. 102).

Distribution : Red Sea to Tahaiti.

Fungia actiniformis Q. and G.

1902. Döderlein, p. 82, taf. vi, figs. 1–10.

The single specimen corresponds excellently with figs. 2 and 3 of the above plate. A photograph of an expanded specimen on the reef is given by Yonge in his book 'A Year on the Great Barrier Reef' opposite p. 63, and in (1930) pl. i, fig. 4 ; and by Saville Kent (1893) in pls. 93 and 94.

Distribution : As given by Döderlein only from the East Indian Islands, the Great Barrier, and as far east in the Pacific as Vanikoro (Santa Cruz Islands) and Rotuma. I distinctly remember it at Zanzibar, but it does not occur in the Red Sea or Tahaiti.

Fungia scutaria Lamarck.

Only one example of this easily recognized species was brought home, No. 275. The specimen is typical, with prominent tentacular lobes.

Distribution : From the Red Sea to the Hawaiian Islands ; in Tahaiti along with the nearly related, if not identical, *F. paumotensis* (Boschma, 1929, p. 44).

Fungia paumotensis Stutchbury.

Specimen No. 258 is labelled ? *Fungia danai* by Matthai, but the equal-sized and equally spiny costae separate it from this species.

It is round, 75 mm. in diameter, thick and heavy, with the septa 25 mm. high. The under surface is flat but for depressed rings, 25, 13 and 7 mm. from the edge. The central scar projects slightly. I conclude that the specimen is abnormal, but nothing but its circular shape separates it from *F. paumotensis.* It corresponds especially well with Döderlein's (1902), Taf. vii, figs. 1 and 1*a*, in the arrangement of septa and their conspicuous synaptacula, and the freely projecting ends of the septa.

Distribution : Red Sea to Hawaii.

Fungia fungites (Linn.).

I place in this very variable genus 5 specimens, Nos. B.M. 386, one not numbered, and Nos. G.B.R. 86, 87, and P. 36. The first is labelled " night Fungia," the meaning of which I do not understand. They are between 75 and 145 mm. across. Of these G.B.R. 86 and 87 have been labelled " *F. repanda* " by Matthai and P. 36 *F. fungites.* Of the two former No. 86 is much like Döderlein's figure of *F. repanda* as regards the upper surface, but it is the spines of the lower which are decisive, and these are (1) pointed, (2) smooth, except sometimes minute granules on their points only, (3) not aggregated into continuous lines and clusters as in Döderlein's figures on pl. xii.

I do not attempt to arrange these specimens under Döderlein's varieties, as this has been found impossible by both Gardiner and Boschma, but remark that the smallest, B.M. 386, corresponds with Döderlein's (1902) figs. 4, 4*a*, pl. xx ; the next, No. " 0," to figs. 7, 7*a* ; while P. 36, the only highly arched specimen, corresponds above with fig. 3, taf. xxi, but below is remarkably thickly covered with long pointed spines, not so crowded as to obscure the costae. No. 86 has the rather widely separated septa referred to above, the underside being like No. 0, but with larger spines, very like Döderlein's (1902) fig. 1*a*, pl. xxii. No. 87 is similar but coarser.

Distribution : I have already remarked in describing Forskaal's collection (1941, p. 40), " From numbers given by Gardiner (1908) this is much the commonest species in the Red Sea, and is distributed all over the Indo-Pacific, except the Hawaiian Islands." Boschma (1929) records it from the Marquesas, but not from Tahaiti, the only Tahaitian record being Dana's for his *F. discus.* It seems to diminish in numbers as it spreads east of the Great Barrier Reef.

Fungia cyclolites Lamarck.

1902. Döderlein, p. 77 ; taf. iv, figs. 7–9 ; taf. v, figs. 5, 5*a*.
1925. Boschma, p. 205, pl. v, fig. 24 ; pl. vi, figs. 25–48.

Stn. XIX, dredge, 26 specimens from 18 to 40 mm. × 34 mm. ; Stn. XXI, 3 specimens ; Stn. XXII, 10 specimens ; Stn. XXIII, 5 specimens.

The smallest are flat, the older highly arched, as usual. The prominence of the principal septa varies, the specimens from Stn. XXII being flatter, and with principal septa less prominent than those from Stns. XIX and XXIII. Costae are generally scarcely visible to the naked eye centrally, but are always clear under a lens.

Distribution : Red Sea, Indian Ocean, Gt. Barrier Reef, Philippines and China Sea, but not from Samoa and Tahaiti.

Fungia patelliformis Boschma.

(Plate XVI, fig. 1.)

1923. Boschma, p. 8, pl. ix, figs. 9, 11, 13–16*a*.

Stn. XVII, 5 specimens (2 in alcohol), also 3 with a label now illegible.

These correspond exactly with Boschma's description and figures. Two are broken into segments, and one has regenerated from a segment only 13 mm. wide and 27 mm. in radius; the regenerated circle being 43 mm. across, the original segment projects considerably from the regenerated part.

I give a photo of the largest specimen, 52 mm. across, by transmitted light, showing (1) the delicate yet imperforate base, (2) the junctions of the septa, (3) the columella.

Distribution : Common in Malay region. Occurs also in Samoa and Hawaii, but not recorded from Tahaiti.

Genus *Stephanophyllia.*

This genus was placed in the Eupsamiidae by Milne Edwards and Haime (1848), p. 93, and by Milne Edwards (1860) p. 109, who remark that it is the only one with discoid shape and horizontal wall. In this they have been followed by all authors except Boschma, who describes (1923, p. 16) a new species found amongst Horst's specimens of *Fungia patella.* I have never been able to see why *Stephanophyllia* should not be regarded as anything but a lightly built *Fungia.* Most species of *Fungia* have perforations, which, in *Stephanophyllia* are more numerous and wider than usual, a result of the light building of many deep water forms. These clearly defined holes, bounded by stout beams, appear to me quite another thing to the general sponginess of the perforata, and made in quite another way. Synaptacula are also conspicuous.

Stephanophyllia formosissima Moseley.

1881. Moseley, p. 201, pl. iv, fig. 11 ; pl. xiii, figs. 6, 7 ; pl. xvi, figs. 8, 9.
1907. Vaughan, p. 146, pl. xliv, figs. 2, 2*a*.
1939. Gardiner and Waugh, p. 234. (Occurrence only.)

One specimen from Stn. XV, dredge, B.M. 621, 25 mm. in diam. × 5 mm. high.

It resembles Vaughan's Hawaiian examples rather than those of Moseley in that the primary and secondary septa are as high as the rest, and the overlaps of the septal junctions do not extend far from the columella. The elongated columella is peculiar, in that, while obviously formed of septal processes, much of it is fused into a solid tuberculate mass pierced with small holes.

Distribution.—Kei and Philippine Islands, E. African coast near Pemba, Hawaii, now Great Barrier Reef.

Herpolitha limax (Esper).

Only one specimen, from Lizard Island, "A" reef, No. 365.

It is one of those in which the septa alongside the central row of mouths are specially wide and prominent, their edges making a pair of flat bands along each side of the groove.

Horst (1921) gives, briefly, reasons for amalgamating the species *limax, foliosa, stricta* and *crassa*, the survivors of the eight names given in his list of 31 references. Independently I came to the same conclusion in 1931 (Horst's work not being accessible in Tahaiti), and gave results in rather more detail (1931, p. 354). I have a note that, in the Red Sea at Ghardaqa, all specimens differ from those of Tahaiti in the solidity and the regular toothing of their septa, and in that bending towards the centres is rare.

S. Manton, p. 303, mentions it from Hedley and Taylor's work in 1907 on East Hope Isle ; Stephenson and others, pp. 67 and 88, list it as found on seaward slopes and anchorage of Low Isles as well as on the Reef Patch at Lizard Island.

Distribution : Common a little below Low Water Springs from the northern Red Sea to Tahaiti.

Halomitra robusta Q.

1886. *Podobacia robusta* Quelch, p. 140, pl. vi, figs. 5–5*b*.
1898. *Halomitra irregularis* Gardiner, p. 528, pl. lxiii, figs. 1, 2.
1909. *Doderleinia irregularis* Gardiner, p. 282, pl. xxxix, figs. 25, 28.
1921. *Doderleinia robusta, irregularis* and *sluiteri* Horst, pp. 17–19, pl. iv, figs. 1, 2.
1925. *Halomitra robusta* Boschma, p. 242, pl. viii, figs. 99–104 ; pl. ix, figs. 107, 108, 112–16, 120, 122 ; pl. x, figs. 130–133.
1929. *Halomitra robusta* Boschma, p. 46.
1932. *Halomitra robusta* Thiel, p. 84 (with full synonymy), taf. xi, figs. 1, 2.
1939. *Halomitra robusta* Umbgrove, p. 45, pl. xiv, figs. 1, 2.

Of five specimens labelled *Doderleinia irregularis* by Matthai, viz. " P. 27," and Nos. 19, 20 and 267, the fifth, No. 225, also labelled " portion of an attached funnel-shaped Fungiid " is a fragment of *Podobacia crustacea.* It has thick spinulose septal teeth and well roughened sides, a character of *Doderleinia,* which, as we have seen, is shared by several specimens of *Podobacia crustacea* which we have examined. If Matthai means by this that all the genera *Doderleinia, Halomitra* and *Podobacia* should be joined, there is everything in favour of his view.

The reasons for uniting all three species of *Doderleinia* under one, *Halomitra robusta,* are given by Boschma in 1925. I have also shown that the strength of toothing and spinulation of the septa is not even a specific character in *Podobacia,* and therefore cannot be a sufficient foundation for the generic separation of *Doderleinia.*

Boschma's account of variation in the genus leaves nothing to add. Of these specimens Nos. 19 and 267 are particularly rough and deformed, No. 20 is oval, somewhat flat, 23 cm. long × 13 cm. wide, with a distinct central mouth, the subsidiaries being radial and many concentric.

Distribution.—East Indian Archipelago and Pacific, out to the Society Islands.

Polyphyllia talpina (Lamarck).

This species is not found in the collection but is recorded by S. Manton, p. 290, a large specimen 34 cm. × 7 cm., on the muddy sea floor at the end of Traverse I. The form is so distinctive that the identification may be taken as reliable.

Distribution : Only from the East Indian Archipelago, Philippines and Murray Isl., Vanikoro, Santa Cruz Islands being the easternmost record.

Genus *Podobacia.*

The genera *Halomitra* and *Podobacia* have been united and again separated ; at the present time they have been placed in distinct families, following Vaughan (1905), supported by Gardiner in 1905 and 1909.

We are on the horns of a dilemma : (1) The whole structure of species of the two sets is identical, down to small details. (2) Gardiner points out that, in spite of this, the union of the genera " implies that the budding off of *Halomitra* from a fixed stock took place absolutely independently of that of *Fungia*, and that *Podobacia* is a form which has retained the primitive fixed character." That is to say, it is impossible to separate the genera on any other character except that one lies loose while the other is attached, and impossible to unite them because of the extreme improbability of the evolution twice over of the reproduction of loose colonies from fixed stocks. The solution is that *Podobacia* is *secondarily* fixed, the descendant of a free form. The method of reproduction by successive sheddings of coralla from fixed stocks was evolved as *Fungia*, from which *Halomitra* is readily derived, especially since Boschma showed how readily *Fungia* itself may acquire accessory mouths. *Halomitra* then gave rise to species in which the calices are retained on the stock, their multiplication spreading into a plate instead of the original free form adapted to lying on sand ; this fixed plate is *Podobacia*. The two genera are thus very closely related, if not identical. Some of the other fixed Fungiidae may derive from free forms in the same way, possibly *Psammocora* from this genus.

Podobacia crustacea (Pallas).

(Plate XII, fig. 1 ; Plate XIII, fig. 3.)

Horst (1921, p. 26) gives 14 references to this species, amongst which I find only the following two reliable figures (the last, by Bedot, is, as all his photographs, specially good, but it is probably a different species, though too young for safe identification) : (1) 1883, Duncan, *Halomitra crustacea*, pl. vi. A young specimen with four rows of calices. Septo-costae arched. Underside with rounded ribs and well perforated. (2) 1905, Gardiner, p. 942, pl. 90, fig. 8. Gardiner had 20 specimens of this comparatively rare form from Goidu and Minikoi in the Maldives. It is not in the " Sealark " Collection. He gives only one figure, though stating that the variation in form, toothing of the larger septa and their granulation and spinulation, vary much. The figure shows septo-costae strongly arched between centres, which are near together. Details of toothing are missing.

Faustino's (1927, pl. 68, figs. 1 and 2) resemble this specimen, No. 36, more than do any other figures. He says that his example is like Dana's, whose description is inadequate, and who gives no figure.

Yabe, Sugiyama and Eguchi (1936, pl. 47, figs. 1–6) show excellently a specimen with thin arched septa, without teeth. Underside concentrically corrugated.

The species has only one mention in the ecological papers, viz., S. Manton (1935, pl. xii) shows one specimen, 45 cm. across, near the base of the pinnacle.

Specimen No. 36 is a portion of a saucer-shaped colony about 23 cm. across. The central calyx is not present.

The difference from all but Faustino's figure is in the flatness of the septo-costae, which begin at a low level on the distal side of each centre, rise gradually to a height of 2–3 mm., and drop suddenly to the next centre. The columella is a distinct style, rising from a flat fusion, in the well-developed centres. The underside of the plate is neglected in most descriptions ; in this case it is nearly smooth but for small spinulose projections, which sometimes fall into radial rows, but real ridges are found only within 1 cm. of the edge. In place of perforations are small scattered round holes, not arranged in rows between ribs, and not perforating the plate, unless within 1 cm. of the edge.

As these peculiarities have not been described in other specimens I give illustrations on Plates XII–XIII. The figure of the upper surface is slightly oblique in order to show the shape of the septa and their toothing. As other photographs are taken perpendicularly to the surface they do not show details, so that Duncan's drawings remain the best illustrations, but the cup-shaped ends of the " ornamental granules of the free septal edge " have not been seen again.

Sample 225 B.M. 153 is a triangular fragment, 14 cm. measured circumferentially and 10 cm. radially, labelled " portion of an attached funnel-shaped Fungid." It is more normal than the other in that the septa are arched, project up to 5 mm. above the centres, are thick, have rough sides, and bear spinulose teeth. Columella none, or rudimentary, or bearing 1 to 3 small points.

No. 52 : The smallest, lightly oval, 15 cm. in diameter, no central polyp, edges bent over downwards, as some of Gardiner's specimens. Septo-costae flat, rarely arched, no teeth, only numerous spinulations along their edges, like those of their sides. Primary septa often thickened. Columella always rudimentary, at best has no style. Underside much as in Great Barrier Reef specimen.

No. 46 : 20 cm., × 15 cm. A flat plate with two overlapping lobes. Base enwraps a dead branch of coral. Septo-costae sometimes arched, often flat, much thinner than in the Great Barrier Reef specimen. Sometimes toothed, but never so distinctly. In general much like No. 52.

No. 43 : Two rather irregular plates from one base, like Faustino's figure, 39 cm. × 27 cm. Edges folded. Much coarser with thicker septa than the other three. (This difference is therefore not due to age, as is already shown by Duncan's figure of a very young one.) Septo-costae not toothed as a rule, but if toothed teeth are low and indistinct. Columella rudimentary. Underside as above, but in places large warts bearing the usual spinulose projections.

No. 42 is a still larger specimen, folded in a complicated way. Some folds with very long septo-costae and very small centres, as in the overfolded part of 52. Septo-costae thinner than in No. 43 or G.B.R. As No. 52 or No. 46, they project little so the whole colony is smoother. Teeth thin, often indistinct. Underside with high ridges, 1 to 2 mm. high and the same distance apart, bearing large teeth with spinules. There are from one to three much smaller ridges between the high ridges. All become fainter after 5 cm. or so, but in places can be traced to the base. Usually base covered only by small, denticulate monticles as in the other specimens. In one area these are enlarged, but do not form warts.

I have also examined five specimens in the Museum of the University of Kóbenhavn, all labelled *P. crustacea* from " Ostindien " or " Singapuhra " and dated 1858 to 1872.

Specimen No. 36 is therefore a strongly marked variation, differing distinctly from the majority of those described and the specimens available to me for comparison ; but it seems unlikely that it is an independent variety.

Distribution : Apparently always local ; only once recorded as abundant (in the Maldives). Also Ceylon, Malaysia, Ryukyu Islands. Absent from the Red Sea and Pacific East of the Philippines.

[Family Pectiniidae.]

Genus *Oxpora* Kent.

1863. *Trachypora* Verrill, p. 53.
1871. *Oxypora* Kent, p. 283.
1879*a*. *Echinophyllia* Klunzinger, p. 69, pl. vi, fig. 8.
1905. *Echinophyllia* Gardiner, p. 949, pl. 93, fig. 26.
1935. *Echinophyllia* Crossland, p. 503, pl. 2.
1935. *Oxyphyllia, Oxypora,* Yabe and Eguchi, p. 429.
1936. *Oxypora* and *Oxyphyllia* Yabe, Sugiyama and Eguchi, pp. 50, 53.
1936.* *Oxypora, Oxyphyllia* and *Echinophyllia* Vaughan and Wells. [Check list of Generic names.]
1939. *Oxyphyllia* and *Oxypora* Umbgrove, pp. 40 and 41.

The confusion in the literature of this genus has justification in its complication in nature. For an example of the latter see the figure (1935, pl. ii) of my Tahaitian specimen, but it is also due to the fact that, although all the colonies I have seen are large, all the illustrations are from fragments of the edges, just as the Great Barrier Reef collection consists of a number of fragments, the largest 8 cm. across.

Consequently the five generic names, have been distributed among several families by Yabe, Sugiyama and Eguchi followed by Umbgrove. Vaughan and Wells, in their List of Generic Names of 15th June, 1936,* complicate the matter by recognizing both *Oxypora* Kent and *Echinophyllia* Klz. as valid, and *Oxyphyllia* as a synonym of the latter. This implies a difference between *Echinophyllia* and *Oxypora* which I am unable to find.

I propose therefore to emend Verrill's definition slightly thus: Growth form in thin free plates, never encrusting for more than a small part of the base,† Calices on one surface only; under-surface ribbed. Generally with slit-like perforations near edge and under centres, but these may be obscured by later growth. Septo-costae continuous from centre to centre, parallel between them, but at edges of centres bent towards the columella; this is especially striking where a rib passes the end of the usually transversely elongated columella, and where they together form an H-shaped structure. Theca absent or imperfect. Septa and septo-costae bear large spines with blunt ends; these are structural, not due to incision. Columella trabecular.

This definition may include other genera than those mentioned. It does *not* include *Echinopora*, which is an Astrean, whereas the septal arrangement of *Oxypora* is Fungiid. The generic distinction from such genera as *Mycedium*, *Leptoseris*, *Podobacia*, *Halomitra*, and others is largely in the spines of the septa and costae.

Oxypora lacera (Verrill).

Samples 28, 29 and 452 are all small scraps from young marginal growths. They show considerable variations, but there is no point in describing these without reference to whole colonies.

I refer to the species under Verrill's name and authorship, though the latter is an empty formality. The only real references are to Yabe, Sugiyama and Eguchi (1936), pl. xxxvii, figs. 1 and 2; and Umbgrove (1939), pl. xii, since no adequate written descrip-

* Distributed privately in advance of the "main body of the revision," which was published in 1943.—[A.K.T.]

† So far as present knowledge goes, and *pace* Ellis and Solander (1786), taf. 39. Compare *Echinopora gemmacea*, of which almost all examples are encrusting some with free edges. Exceptionally some may be free but for a small attachment. (See Crossland, 1935.)

tion of the species exists. It is unknown whether Klunzinger's *E. espera*, Gardiner's *E. espera* (*sic*) and Matthai's *Mycedium aspera* are all the same species or not, and the material for determination apparently does not exist. A step might be taken if I had access to my Ghardaqa specimens. To found anything upon such accounts as are given by Ellis, Duncan, Verrill, Schweigger and Dana is impossible, Ellis's figure is of the roughest, and his description *nil*. Verrill's description is good (with modifications) for the genus, but will include any species hereafter to be described. The first descriptions of any value are those by Klunzinger and Gardiner, but the identity of their species with those of Ellis and Verrill is apparently based on the supposition that only two species of the genus, doubtfully distinct, existed or would be discovered in the future.

Oxypora aspera (Ell. and Sol.).

1939. *Oxyphyllia aspera* Umbgrove, p. 40, pl. x, figs. 1, 2.

I have pointed out the identity of these two genera, the latter of which Vaughan and Wells identify with *Echinophyllia*. With the same proviso as in the preceding species I refer sample 84 to Umbgrove's (1939) fig. 2 on pl. x, which it exactly resembles. Information as to what the rest of the colony was like is shown in Umbgrove's fig. 1, though this is badly printed. The relationship to *Mycedium* is evident.

One end of the small Great Barrier Reef sample No. 84 is thinner and more like the usual growth of the genus, and here are calices without walls and with long septal teeth. These teeth correspond to the upper thinner free portions of the septa conspicuous in Umbgrove's fig. 2, as is shown by a single calyx of intermediate structure. Teeth on the costae are comparatively small in the sample No. 84, and in Umbgrove's and Yabe, Sugiyama and Eguchi's figures, which makes it almost certainly not the species Ellis deals with.

Genus *Tridacophyllia*.

The name *Tridacophyllia* was exchanged with *Pectinia* Oken by Vaughan in 1901, but as the former has been in constant use since 1830, the change can only cause more confusion than uniformity, and is therefore contrary to the rules of nomenclature. Matthai (1928), Yonge (1930), Thiel (1932), Yabe, Sugiyama and Eguchi (1936) and Umbgrove (1939), all retain the well-known name.

Matthai (1928) p. 262 writes : " This genus is usually placed in the family Astraeidae, but it seems to be related also to certain colonial Fungiids. Its systematic position can, therefore, be ascertained only after a comparative study of the latter group." Yonge (1930), 'Physiology of Corals,' I, p. 29, in this series, in a note says, " I am uncertain whether this genus should be considered here or under the Mussidae ; in any case the two families have a great deal in common."

I unhesitatingly place the genus in the Fungiidae for two reasons : (1) The arrangement of the septo-costae and columellae of the secondary centres on the leafy expansions are certainly Fungiid, generally showing the characteristic H-form. Those of the main polyps are, as usual, regular, the genus differing from, *e.g.*, *Podobacia* and *Leptoseris* in that there are many, instead of only one, primary polyp. (2) The method of feeding, as described by Yonge, is surely Fungiid. If it were of the Astrean or Mussid type, the mouths and minute tentacles, placed deep among the leafy expansions, would get no food, but, as things are, these expansions are themselves the food-capturing organs. The long series of specimens in the Kóbenhavn Museum shows a curious morphological fact, viz., that the "leaves" are all enormously overgrown septa, so that of the hundreds of calices in a large colony, only a few primaries have any connection with the theca. This is quite clear in young colonies (such as those figured by Matthai in 1924), and the fully grown colonies may be compared to a bowl, an enomous theca, filled and overflowing with a mass of huge leafy septa, with many mouths, both principal and secondary. It of course makes no morphological difference that, in many cases, this bowl is cut up into branching segments.

I hope later to describe this Kóbenhavn series and give full proofs later. From this I am inclined to doubt whether such species as *T. alcicornis* Kent, *T. cervicornis* Moseley and *T. primordialis* Gard. really belong to this genus, since their outgrowths are thecal. The name *T. alcicornis* Kent has been given to a Japanese species by Yabe, Sugiyama and Eguchi, but I doubt its identity.

A revision of the genus was undertaken by Thiel in 1932 (pp. 96–103), but it is rendered invalid by his taking the symphylloid form as primitive, and, apparently, deriving the genus from the meandroid astreans through this. His speculations on the biological value of the "leaves" were written before we had Yonge's work on the feeding arrangements. The names given below are provisional.

Tridacophyllia lactuca (Ell. and Sol.).

1786. Ellis and Solander, pl. 44.
1849. Milne Edwards, in : Cuvier, 1836–49, pl. 84.

No. 417, a small distorted and partially diseased colony is probably of this species. The expansions bear secondary centres, and both these and the principals are loosely made by meetings of the widely separated septa, and neither have any columellae. All the expansions are thin.

Distribution : Indian Ocean to Fiji, reaching its greatest abundance in Malaysia.

Tridacophyllia paeonia Dana.

1927. Faustino, p. 160, pl. 42, fig. 1. (The only published figure giving details).

No. B.M. 493 from Stn. XX (Yonge gives 6 fms. off Eagle Island) is labelled *T. lactuca* (Pall.) by Matthai. *P. paeonia* is probably only a variety, but provisionally I find that this specimen corresponds exactly with Dana's and Faustino's descriptions and Faustino's figure pl. 42, fig. 1. I add that the differences from *T. lactuca* appear to be (1) the thickness of the septa and their prolongations, which are as often pillar-like as plate-shaped, *e.g.*, measuring 13 × 4 mm. in section, or round and 5 mm. thick and *solid* ; and (2) the well-developed columellae, of thin, closely packed trabeculae. The way in which the septa at the edges of the colony draw out the theca recalls Kent's *T. alcicornis*.

Distribution : Fiji and Southern Philippines ; now G.B.R.

[Family AGARICIIDAE.]

Genus *Pavona*.

The distribution in quantity of the species of this genus is exceptionally interesting. In the Northern Red Sea it is rare, the specimens seen at Ghardaqa numbering about four, but it may grow to a considerable size, as examples in the raised reefs show. Similarly on the Great Barrier Reef, though Stephenson and others mention the genus five times (the specimens come from five scattered localities, *viz.*, Low Isles, Three Isles, Lizard Island, and Yonge and Batt Reefs), S. Manton, in her detailed ecological surveys, met it only once (pl. xi). On the other hand, Gardiner found both solid and leafy forms common in Fiji and Rotuma, while in the Maldives only *P. varians* (*P. repens* Brüg.) and other solid forms are important builders. In Hawaii only two solid forms are present, but not in any abundance. Both forms are abundant in most places in the Pacific, perhaps reaching a climax in Tahaiti, where many lagoon reefs are practically made of leafy species of *Pavona* and *Porites* (*Synaraea*) *convexa* alone. These leafy Pavonas are good builders; they appear fragile, but in fact one can walk on most of them without doing much damage.

It is deeply regretted that Matthai's revision of the family was interrupted by the war.

Pavona decussata Dana.

One specimen, No. 260, is the only leafy *Pavona* in the collection. Hoffmeister (1925, pp. 40, 41) discusses at length the relationship of this species to *P. danai*, concluding that they are the same; Vaughan (1918, p. 137) keeps them distinct, though remarking on their relationship; his figure of *P. danai* on pl. 55 resembles *P. decussata*, and is widely different from the type of *P. danai* on pl. 56. Horst (1921, p. 22) keeps the species distinct, though considering them " nearly related." I leave the point without coming to a decision, only remarking that (1) Small scraps should all be destroyed, or at least, left out of consideration. (2) Vaughan's figures of *P. danai* are objected to by Hoffmeister as being of very young specimens. Photographs of fully adult specimens of *P. danai* are published in my description of Forskaal's collection, copies of which were sent to Vaughan and Matthai in August, 1939. The former agrees that Faustino's *P. cactus* is the same as Milne Edwards and Haime's *P. danai*, the latter that it falls within the limits of *P. cactus*. If so it seems as if Matthai were preparing to run nearly all the leafy species of *Pavona* into one. We await his evidence, which we trust will be given in full.

The present specimen is rather remarkable for the delicacy of the septa, the alternate ones being extremely thin as well as narrow, and for the prominence of the principal septa near the columellar pit, the latter feature giving the surface of the leaves a character visible to the naked eye. These are characters of *P. venusta* Dana (Vaughan, 1918, p. 136), a species never figured, until Horst (1922, pl. 31, figs. 1, 2) did so. These show the narrow curled leaves described by Dana, so different from those in *P. decussata*.

Distribution: Red Sea, Indian Ocean, Malaysia, Rotuma and Samoa.

Pavona danai M. E. and H.

A single large leaf, 8 cm. high × 9 cm. broad, is thus labelled by Matthai. It differs from most specimens of *P. danai* in its thickness and weight, the small size and blunt edges of its marginal lobes, the few thick septa (the alternating thin ones being generally absent) and the absence of a columellar tubercle, the deeply placed columella being only an irregular fusion of septal ends. (See remarks under *P. decussata*.)

Distribution: Northern Red Sea to Tahaiti, the latter locality based on an identification by Matthai.

(?) *Pavona cactus* M. E. and H.

Two small and very thick fragments : (1) from Batt Reef Patch No. 1 (the common species labelled by Matthai ? *Pavona cactus* (Forsk.). (2) No. 223 from T2 deep (without the ? mark). I agree that this is probably the species named by Matthai, but alter the author's name to M. E. and H., since Forskaal's species is *P. danai.* It would be correct to suppress the name *cactus* altogether, but this would cause much confusion.

Distribution : Indo-Pacific.

Pavona varians Verrill, 1864.

(Plate XIII, figs. 1, 2 ; Plate XIV, fig. 4.)

Three very distinct forms of this astonishing species are present :

Form A, No. 55 : The commoner of the three, but the most striking. It is an irregular mass, apparently a thick crust over branches of a dead coral. In places it is almost smooth, in others it has sharp ridges which, on the upper parts, are 5 mm. high (at one point 15 mm.). These bear calices after the fashion of the leafy species.

I am surprised to find only one illustration comparable to this (Horst, 1922, pl. 31, fig. 3), as I found similar curious intermediates between plain crusts and leaves not uncommon in Tahaiti. Horst's figure is not very good.

In both this and Horst's specimen the leafy expansions develop at the apices of lobes, as would be expected ; the high ridges result from vigorous growth in positions where horizontal expansion is no longer possible. We find the same thing in many other corals, *e.g.*, *Montipora*, *Merulina* and *Echinopora*, and other encrusting organisms such as Polyzoa.

Form B, No. 117 (Plate XIII, figs. 1, 2) : This is a rare form, so distinct that a special name may be desirable, in which case I suppose var. *obtusata* would be correct. Its synonymy has been confused by Quelch's imperfect illustrations.

1886. *Tichoseris obtusata* Quelch, p. 114, pl. v, figs. 3–3*c*.
1898. *Pavona calcifera* Gardiner, p. 532, pl. xliv, fig. 4.
1905. *Pavona repens* Gardiner, p. 946, pl. xc, figs. 9–11.
1907. *Pavona varians* Vaughan, p. 135, pl. xxxviii, figs. 1, 1*a*.
1918. *Pavona varians* Vaughan, p. 138, pl. 57 (7 figs.).
1936. *Polyastra obtusata* Wells, p. 551, pl. ix, figs. 1. 2.

The general appearance of this specimen is illustrated by Gardiner (1905, pl. xc, fig. 11) ; details by figures quoted below. It is uniform in structure over the whole mass, which is a rounded ridge 9 cm. high × 9 cm. broad, and about 6 cm. thick. Its infestation by a serpulid and several cirripedes has had no effect either on form or on details of the calices.

The resuscitation by Wells of Ehrenberg's and Quelch's names, so deservedly sunk into oblivion, is nothing but a misfortune.

The invalidity of the genus *Polyastra* had already been shown by data given by Gardiner (1898), and a glance at Vaughan's (1918) pl. 56, figs. 3*a*, 3*b*, would have been sufficiently convincing. Wells's fig. 3, pl. ix of Quelch's *Tichoseris obtusata* is so exactly like Gardiner's 1898, P.Z.S., pl. xliv, fig. 4 of his *P. calicifera* as to return Quelch's name to oblivion finally. This paper is apparently unknown to Wells.

I should have been inclined to keep Gardiner's species *P. calicifera* had he not himself in 1905 incorporated his closely allied *P. intermedia* into *P. repens* (which is *P. varians*).

No. B.M. 265 (Batt Reef, Patch 1, Square 4) is similar but small, irregular and of coarser growth, and much infested by a cirripede.

Form C: Sample 251 is a thin crust of a more usual form, in which the calices are in valleys, few having separate walls.

Distribution: Northern Red Sea, Indian Ocean, Pacific to Tahaiti and Hawaii.

[In the course of unpacking at the B.M. (Nat. Hist.) during January, 1950, of the Gardiner Bequest of corals from Cambridge there came to light what appears to be an important G.B.R.E. specimen "47." On one side of the label in C. Crossland's handwriting in ink appears: "*Pavona ? varians*, see other labels. G. W. Otter, Gt. Barrier Rf. Expedn., Low Island." In the corner is pencilled "47." On the other side in G. Matthai's handwriting in pencil is: "*Pavona varians* (Verrill). This is an important specimen, as it shows the transition from the *Pavona varians* (Verrill) condition to the *Pavona ponderosa* (Gard.) condition. Note formation of corallites by intersection of radiating ridges and concentric collines. Photo—47*a*, nat. size. Photo—47*b*, nat. size. G.M."—[A.K.T.]

Pavona duerdeni Vaughan.

1907. Vaughan, p. 135, pl. 38, figs. 2, 2*a* and 3.
1918. Vaughan, p. 135, table of species and footnote.
1922. Horst, p. 420 (synonymy), pl. 31, fig. 7.

I consider that Horst is over-precipitate in combining this species with Dana's *P. clavus* and Gardiner's (1905) *Siderastrea maldivensis*. Vaughan, in his synopsis, gives a note that *clavus*, *duerdeni* and *maldivensis* are probably synonyms of *P. explanulata*, but no evidence has since been given.

Sample No. 427 is a flattish stone, heavy for its size, rather irregular in outline owing to projecting angles (probably due to cirripedes and serpulids, of which a number are visible on the surface). It lay loose on the bottom, and is completely covered with healthy calices of practically uniform structure on every side and not modified by the presence of parasites. There are a few low rounded ridges in places, recalling *P. varians*.

This specimen corresponds perfectly with Vaughan's of 1907 except in form. Septa of the third cycle, when present, are so thin as to resemble white hairs, and some of the ordinary septa have prolongations of the same kind. Particularly important is the structure of the walls; all are thick and homogeneous, but while some are solid, others are plainly made of synapticula. In no case are they loose or thin as in Horst's pl. 31, fig. 7, or Vaughan's pl. 56, fig. 3*b*.* The septa are never thick as in fig. 3*a*, nor are there projecting cushion-shaped sets of septa, or cut-off septa and costae as in Gardiner's (1905) pl. 89, figs. 2 and 3.

It is impossible to agree, in the absence of cogent evidence, that every solid *Pavona* with synapticular walls, whatever the form of those walls, of their septa, calices and costae, is of the species *P. clavus*. In fact I doubt if this species has been seen since Dana's time. If the present specimen is a synonym of anything it is yet another variety of *P. varians*.

Distribution: Hawaii and now G.B.R.

Genus *Pachyseris*.

The uniqueness of the skeleton needs no comment; and for the complete difference between the polyps and their feeding methods from those of all other corals see Yonge, vol. i, p. 42.

* Crossland's typescript said "fig. 7," but he did not specify which paper of Vaughan he was quoting. The seventh figure on pl. 56 (1918) is marked 3*b*, *Pavona maldivensis* (Gardiner).—[A.K.T.]

Stephenson and others give references to it on pp. 67 and 87, as one of the corals characteristic of seaward slopes and anchorages, and of the fringing reef at Lizard Island. It is evidently rare, as usual, as S. Manton does not mention it.

Pachyseris speciosa (Dana).

Sample No. 451, a deeply folded fragment, is typical of this species. No. 444, another fragment, has the same form of columella, but the ridges are vertical, thin, high and sharp-edged. They measure (in sections) 5–6 mm. high, 2 mm. thick at the base, and 1 mm. at the top, which is rounded. There are 7 ridges in 2 cm. Only at the extreme edge of the plate are the ridges low, rounded and steeper on one side than the other, in the typical way.

Two specimens from Singapore in the Kóbenhavn Museum show the variation in the height and sharpness of the ridges noticed by other authors (Horst, especially, 1921, p. 35), but the highest hardly rival those of the Great Barrier Reef specimen. In one specimen all the ridges are high and valleys narrow.

Distribution : Northern Red Sea, Indian Ocean and Pacific as far east as Tahaiti ; but not Hawaii.

Pachyseris torresiana Vaughan.

1918. Vaughan, T. W., p. 132, pl. 55, figs. 1, 1*a*.

Specimen 16, thus labelled by Matthai, is four small fragments, which fit together. The ridges are triangular, mostly very oblique, none high. Columella plate-like, interrupted by mouth centres.

My only Tahaitian example of this genus seemed to me to combine the characters of this species with those of *P. speciosa.* The species is not recognized by Hoffmeister, while Horst thinks it may be identical with *P. rugosa.* I think the species should stand till more evidence is available.

Distribulion : Great Barrier Reef, Timor, and Tahaiti.

Genus *Coeloseris* Vaughan.

Coeloseris mayeri Vaughan.

1918. Vaughan, T. W., p. 139, pl: 58, figs. 1–3*b*.
1924. Matthai, p. 56
1936. Yabe, Sugiyama and Eguchi, p. 63
1939. Umbgrove, p. 53

} These are records of occurrence only.

Only one fragment, No. 405, 6 cm. across × 3 cm. thick, broken from a larger mass. It is evidently rare on the Great Barrier Reef, as it is not referred to in either of the ecological papers.

This piece is all of the light type, with thin walls and thin septa, like Vaughan's fig. 1*a*, so does not show the thickening of the inner part of the curved septa so often characteristic.

Distribution : Bay of Bengal,* Batavia, Murray Island, Southern Philippines, Palau, Riu Kiu Islands and Taiwan.

* The record of occurrence in the Bay of Bengal is due to Matthai who, in 1924, found a specimen in the Indian Museum labelled " Arracan," a place not to be found in an ordinarily good atlas. In an exceptional atlas Arakan is found, a large estuary on the Burmese coast, 20° N.—a most unlikely place for corals !

[Family SIDERASTREIDAE.]

Anomastrea irregularis Marenzeller.

1901. Marenzeller, p. 125, figs. 3, 3*a*.

One tiny, but typical specimen, of 6 full-sized calices and some marginal buds on a mass of lithothamnion dredged from Station XVI. It differs from the type in the regularity of the calices, and in that the septa of the first cycle and part of the second are a little thicker and slightly more prominent than the others. These are the characters of youth.

Distribution: Equatorial East Africa and Natal (collected by T. A. Stephenson). This is the third record.

[Family THAMNASTREIDAE.]

Genus *Psammocora.*

Psammocora contigua (Esper.).

(Plate XV, figs. 4 and 5 ; Plate XVII, fig. 3.)

Two small pieces, both alike, numbered 11 and 18, and a third, B.M. 417 "Low Island Reef" and No. P.25. The species is fairly common in the deeper part of the moat, but not elsewhere, but even in the moat it is common only in places (S. Manton, pp. 284 and 288, pls. iii and ix ; Stephenson and others, p. 49 ; under the name *Ps. gonagra.*)

Three pieces are named *Ps. gonagra* Klz. by Matthai, a name rarely used since Klunzinger's time. Vaughan's (1918) pl. 59, fig. 1, is difficult to reconcile with Klunzinger's taf. ix, fig. 1, with its thin septa, flat net-like coenenchyme, and much smaller calices ; but examination under a lens of the upper right-hand part of Klunzinger's photograph shows a greater resemblance. In fact the type specimen is abnormally variable ; having been collected at Qoseir it is almost certainly a rough-water form, probably of *Ps. contigua* ; but discussion of synonymy without work on the reef is futile.

It is curious that figures of this common and oft-described species should be incomplete. Hoffmeister's figures of Samoan specimens (1925, pl. 5, figs. 1*a*, 1*b*) and Faustino's (1927, pl. 70,) are the best, but the former is abnormally branched, and the latter shows only the outside of a colony. The present specimens 17 and 18 are so exactly like the one Esper figures that I give photographs corresponding to his figs. 1 and 2 (1795, pl. lxvi). These show the outer side of specimen 11, and the inner side a broad flat branch with its distinct rows of "stars" ; also enlarged views of these latter. Those on the upper parts are similar, but rougher and looser.

Distribution: Red Sea (?) ; through the Indian Ocean to Mauritius (Stephenson's unpublished collection), Malaysia and the Pacific to Tahaiti and the Marquesas, but not to Hawaii.

Psammocora exesa Dana.

(Plate XVI, figs. 2 and 3 ; Plate XVII, fig. 4.)

1846. Dana, pl. 26, fig. 1 *a–c*.
1905. Gardiner, J. S., p. 952, pl. xcii, fig. 22.
1936. Yabe, Sugiyama and Eguchi, pl. xliv, figs. 3 and 4.

One good specimen, No. 17, 14 cm. high and 10 cm. wide at the base, and a scrap, "P. 26. Outside rampart Low Isl." The latter is given this name with a query by

Matthai. It is certainly this species, but is a younger growth, with looser structure, *i.e.*, thinner septa, more spicular toothing and looser structures between the centres. Only in certain places does it resemble Gardiner's figure quoted above, but neither in this figure nor the present specimens do I find " interseptal spaces relatively large, at least of the same breadth as the septa." This specimen might be worth describing in detail were it complete. It would not, however, form a link with Quelch's " Challenger " specimen (p. 128, no figure), which I do not believe to be of this species.

Specimen 17 corresponds well with Yabe, Sugiyama and Eguchi's figures, which show part of a colony of columnar growth and calices (magnified 3 times). In the extreme coarseness of the septa, etc., it exceeds that of Gardiner's and Dana's figures. It does not, however, show the thick teeth, so closely placed as to leave only a series of narrow transverse cuts between them (pl. xvi, figs. 2, 3). The present specimen, No. 17, is nearly complete, as shown by its unattached spreading base (pl. xvii, fig. 4). It was growing over two dead columns of *Heliopora*, and doubtless owes its form partly to this, but not entirely, as the three small humps on the basal expansion are quite independent.

It is remarkable that the characters of the septa remain the same over the whole colony, except on the tops of the columns, where, as expected, the whole structure is looser and lighter, as in the other specimen.

Distribution : Never abundant. Indian Ocean (Maldives) ; Pacific only as far east as Fiji.

[Family AGATHIPHYLLIIDAE.]

Genus *Diploastrea* Matthai, 1914, p. 72.

1816. *Diploastrea heliopora* (Lmk.), ii, p. 265.

This species is one of the few corals immediately recognizable, and which has been given this specific name by almost all authors. The numerous figures published show no striking variation : only the toothing of the septa may be more or less pronounced. This uniformity may be correlated with the fact that the species was an important member of the Oligocene coral fauna, and it has therefore had time in which to become stabilized. It occurs in great masses where it establishes itself, but elsewhere it is rare. For instance, Umbgrove (1939, p. 42) never collected it himself in the Bay of Batavia, but saw it being brought ashore for road-making ! Similarly at Low Isles it is a rarity, mentioned once by Stephenson and others but not by S. Manton. The former authors (p. 88) refer to reef patches near Lizard Island, " a notable mass of coral many feet deep, square yards of which were covered by a living colony of *D. heliopora*."

Distribution : From the Gulf of Aden (Jibuti) to Samoa ; but not reported from the Red Sea or Equatorial East Africa. It does not occur in Tahaiti.

[Family DENDROPHYLLIIDAE.]

Balanophyllia incisa, sp. n.

(Plate XV, figs. 1 and 2.)

This species is branched, and therefore would usually be placed in the genus *Dendrophyllia*, but, as Plate XV, fig. 2, shows, its branching is an entirely different thing from that of such species as *D. micranthus*, in which a special elongated polyp forms the stem and its lateral buds the branches and twigs ; or such as *D. axifuga*, which is more or less dichotomous. I therefore retain this new species in the genus *Balanophyllia*.

Two small broken scraps are present, which, by good fortune, fit together. There is no number but B.M. 369, and no note of habitat, but the following description of the colour is given on the label : " Colony of a uniform combination of orange and carmine (nearly vermilion). Polyp carmine in its depth, modulating through light shades to white at its edges. Base of colony brownish."

I have one complete, undamaged calyx, the half of one of its buds, and a much broken second bud on which to describe the species. Fortunately it is distinctive, the compression and lateral outline of the calyx being unique. The main calyx measures 17 mm. × 7 mm. and is 10 mm. deep if measured at the middle of one side ; but at one end the wall rises only 3 mm. above the columella and even less at the other. The half of the second, much smaller calyx, the first bud, shows a similar, but less pronounced form ; it is usual in most species for the younger calices to be more nearly round.

The wall is highly perforated, the part above the columella translucent. Costal ridges corresponding to the 12 principal septa are prominent. Between them is a coarse branching reticulum with a mere tendency to vertical lines. On the buds the ridging is more regular. The lower part is nearly smooth, being covered by a dense epitheca. At the same time the walls, septa and columella thicken below, and, with the epitheca, make an almost solid stem. This, like the bases of the buds, is nearly round, and is 9 mm. in diameter. The 12 septa of the first two cycles are of nearly, but not quite, equal size. Between them are the 3rd and 4th cycles, the former short and cut off by the meeting of the septa of the 4th cycle at half to one-third the distance below the top of the wall. In one loculus a septum of the 5th cycle is present, in another both 5th and 6th on one side of the 3rd. The upper ends of the 4th cycle run close alongside and fuse to those of the first two cycles, and with them form the prominent projections of the walls shown on the plate.

All septa are fairly thin and rough, with coarse tubercles, especially at their upper ends, which, like the walls, are abundantly perforated. Septa of lower cycles toothed, but these teeth appear to be perforations which have not closed up laterally.

Balanophyllia yongei, sp. n.

(Plate XIV, fig. 2 ; Plate XV, fig. 3.)

Seven adult and four young specimens were obtained by dredging at Stn. IX. All grew alone but one, which seems to bear a lateral bud at its base, but some sort of abnormal epithecal deposit hides the actual junction.

Two adult and three young are attached to lamellibranch shells ; one has settled upon a dead example of the same species (it is quite clearly not a bud), one is on a fragment of yellow calcareous sandstone (probably consolidated coral mud), and two have their bases broken off.

Three of the specimens have been named *B. bairdiana* by Prof. Matthai. Milne Edwards and Haime's (1860) description (III, p. 103) is too brief, and has no figure. We have only the account of Moseley (1881, p. 190), who had access to the type, " which is not in good condition." The following are the differences from the present species. (Compare

Plate XV, fig. 3, with " Challenger," pl. xii, fig. 4.) Ends of longer axis much lower than those of the short.

" Calicle in the adult irregularly elliptical in outline, being angular at the ends of the long axis." The " Challenger " figure shows straight parallel sides with slightly pointed ends. The present specimens are generally regularly oval, but in three cases one end is rather blunter than the other. Principal septa slightly or considerably projecting, their costae decidedly the more prominent. They are straight, or sometimes *slightly* curved, and are twice as wide as those of the third series.

" Columella spongy, well developed, flat at the bottom of the fossa." Milne Edwards and Haime say " peu developpée." It is fairly well developed and flat in these specimens, but less so than in Moseley's figure (1881, fig. 5, pl. xii), and quite without the lateral extensions shown in this figure, and the diagram of the septal arrangements on p. 191. Even in those specimens with thick and very spinulose septa, where in consequence the fusion of the septa of the 3rd and 4th cycles is at its greatest thickness, " their junctions are '*not*' thickened by processes of the spongy columellar substance," such as is shown clearly in Moseley's plate.

In normal specimens with thin septa the fusion remains thin and keeled, and the septum of the 3rd cycle runs distinctly through it to the columella ; on rare occasions it first joins, but does not interrupt, a 2nd cycle septum immediately above the columella.

Milne Edwards and Haime's type is about twice the size (area of calicle) of either Moseley's or of these specimens. It is also significant that Moseley's examples are from Bass Straits and Port Jackson, which are in a different current system to that of the tropical Pacific.

Measurements of the 7 adult calices in mm. :

No. 1. 13 × 10 × 14. 3rd order with entire margins. Septa thin, and finely spinulate.
2. 12 × 9 × 13. 3rd order toothed. Septa thin, and finely spinulate.
3. 12 × 9 × 16. 3rd order toothed.
4. 13 × 9 (broken). Sometimes toothed. Septa thin, and finely spinulate.
5. 14 × 9 × 17. Slightly toothed.
6.* 15 × 9 × 20. Always toothed. Septa thick, coarsely spinulate.
7. 13 × 8 (broken). Sometimes slightly. Septa thick, coarsely spinulate.

* No. 6 is chosen as the holotype.—[A.K.T.]

The heights cannot be measured accurately owing to the widely spreading base, which often includes projections of the substratum.

These proportions agree fairly with Moseley's measurements. On p. 191 he gives ratio of axes as 100 : 200, but the measurements of his larger specimen are 14 mm. × 8 mm., say 100 : 175. Milne Edwards and Haime give 22 mm. × 12 mm., or 100 : 185. Besides this variation in measurements there is a considerable other variation in these seven adult specimens. No. 3 is remarkable for the breadth of its principal septa, which, however, remain thin. In Nos. 5, 7 and 6, in this order, they thicken, become more coarsely spinulate and perforate, and spongy near the upper edge of the walls. The projection of the walls at the junction of the principal septa is variable, usually very slight, but in No. 6 so considerable as to deserve illustration (Plate XIV, fig. 2). In this and the thickness and spinulation of the septa it approaches *D. incisa*.

The younger specimens differ in the usual way from the adult.

(1) The largest, 8 mm. × 7 mm., and 11 mm. high, is alone on a shell. Septa thin but with conspicuous spinules. Septa of second order joined by those of the third, and third by fourth high up the walls, the latter near the edge of the calyx. Columella well developed but loose.

(2) A second, 7 mm. × 5 mm., growing on the side of No. 1, but probably *not* a bud. Septa thin and spinules small and inconspicuous. Septa of three cycles meet the columella, 3rd joined by 4th high up. Columella very loose.

(3) The next smaller is damaged. It is practically round.

(4) A round specimen, 4 mm. in diameter, alone on a small *Anomia* shell. Septa of second order met by the third high up on the wall. Fourth present as rudiments only in three loculi.

Genus *Dendrophyllia.*

The genus can only be defined as a colonial *Balanophyllia*, with colonies either encrusting or arborescent. Such a definition is unsatisfactory, being without morphological foundation. See J. S. Gardiner in " John Murray," 1939, p. 237, on *D. horsti*, and compare the figures of this species on pl. ii with those of *B. diffusa*, immediately above them—a comparison which illustrates perfectly the difficulty of the distinction, especially as the septal arrangements of these two species are of the same type.

It is conceivable that a distinction might be found between those species in which, in fully developed calices, the first three cycles of septa do not meet before joining the columella, and those in which some cycles meet, cutting off one or more of the lower cycles. Any two genera so founded would, of course, include both simple and compound species.

The species fall into three groups according to colour :

(1) *Orange to vermilion*, tentacles often pure yellow. Abundant as crusts and rounded masses under stones or corals in all warm seas—*e.g.*, Cape Verde Islands—under bottoms of coal lighters and under stones just below Low Water Springs. At the mouth of the harbour in masses of branched forms at Low Water Springs, the only time it has ever been seen exposed to light. Panama, under stones, abundant, never exposed to light. Also in the Red Sea, in a similar habitat ; and generally through the Indo-Pacific, including Hawaii ; but none from the Great Barrier Reef collections or from the Murray Islands. Branched orange vermilion forms are from deeper water, and of these two species are here.

(2) *Black* (the "*nigrescens*" group). In rather deeper water, not in the shade, branched. Stunted black specimens in habitat (1) are quite exceptional, if they ever occur. These species are very much more rare than those of group (1), and I have seen them only in the Northern Red Sea.

(3) *Brown.* In deep water, branched. Occasional brown specimens of group (1) are very exceptional.

These colours are protective against actinic light ; the orange is exactly the colour of the paper in which photographic plates were wrapped 30 years ago. This light protection is obviously correlated in some way with the absence of zoochlorellae.

Dendrophyllia arbuscula Horst.

1922*a*. Horst, p. 53, pl. viii, fig. 6.

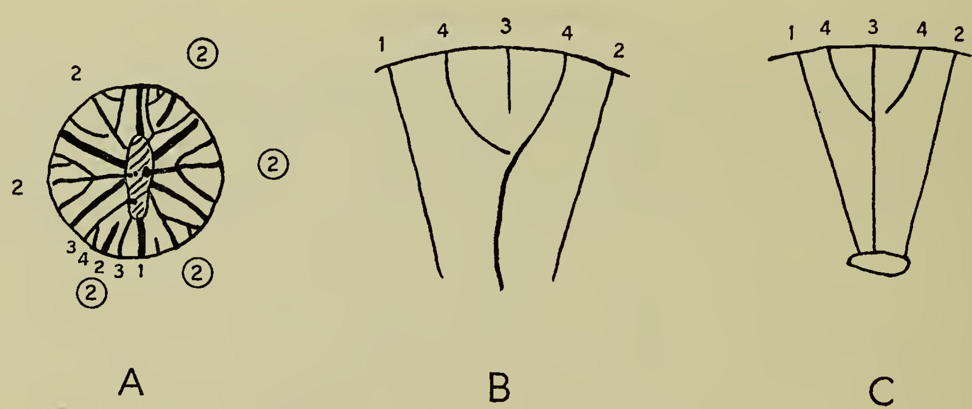
(Plate XIV, fig. 3.)

Specimen B.M. 490, Stn. 9 and a number of small broken pieces (formerly in spirit which has dried up), which cannot be fitted together to make a second colony.

I am attributing these fragments to this species in spite of differences. They agree in details of mode of growth, shape of calices, ribbing and the septal arrangement. (Compare Plate XIV, fig. 3, with Horst's fig. 6.)

They differ in being thicker in their stems, with the openings of the calices correspondingly larger, in the thinness and imperforation of the septa, on which lines of spinules are parallel to both horizontal and vertical edges. The columella may be a little smaller.

A relationship to *D. fistula* (Alcock) is apparent. (Compare Plate XIV, fig. 3, with Alcock's (1902, fig. 36, pl. v, of the type.) It may be that this species is merely a deep water—ooze habitat—form of *D. arbuscula*, differing mainly in the elongation of its calices and rarity of budding—a kind of etiolation.



TEXT-FIG. 1.—*Dendrophyllia arbuscula*. A. Diagrammatic representation of the septal arrangement in a small lateral bud 4 mm. in diameter at the base of a long calyx. Four septa of cycle 2 are cut off by those of cycle 3, or at least do not reach the columella directly; and two are complete to the columella. [From Crossland's inking over of the septa of cycle 2 in his original pencil, ink and red chalk sketch it appears that the four septa of cycle 2 that he refers to as "cut off by those of cycle 3" are those marked in this text-figure 1A by the number 2 in a circle, 2. A.K.T.] B and C. These diagrams represent adult calices whose longest diameter reaches 10 mm. In the great majority the arrangement of septa is as shown in B, but sometimes it is as shown in C, where there are no fusions of the fourth cycle.

D. fistula is described briefly by Alcock (1902, p. 42, pl. v) and by Gardiner and Waugh (1939, p. 237), and in detail by Marenzeller (1906*a*, pp. 8 and 16, pl. i). The three descriptions seem to differ fundamentally, as illustrated by the diagrams of Text-fig. 1, but the discrepancy is only apparent, as a study of younger calices of the Great Barrier Reef specimen shows. In these septa of cycle 3 may be found (1) running in to the columella without complication by those of the 4th cycle; (2) joined by the 4th cycle, but proceeding to join the columella; (3) apparently cut short by the 4th cycle; septa meeting below it, as in the great majority of adult calices (Text-fig. 1B). In the youngest calices the 3rd cycle septa cut off those of the 2nd, but as Text-fig. 1A shows, the 2nd cycle septa may run right through the junction to the columella. In the great majority of adult calices the arrangement is as shown in Text-fig. 1c, in which the 4th cycle appears to cut off the 3rd completely. Parts of a 5th cycle are present in some of the oldest calices, but there is nothing like the complication. Marenzeller figures for the older calices of *D. fistula*. There is no note of the colour of these specimens.

Distribution : *D. arbuscula* has been found only once, by the " Siboga " in the Banda Sea at 45–90 metres. *D. fistula*, possibly a deep water form of this species, is found in the Red Sea, Indian Ocean, and in Malaysia.

Dendrophyllia micranthus (Ehrb.).

Not *Dendrophyllia nigrescens* Dana.

1879. *Coenopsammia micranthus* Klunzinger, p. 58, taf. vii, fig. 13 ; taf. x, fig. 13.

I am compelled to note typical examples of this species, such as do not occur in the collection, before it is possible to describe the var. *grandis* which represents the species on the Barrier.

Klunzinger gives the synonymy, and refers to Milne Edwards and Haime's (1857*a*) pl. E.2, fig. 2, of *C. viridis*, which, apart from its being " green," does not resemble this species very clearly. On p. 129 (1860) they give, under *D. nigrescens*, green, black and red species as synonyms, which I do not believe to be possible. They have only the barest mention (1848, p. 104) of Ehrenberg's *O. micranthus*, merely quoting his two and a half lines of useless Latin description.

Klunzinger writes " nec *Dendrophyllia nigrescens* Dana," in which he is right, though all subsequent writers are against him. I therefore can only refer to such later records as bear upon the distinction from Dana's species, as, in the case of others, there is no knowing which species is referred to. The species is fairly common near Ghardaqa, in the Red Sea, but not as abundant as the orange and vermilion encrusting species (whether one or more), and never found in the same habitat, the black *D. micranthus* being always exposed to the light and never exposed at Low Water Springs : the orange species grows only in the shade under coral slabs on the outer reef edge, rarely on the inner reefs. The precise localities are the wall-like outer slope of the Abu Qalawa and Abu Fanadir reefs, and on Mortensen Rock, a great mass of decaying *Porites* in the middle of the lagoon.

None of these Red Sea specimens, either Klunzinger's, my own, or the five now before me belonging to the Kóbenhavn Museum, exceeds 12 cm. in height. Klunzinger's (1879) description and figures remain the only ones available. His figure (taf. vii, fig. 13) of the corallum is small, but being an actual photograph can be examined under a lens. The figure of the calyx (Taf. x, fig. 13) is not quite satisfactory. I wish to emphasize that features of the mode of growth which might be taken as accidental to Klunzinger's specimen are, in fact, common to all that I have seen. Horst's (1922*a*) figures are doubtful and too poorly printed to give any information. The only photographic figures of *D. nigrescens* Dana accessible to me are those of Vaughan (1918, pl. 60) and Faustino (1927, pl. 72), which show a quite different species to that of Klunzinger. All that Horst says (1922*a*, p. 50) is perfectly true, but the points he discusses are not those which really separate the species. The following differences are constant, and until further proofs and figures support Horst and Vaughan I regard the species as quite distinct.

Colour: Dana (1849, pl. 27, fig. 1) gives a coloured picture of his *D. nigrescens*, differing from *D. micranthus* not only in form but also decidedly in colour. He shows a green black (*micranthus* is purple black, sometimes with a brownish tinge), tentacles of polyps white (light brown in the text), disc *bright* green; the polyps of *D. micranthus* are black uniformly.

D. micranthus (Ehr.): Bushy, few short stumpy branches. Height up to 15 cm. Branches flattened, or, if rounded basally, generally flattened at their ends. Outline of the principal polyp always more or less visible on the outside of the stem. Majority of the calices narrower at base and deep. Average breadth 7 mm.

D. nigrescens Dana: Long straggling branches, often in one plane (according to Klunzinger, but see Horst). Branches round, 7–10 mm. thick. Majority of calices short and straight, comparatively shallow, 5 mm. in diameter. The appearance of ribbing outside the calices and down the stems, and character of the coenenchyme by which the stems are thickened, are variable in both species. The appearance of specially long calices in both may mean the beginning of a new branch. A group of them at end of a branch seems to indicate cessation of growth in length.

As regards slenderness of branches and bushy shape, my Red Sea specimens were all from sheltered water, and though some have more slender branches than have the specimens before me, *none* approach Vaughan's figure, and are all built recognizably on the same plan as that of Klunzinger's specimen—*viz.*, a main polyp forming a continuous tube from the base to the summit of the colony, which buds laterally, the larger buds originating side branches. As these buds often come off from opposite sides the branches become flattened, particularly at their ends, when growth in length slows down, so that nearly all colonies show the peculiar flattening of the ends of branches shown in Klunzinger's fig. on pl. vii. Coenenchyme of a loose texture is added to the original calyx, so that the lower parts of branches are considerably thickened. As this addition tends to be more developed at the sides of the branches, particularly in the axils of buds and lateral branches, the round, main, original polyp-tube is more or less conspicuous in the flattened branches. This coenenchymal deposit may be ribbed longitudinally or be irregular (both conditions to the eye so different), often on adjacent areas of the same stem, and in some colonies the longitudinally ribbed form may cover the whole, from the youngest twigs to the base.

The septal arrangements are, as described by Klunzinger, and by him alone, the simplest possible, *viz.*, 6 septa of the 1st cycle rather broader than the 6 secondaries, and 12 (generally rudimentary) of the 3rd. The two 1st cycles reach a rudimentary columella of septal trabeculae, or sometimes only those of the 1st reach it, but in most calices, when fully grown, all the 12 septa of the first two cycles are equal in thickness and breadth and all reach the columella: sometimes even one or two of the thin 3rd cycle may also join the columella. There is no fusion of septa above the columella, but sometimes a septum of the 3rd cycle bends towards its neighbour of the second. In young calices the septa are thin and finely granulated on sides and edges, in older they are thick and coarsely granulated. In both they form a short triangular thickening at the wall: in the older they usually thicken decidedly just above the columella. These exceptions are to be recorded, but in the great majority of calices 12 septa reach the columella and 12 rudimentary septa alternate with them.

Dendrophyllia micranthus var. *grandis* var. nov.

(Plate LV, fig. 1; Plate LVI, fig. 1.)

This variety is represented by a single branch broken from a large colony. It is much regretted that more specimens, and at least one complete colony, were not brought home.

The branch measures 15 cm. high, and side branches make the specimen 14 cm. wide. The broken stem is oval in section, 25 mm. × 17 mm. As shown on Plate LV the branches are nearly in one plane. The finer are, of course, the thickness of a single calyx, *i.e.*, 7 mm., but the main stem retains its thickness nearly to the top.

Details of the calices are as in the type species, but the columella is generally larger, and is of loose structure. In a few calices there are irregular traces of a 4th cycle, and pairs of the 3rd cycle may actually join the 2nd between them.

The most striking difference between this variety and the type, after the size of the colony, is the rough "woolly" surface of the stems, from a little below the terminal twigs to the base, though in most places a tendency to longitudinal ribbing can be made out.

There is no note of the colour of the living polyps nor of the origin of the specimen, which is numbered 75, B.M. 500.

Dendrophyllia velata, sp. n.*

(Plate LV, fig. 3.)

A single branch of this minute form (habitat unknown) numbered only B.M. 390, but with a note on colouration: "Colony orange, verging into brown towards its base. Polyps reddish brown."

In growth form it resembles Horst's *D. minuscula* (which does not agree very well with Bourne's species,† especially as the latter has remarkably thick septa, and therefore cannot be young, as Horst says), but the columella and septa differ from both descriptions. There are also the curious hoods over the calices, recalling *Stylophora*, which are unique in this genus.

The specimen is a fairly straight branch, 25 mm. long, of circular section, 4 mm. in diameter at the broken end, and that of the terminal calyx being 3 mm. This axillary polyp bears 8 buds, 6 of which are in pairs, but the pairs are none of them in the same plane, nor at right angles.

Young calices are nearly sessile; the youngest bud is near the lip of the terminal calyx, but the lowest on the stem are not the largest, and do not have the appearance of being the oldest. All are round, or very nearly so. The calyx walls are thin and perforated, costal ribbing and perforations of the stem coarse for so small a species, and flaky.

The characteristic hoods vary in thire development, being absent from the terminal polyp and younger buds. In the uppermost pair one wall is higher than the other, rising gradually on one side, then dropping suddenly to the original level; this makes the wall look as if broken, but examination shows that this is not the case. The lowest theca shows

* Great caution should be observed in accepting this as a new species. Only one "hood" can be seen, and that appears to be a morbid growth, or perhaps the beginning of a new calicle.—[A.K.T.]

† Crossland is evidently referring to *D. minuscula* Bourne, 1905, "Report on the solitary corals collected by Professor Herdman, at Ceylon, 1902." R. Soc. Rep. on Pearl Oyster Fisheries, IV, p. 213.—[A.K.T.]

a similar development, but here the peak is at the side, not above the calyx when the branch is upright. The case of that of the longest calyx, one of the middle pair, is extraordinary, the hood being above and to one side, but also bending downwards so that much of the opening is hidden, and there is also a kind of crest above it. These curious arrangements can only be explained by figures.

The septa are moderately thick, with fine spinules; one to three of the primaries are especially prominent, secondary septa cut off from the columella by fusion of the tertiaries, this fusion often high above the columella, but sometimes near it, and sometimes not visible; no traces of a 4th cycle, even in the cross-section of the main calyx tube given by the broken end of the branch. Here the septa are thickened so much as to be, in most cases, thicker than the spaces between them, but the addition to the outside of the wall is slight.

The columella is remarkable for the height it rises above its junctions with the septa. It is relatively small, but well made of broad twisted ribbons with lightly scalloped edges.

Genus *Turbinaria*.

T. W. Vaughan (1918, p. 147) remarks: "The species of *Turbinaria* reported from Australia by Bernard are listed on the following page. How many of the 27 reputed species should be recognized as valid can only be determined by a critical revision of Bernard's original specimens." Of these 27 species, 21 are from the Great Barrier Reef and Torres Straits, 4 are from West Australia only, and 6 are common to E. and W.

The genus is mentioned by Stephenson and others (p. 67) as characteristic of the seaward slope and anchorage, on vertical or overhanging surfaces below the level of low water, and both massive and foliose species on the reef patch at Lizard Island. S. Manton refers to it four times, and figures a single specimen at the base of the pinnacle of pl. xii. As her diagrammatic sign is a cup with a *thick* border the species is almost certainly *T. peltata*. It is among the first corals to appear on the seaward slope of Traverse I, and minute specimens are among the corals which survive the mud at the foot of the slope and on the sea floor. It appears again, but rarely, near Traverse II. Apparently the genus was found to be more common by Hedley and Taylor on the lee side of East Hope Island.

Distribution: The genus is not recorded from Samoa,* Tahaiti, or Hawaii, though common from the Red Sea to the Western Pacific. Gardiner (1898, p. 262) notes: "There is a marked absence of this genus both at Funafuti and Rotuma, only one colony having been found, while in Fiji three species were obtained."

Turbinaria peltata Esper.

(Plate XVI, fig. 5; Plate XVIII, fig. 2; Plate XIX, fig. 2.)

1896. Bernard, p. 38, pls. vi, vii, viii and xxxi, fig. 15.

Sample 435 (major diameter 18 cm., height 8 cm.) is a stage between those figured by Bernard on pls. vi and vii, in which the edge of the cup is folded (one fold fused to a two-sided plate) and there is one upgrowth from near the centre. Having a second variety with which this is to be compared it is necessary to fill in some details of Bernard's description.

* Except one doubtful record, *T. frondens*, by Bernard (1896, p. 46); see note on p. 93.

The aperture is circular except when the calices are crowded. The majority are 4 to 5 mm. across, or 6 mm. by 4 mm. if oval, the thin walls adding 1 mm. (as in the three examples figured by Bernard and the one by Faustino). Milne Edwards and Haime's 10 mm. must refer to a giant calyx, such as is not present in this or in Bernard's collection.

According to Bernard the septa are 12 primary and 12 secondary. In this specimen I distinguish 6 primary, 6 secondary, and 12 tertiary, the total number of 24 being constant. At first sight all seem to be of the same width, as in most species, but more careful examination shows that the 6 primaries are a little broader than the secondaries, and these than the tertiaries; minute points and ridges indicate a rudimentary and incomplete 4th cycle. The septa are often toothed on their upper quarters, and are slightly granular on their sides. The septa being narrow, the columella is large, and, even in round calices, generally oval, the septa at each end slightly narrowed. It is composed of broad twisted leaves, thin and well separated, on the whole extending upwards to form an irregular honeycomb, but in many cases a central leaf forms a ridge along the top of the columella, which may become conspicuous and to which the lateral leaves may be joined pinnately. As published figures show this structure imperfectly or not at all, I illustrate it on Plate XVIII, fig. 2.

The coenenchyme is spongy, composed of broad, thin, twisted plates, more or less horizontal, bearing a few small, blunt upward points; in rare places these run into irregular sinuous lines, on which the teeth are more numerous, with grooves between—"a well marked gyrating system of ridges and furrows," as Bernard describes it. On the underside this arrangement is the rule, the ridges running radially, and the upright processes are more marked, though still low and blunt. There are numerous round or oval holes, resembling worm-holes.

Saville Kent (1893, p. 188) describes the colour of the living colony as whity-brown, whitish polyps with greenish centres; tentacles numerous and simply subulate; both occasionally a delicate rose pink. Dana (1849, pl. xxx, fig. 4*a*) shows the colours as brown, yellow or greenish brown with bluish discs. The colours of other Turbinarians, though often brilliant, are variable within limits (see Waugh on *T. mesenterina*, 1936, p. 913).

Distribution: Bernard (1896, p. 38) says: "This species is the most striking in the genus *Turbinaria*, and also the commonest." This latter is due to the diligent collecting by Saville Kent. Nearly all Bernard's localities are from the Great Barrier Reef and Torres Straits, but some are also from W. Australia and Singapore. Most other records are from Malaysia, but Dana, Milne Edwards and Haime and Faustino took it as far east as Fiji and the Philippines. The only Indian Ocean record is Mauritius, probably as unfounded as that from the Red Sea referred to in a note by Bernard. To the evidence for its absence from that sea I add Gravier's, Waugh's and my own. I have here from Mauritius a very different species, *T. plicata*, collected by Stephenson.

Turbinaria peltata var. *gibiari* n. var.

(Plate XIV, fig. 1; Plate XVI, fig. 4; Plate XVII, fig. 1; Plate XVIII, fig. 1; Plate XXII, fig. 2).

Sample 193 is a sector from the edge of an explanate or cup-shaped colony measuring 11 cm. along the base and 6 cm. radially. The broken base is 17 mm. thick in the middle, 7 mm. close to, and 4 mm. at the extreme edge; it is gently folded.

The differences from the normal are :

(1) Calices projecting obliquely, those near the base 10 mm. on proximal side, near edge 5 mm. ; the distal sides 3 mm. and 1 mm. (2) Columella as in preceding, but the directive ridge may rise high above the rest.

The coenenchyme is covered with thin plate-like ridges bearing numerous minute but distinct pointed teeth, which, under the binocular, are seen to be set transversely to the plate. The underside is grooved, the grooves long or short, more or less sinuous. On their walls are similar plates, but thicker, shorter, and with less distinct teeth, often two rows of plates on each wall. Near the edge the round holes are deep and numerous, centrally rare and shallow.

Specimens with obliquely projecting calices are not mentioned in the literature, but there are three large examples in the Kóbenhavn Museum, labelled *T. lactuca* n. sp. by Lütken. They differ from the above in that the columella never has a directive ridge, the 1st and 2nd cycles of septa are hardly distinguishable and in the coenenchyme. I hope to describe these and other specimens of the Kóbenhavn Museum later. Possibly Lütken's unpublished name will stand, if only as a variety.

Turbinaria bifrons Brügg.

(Plate XXI, figs. 1, 2.)

1896. Bernard, p. 69, pl. xxi, pl. xxxiii, fig. 1.

Specimen B.M. 272 is whole, 13 × 20 cm. and 16 cm. high, and is evidently one of those referred to by Stephenson and others as growing on a vertical surface. Specimen B.M. 413 (Stn. XXIII dredge) is a single " leaf " 10 × 10 cm., with two fragments.

The species is easily recognized by the complete fusion of its folds, its spiny septa and fused (" glassy," Bernard) columella. The obliquely placed thecae are also a constant feature.

Specimen 272, in its complicated folding, shown on pl. xxi, resembles the " two minute stalked specimens " of Bernard's pl. xxi, rather than the larger one of the same plate. A curious feature is the occasional formation of small round branches, which superficially resemble an *Acropora* by the oblique calices. The doubling of the plates is not all due to folding, as fig. 1 shows the outside of the colony is also overgrown by calyx-covered leaves, though not always completely.

In this complete specimen the spinulation of the sides of the septa is usually less marked than in Bernard's pl. xxxi, fig. 1 ; but in the dredged fragments the septa are both thicker and more spinulate. The columella is not always prominent, and often appears folded or granular on the top.

Distribution : West Australia (young examples, Bernard). Also, if synonymous with *T. conspicua*, already recorded from the Great Barrier Reef.

Turbinaria frondens (Dana).

(Plate XXIII, fig. 1.)

1846. *Gemmipora frondens* Dana, p. 412 ; 1849, pl. 27, fig. 10.
1860. *Turbinaria frindescens* Milne Edwards and Haime, p. 167.
1896. *Turbinaria frondens* Bernard, p. 46 (no figure).

Possibly *T. brassica* (Dana) and *T. danae* Bernard are the same species, but the latter seems to be distinguishable by its broad septa, the former by its shallow calices and smooth coenenchyme: a series of specimens might possibly bring them together. The two pieces here, Nos. 326 and 383, both from Lizard Island, Reef A, agree completely in these respects, and differ from a specimen in the Kóbenhavn Museum, which constantly agrees with *T. danae.*

Dana's description being altogether too brief, and his figures often inaccessible, I redescribe the species.*

The specimens before me are two plates, both folded and one deeply wrinkled at one side, measuring 12 and 17 cm. radially and 16 and 10 cm. across. I take the obliquity of the calices to indicate that they grew more or less vertically. One of them has a small branch 15 mm. high, growing from the surface of the plate after the style of Bernard's *T. aurantiaca;* its seven calices are all on the distal, or upward, side. Another projection surrounds what looks like a mollusc burrow.

The obliquity of the calices is shown in figure on Plate XXIII; even the immersed calices of the proximal part are also oblique at their openings. Near the edge the thinness of the plates allows the lower parts of the calicinal tubes to form ridges, which are also visible on the outer side of the plate (which is thus wrinkled). Lower down the coenenchyme is rather thicker, and the calices, cylindrical above, become elongated cones: close to the base they are, as usual, immersed. They are slightly oval, 2 mm. in larger diameter; the walls are thin.

The septa are always narrow, though a little broader in the proximal calices, at first sloping steeply, then dropping vertically, leaving a wide open fossa, of some depth. They are practically all alike, 20 to 24 in number (most often 22), thin and smooth.

The columella is broad and oval, only slightly arched above. It is formed of comparatively large foliae, twisted in the usual manner, which do not make a directive ridge.

The coenenchyme is covered with short ridges, bearing granules, or blunt and indistinct teeth, often set transversely. The ridges are thicker than those shown in Dana's fig. 10*c*, but have squarish knots in them such as he shows. They are thinner and more regular on the back of the plate, which, to the naked eye, appears smooth. There are no holes.

Distribution: Dana's specimens were from Fiji. Bernard records one from Samoa (presented by Rev. S. J. Whitmee), but no Turbinarian was found there by Mayor, and missionary records must be received with caution as, in past days, they carried on a trade in corals as curios.

Turbinaria sp.

Specimen No. 7 is a small flattish cup, 9 cm. in diameter, with a very eccentric stem; this eccentricity, together with the appearance of the calices towards the edge of the higher rim, suggests that it is the young form of such a growth as *T. frondens.* It is not of this species however.

I consider it rash to name so young an example. Matthai suggests (with a ? mark) *T. aurantiaca*, but it differs from this species thus:

* I owe my copy of Dana's work to the Librarian of the Zoological Museum of the University of Kóbenhaven, who obtained the loan from the Royal Academy of Science, Stockholm. I am deeply gratified by this example of international co-operation.

T. aurantiaca (Bernard, p. 33).	*This specimen.*
Calices 1·5 mm. or less	Regularly 2·0 mm.
Not typically projecting	Most project 1 mm., but openings are not oblique.
Septa 18–20	Septa 20–24, usually 20. Distinctly spinulose sides.
Columella spongy, compact	Columella formed of thick, close-fitting, granular leaves, usually transverse to oval. No directive ridge.

The septa are not like those of *T. pocilliformis*. In calicinal characters it comes nearest to *T. auricularis*, and there is no reason why this should not be the start of a large growth like those of this species.

I am confirmed in my refusal to name the specimen by comparison with one of the same size in the Kóbenhavn Museum, and almost identical to the naked eye, but the calicinal characters of which are completely different.

Glomerate Turbinarians.

Although I cannot follow Bernard in his emphasis upon growth form in this genus these solid glomerate forms are probably separated by a real morphological difference in the continued growth of their polyps into long tubes. Bernard himself writes (p. 166), " I was at first disposed to look upon these as merely massive varieties of other types," but in the only species of which the growth variations have been specially studied, *T. mesenterina* (Waugh, *l.c.*), such elongation of the polyps does not occur. Pending further investigation on the reefs, I therefore regard this as a distinct division of the genus, and the species about to be described as characterized by, among other things, their mode of growth. To describe two new species from single specimens is most uncongenial, but I have no choice.

Turbinaria stephensoni, sp. n.

(Plate LV, fig. 2 ; Plate LVI, figs. 2, 3.)

This might be a variety of *T. stellulata* Bernard,* but there are constant characters of the septa and columellae not mentioned by Bernard, and which are unique in the genus.

Specimen 449 is a rounded hump, 75 mm. in diameter × 50 mm. in height, growing on a piece of rotten coral, probably a solid *Montipora*. By prising this away I find that the hump, though concave beneath, and spreading downwards into an encrusting sheet, is, in reality, 30 mm. thick. There is also a thinner extension on one side of the base about 3 cm. wide and 10 mm. thick (near the edge about 5 mm.).

The calices project slightly and are conical, conspicuously so on the top of the hump, where they may project 3 mm. and be 3 mm. across on the top, though the openings are only 2 mm. On the lower expansions they project little though remaining conical, and the opening is generally 1·5 mm. across. It is slightly oval. The calyx wall is well defined.

The coenenchyme bears little plates and ridges, with sharp-pointed processes in little groups, a distinct contrast to the blunt granules of the next species.

The number of septa averages 25 on the hump, 20 on the lower expansions. They are thin, very finely toothed along their edges, their sides very finely spinulate, thicker

* Bernard, p. 65, refers the species to Blainville and Lamarck, but on very slender grounds. The only way to define the species is by using Bernard's name.

and more spinulose on the spreading bases. They are very narrow above, and slope down to the columella either without forming an angle, or forming at most a low and rounded one. The septa share with those of *T. stellulata* a peculiarity in this genus, that they are not all the same length : short and long do not regularly alternate, the short being much the fewer. A further peculiarity, not mentioned by Bernard, is that septa adjacent to a short one are often bent towards it. and sometimes (generally once in each theca) fuse between the end of the short septum and the columella. In distinction from *T. stellulata* most of the long septa very clearly join the columella, and sometimes bear a knob just before they join.

The columella is also very distinctive. At its best development it is small, oval, not arched above, elongated in the same direction as the calyx, solid and tuberculated above. A line of the small but high tubercles forms a crest along the top, which often developes into a high plate. In many cases the lower part is inconspicuous, often invisible, the plate then remaining the chief, or even the sole, representative of the columella. Ordinarily this is quite distinct as a row of tubercles, but, towards the edge of the colony it may become irregular and fused ; in a few calices it degenerates to a tubercle or two, or may be absent, the septa then meeting in the centre.

Where the columella is less developed the lower teeth of the septa are more prominent, as would be expected.

Turbinaria mantonae, sp. n.

(Plate XVI, fig. 6 ; Plate XVII, fig. 2 ; Plate XIX, fig. 1.)

Specimens 323 and 316, both labelled " A " reef, Lizard Island.

To the naked eye the specimens are distinguished from the preceding by the slightly projecting cylindrical thin-walled calices, sometimes level with the surface ;. they are 2·5 mm. across the openings, with many smaller, down to 1·5 mm.* and even 1·0 mm. (fully developed) on the sides low down ; on the hump are also numerous small calices, but these are young. They are distinctly deep.

One hump of No. 323 is broken through and shows thecal tubes 5 cm. long. The specific gravity is high, perhaps more so than in *T. stephensoni*.

The coenenchyme is a fine but loose network on the summit, but in places gives place to more regular, wavy lines bearing low blunt granules.

Fully developed calices are completely regular, oval or round, of a type common in the genus. The septa are all alike, sloping gradually at first then dropping vertically to the columella. They are thin and smooth, and in full-sized calices their number averages from 24 up to 27.

The columellae are large, oval, of closely packed trabeculae, lying deep in the fossa, flat on the top and bearing numerous upright tubercles. In many calices the lower parts of the septa are toothed and bend suddenly towards the centre, passing into the columella, on the top of which they form low ridges. In younger calices the septa remain distinct almost to the centre of the columella. Thus we have here two cases in which the columellae are seen to be made from the septa, a fact which seems to be not usually visible in this genus.

* Corresponds in these respects with *T. parvistella* Kent, which cannot be identified from the description given. The name therefore lapses.

[PERFORATA.]

[Family ACROPORIDAE.]

Genus *Astraeopora.*

As an example of the difference between pure museum work and observations on the reef compare Bernard's division of this genus into explanate, pulvinate and glomerate forms with Waugh's demonstration that all these forms frequently occur in one colony. His glomerate division is particularly artificial. Such detached forms occur in almost any sort of coral, and is purely environmental. This is especially well shown by the numerous potato-like loose growths of *Leptastrea, Cyphastrea* and *Porites,* which abound in a certain habitat near Ghardaqa—*viz.*, the wide, weedy flat on the west side of Abu Qalawa Reef.

Bernard's Australian species are listed by Vaughan (1918, p. 145), who accepts four of them, describing *A. myriophthalma* (Lmk.) and *A. ocellata* Bernard, while *A. profunda* Verrill is redescribed, after examination of the type, by Hoffmeister. When in Tahaiti I tabulated these species for comparison with the single good-sized specimen I found there. There may or may not be a columella (the distinguishing mark of *A. profunda* according to Hoffmeister) and the primary septa may or may not meet, and, in short, this specimen seems to combine the characteristics of all these three species. Indeed, of Bernard's 14 species it seems unlikely that more than three or four are real.

The genus is listed by Stephenson and others on pp. 67 and 86 as characteristic of the seaward slope and anchorage at Low Isles and of Yonge Reef. By S. Manton it was found on the muddy sea floor (two quite fair-sized colonies 16–20 inches across) and on the slope where the influence of the mud begins.

Astraeopora myriophthalma (Lmk.).

1930. *Astraeopora ocellata* Yonge, p. 46.
1936. *Astraeopora myriophthalma* Waugh, p. 927.

Specimens 41 and 329, the latter from Ribbon Reef, are typical of massive growths of this species. No. B.M. 392 and No. 428 are of different appearance, but, in view of what I have written above I consider them the same. No final revision of the species is possible without long investigations on the reef, and an extension of Miss Waugh's work to other seas.

Both Yonge and Waugh give figures of the living polyp which differ widely. It seems more likely that Yonge's specimens were not fully expanded than that the species *A. ocellata* can be distinguished by having short stumpy tentacles. At the same time the naked eye anatomy of polyps may very well be of use in the descrimination of species. Preliminary observations at Ghardaqa showed that this is possible for some Faviidae.

Distribution : Though not common in collections the species has been recorded from the whole Indo-Pacific, from the Red Sea to Samoa and Tahaiti.

Genus *Montipora.*

The usual division of this genus, introduced by Bernard, into smooth (glabrous), foveolate, papillate and tuberculate is generally useful, and the only one possible ; but the 19 species here described include some which are both smooth and foveolate—*e.g.*, *M. ramosa ;* and tuberculate and papillate—*e.g.*, *M. prolifera.* In foveolate species the ramparts may occasionally break up into papillae, and Bernard's class "*Papillae irregular*" includes such forms as *M. venosa*, which are often more foveolate than papillate. It is just possible that papillae formed from ramparts are not homologous with those formed independently, but this is hardly a practical distinction.

I have not attempted to trace out all possible synonyms, contenting myself with the few which are well grounded and illustrated by the present collection. Doubtful and possible synonyms are not helpful, witness the wild confusion caused by baseless guesses at the identities of Forskaal's *Madrepora monasteriata* and *M. rus.*—the trouble by no means ended by Marenzeller's showing what these species really are.

As in the case of *Acropora* and the other perforates most of the species are confined to the Malay-Fiji area, in contrast to the imperforates, many of which are found over the whole Indo-Pacific, from the Red Sea to the Tuamotus, dying out in the Marquesas.

Smooth, explanate *Montiporae*.

Montipora granulosa Bernard.

(Plate XXV, figs. 1, 4; Plate XXVII, fig. 4.)

1897. Bernard, p. 21; pl. i, fig. 2; pl. xxxi, fig. 3.

Bernard described 14 glabrous, explanate species: other authors very few. The present specimens do not completely correspond with any of them, but come so near to *M. granulosa* that I give them this name and detail the differences from Bernard's single specimen from 44 fms. on Macclesfield Bank. These, No. G.B.R. 113, dredged from Stn. XXV,* consist of 4 small irregular thin plates, the larger 8 cm. across its base, 9 cm. radially; they may or may not have formed one corallum originally. Unlike Bernard's specimen they grew freely, no point of attachment is present, the only approach to one being portions of older lamellae of the same species.

The epitheca is well developed, generally right up to the edge, which, in some places, bends back and forms a thin, living layer over the epitheca for from 5 to 10 mm. The epitheca is strongly marked with fine and coarse concentric wrinkles, besides deep wrinkles in the corallum itself. These were caused by periods of cessation of growth, as shown by small portions of the free edges projecting from the epitheca at some of these folds.

The surface is raised into low rounded hillocks, often elongated radially or circumferentially, and easily distinguished from those resulting from adhering Balanids and Serpulids. They do not bear calices, all of which are level with the more or less flat surfaces between these hillocks, nor is there any relation suggesting modified foveolae.

Calices correspond with Bernard's description, except that none "appear to open irregularly on slight mounds of coarse reticulum." Some are irregularly compressed. The "granulations" of the surface extend onto the proximal parts of the septa. These "granular ends of reticular threads" deserve more description than Bernard gives; as he says, they "give a soft velvety sheen to the whole surface," which is characteristic of these specimens, and of no others in the collection. With few exceptions—*e.g.*, close to the growing edge—they cover the whole surface thickly; they are in the form of minute plates bearing a row of 2 to 5 vertical slender spinules, or else a little clump of the same; between them can be seen the rounded pores of the reticulum.

* Comparatively shallow water near the Low Isles may be ecologically equivalent to much greater depths in the open sea—*e.g.*, at Macclesfield Bank.

The section shows a thin glassy solid layer, not distinguishable from the epitheca (a narrow reticular layer), above which most of the section is occupied by thin irregular vertical rods joined by horizontal nodes. Bernard describes them as short. This is, of course, the case where the lamina is thin; near the growing edge the reticulate layer occupies most of the section.

Distribution: One specimen from Macclesfield Bank in 1888. Now Great Barrier Reef.

Montipora millepora, sp. n.

(Plate XX, figs. 1 and 2; Plate XXII, figs. 1, 3, 4, 5.)

Specimen B.M. 410 (dredged from Stn. XXIV) bears an extraordinary resemblance to a crust of *Millepora*, not only in its green-brown colour and the character of its surface, but also through the small, widely separated pore-like calices; only under a lens do the septa come into view. The section of the corallum is unlike that of any other *Montipora* yet described.

The single specimen, fortunately broken across, forms a crust of an average thickness of 6 mm., near one edge 3 mm., growing on dead and rotten coral, possibly a *Cyphastrea*. The edges are blunt, usually bent downwards over the edge of the substratum, but at one corner upwards, following the substratum. The surface is smooth, with fine granules, closely placed, and not continuous with any structure seen in the section.

The calices are of different sizes and stages of development. The larger are 0·5 mm. across, and have roughened well-developed septa, some fairly regular, others not, without prominent directives; a few septa of the 2nd cycle present; they nearly meet, but there is no columella. The calices are raised on conical or roughly cylindrical mounds. Many of those on the surface are oblique, one side slightly raised, in which case the three lower septa are much broader than the upper, the middle one the broadest. The wholly immersed calices are only about 0·25 mm. across, some of them of irregular outline, with indistinct and irregular septa; or perhaps with only two or three septa, which are, however, indistinct.

The section shows a series of hard, glassy, horizontal strata, separated by thin, vertical rods; at the base these fuse into a solid layer several mm. thick. In only two places, one below this and one above, are there patches of the usual reticulum. It is evident that at a different stage of growth the appearance of the surface would be very different, as the thin rods would stand up above the granulations. This can be seen at a point in the section where a portion of one of the hard layers is exposed. Possibly, as in *Cyphastrea* and *Orbicella* (in which a somewhat similar mode of growth occurs), the whole surface would not be at the same stage at the same time.

The species resembles Bernard's species *tenuissima* and *reticulata*, which have conical protuberances bearing the larger calices; certainty is not possible until Bernard's specimens are re-examined, but it is unlikely that Bernard would not have emphasized the peculiarities of this new species if it had been in his hands.

Smooth, Branched Montiporae.

Montipora prominula, sp. n.

(Plate XXIV, fig. 1; Plate XXVII, fig. 6.)

No. 327 rises from an irregularly-shaped stem 20 mm. × 17 mm., and expands into two irregular lobes, apparently formed of fused branchlets (best described by the figure on Plate XXIV). The section shows two layers of coenenchyme, vaguely divided and both spongy. The surface is covered with minute white points, between which it is reticular. There is no trace of foveolation. The principal characters are the large (1·0 mm.) calices with projecting coenenchymal walls, both of which characters are conspicuous to the naked eye: and the septa, which, represented only by points at the orifice, are seen lower down to be thick, in two cycles and swollen at their inner ends, where the primaries generally meet to form a thick columella. The septa of the 2nd cycle are generally narrower; but where the columella is exceptionally broad they may join it. The walls are thin, perforate, and end in a row of upright spinules and costal ridges along their rims. These walls are not developed on the tips of the branchlets, though appearing immediately on their sides. Nor are they developed round some calices in the grooves between the the main lobes, or they may be reduced to low rings. But over all the sides of the branchlets and ridges they are conspicuous, and usually higher on the proximal sides, thus directing the opening upwards.

In growth form this species resembles *M. divaricata* Brügg. (Bernard, 1897, p. 39, pl. iii, fig. 4), but in that species the calices (0·75 mm.) open flush with the surface and the septa, though stout, are very short. *M. compressa* Esper. from the Philippines (Bernard, 1897, p. 42, pl. iii, fig. 5) is "a loose bush-like cluster of long and very irregular branches" but flattens in a somewhat similar way: the coenenchyme is divided sharply into two layers, the outer of which is nearly solid and the calices, 0·75 mm. across, are "lined by a membranous layer of coenenchyme, which rises slightly above the surface as a thin white ring." In spite of the difference of form, work on the reef might possibly connect these last two species, though it seems unlikely.

Montipora digitata (Dana).

(Plate XXVI, fig. 1).

1846. *Manopora digitata* Dana, p. 508; 1849, pl. 48, figs. 1, 1*a–c*.
1886. *Montipora levis* Quelch, pl. 8, figs. 2–2*a*.
1897. *M. digitata* (D) Bernard, p. 47.
1897. *M. levis* Quelch, Bernard, p. 41, pl. xxxi, fig. 19.
1918. *M. levis* Vaughan, p. 150, pl. 61, figs. 1, 1*a* (no description).

The single specimen of this species, B.M. 281 (without Expedition number or locality) is the first of any size to be described, and to this is due the fact that it combines the characters of the two species named, the modes of growth of which seem so different. Both Quelch's and Vaughan's specimens are mere scraps, the former with crowded stunted branches, and broken remains of long, slender branches in the background; Vaughan's specimen only one branch from a more normal specimen. This specimen from the Great Barrier Reef combines both the cockscombs of *M. levis* and the long slender branches of *M. digitata*. The outwardly bent tips of branches which give Dana's specimen its peculiar appearance are not conspicuous, but two broken branches show them perfectly. The closeness and parallelism of the main vertical branches are also shown in this specimen.

Bernard, 1897 (p. 44, under *M. fruticosa*), says: "I have no hesitation in separating this from the *M. digitata* of Dana, in which the apertures are irregular breaks in a surface reticulum (*cf.* Zooph., pl. xlviii, fig. 1*c*)." Dana gives a rough figure which shows an irregular but distinct wall. In this specimen the wall is more often quite circular. The septa are irregular in breadth, as in Dana's figure.

Distribution : Banda, Solomons, Fiji. Now G.B.R.

Smooth-foveolate, Branched Montiporae.

Montipora fruticosa Bernard.

(Plate XXIII, fig. 2.)

1897. *M. fruticosa* Bernard, p. 44 ; pl. iv, fig. 2 ; pl. xxxii, fig. 2.
1918. *M. ramosa* (part) Vaughan, p. 151, pl. 62, fig. 2.

This species is near to *M. ramosa*, with which it is considered synonymous by Vaughan, but the differences seem constant.

The collection contains four specimens, B.M. 193, 277, 287 and 300. The first is G.B.R. No. 8, but no locality is given. It is labelled *M. fruticosa*, *M. divaricata*, *M. compressa* by Matthai, who thereby recognizes its distinctness from *M. ramosa*, but follows Vaughan with regard to the other two species (reasons against which are given under *M. ramosa* on p. 186).

The differences from *M. ramosa* are :

(1) The "fruticose," loosely branching growth-form. There are flattenings and fusions, but no large, long fusions of parallel branches. These specimens, like Bernard's and Vaughan's (Plate 62, fig. 2 labelled *ramosa*), are all small, the largest 11 cm. high.

(2) The small size of the calices, which are, however, conspicuous through their depth and openness, "as if punctured in the almost solid corallum" (Bernard). In these specimens the calices measure generally 0·5 mm. or even 0·75 mm., not many so little as the 0·35 mm. of Bernard's specimens.

(3) The solidity of the coenenchyme surface, and its spinulation. These specimens show the "almost solid cortical layer" only near the base, but the threads of the reticulum are all thick.

The figure on Plate XXIII shows a specimen in which fusion is at a maximum.

Distribution : Recorded only by Bernard and Vaughan. From the Great Barrier Reef only.

Montipora ramosa Bernard.

(Plate XXVI, figs. 3, 4 ; Plate XXVII, fig. 3.)

1897. Bernard, p. 49, pl. v ; pl. xxxii, fig. 3.
1918. Vaughan, p. 150, pl. 62, figs. 1 and 3 (not fig. 2, which is *M. fruticosa*).
1932. Thiel, p. 114, pl. xvii, figs. 2 and 3.
1938. Eguchi, p. 375.
Umbgrove and others on distribution on reefs.*

This widely distributed species is known for the variation in its forms of growth. The Great Barrier Reef specimens, though without an Expedition number or note of locality, have evidently been carefully selected, and show a wider variation in form than anything hitherto described, but, paradoxical though it appears, show also that the mode of branching is a specific character. They also show wide variation in structure, com-

* Perhaps Crossland was referring to Umbgrove's (1939, p. 5) work on "facies-types."—[A.K.T].

bining completely smooth with markedly foveolate forms. This is one of those species of great importance on some reefs, but absent, for some quite unknown reason, from others. Umbgrove (1939, p. 12) remarks on its abundance in the Bay of Batavia (in the moats, as at Low Isles), but that it is absent from the Togian Reefs, though carefully searched for.

Apparently the specimens were not regarded as of this species by the members of the Expedition, as there is no reference to thin-branched examples in the ecological reports, all mentions of this name referring to *M. fossae* n. sp.

The specimens are B.M. 271, 273, 275, 279A, 279B and 300A. I have added the letters A and B since the two pieces of 279 and 300 do not fit together and those of 300 are of different species.

No. B.M. 300A is almost exactly like Bernard's pl. v, fig. 3. Others are more like the very slender form of his fig. 2, which shows the distinct foveolation of the upper ends of the branches characteristic of most of the Great Barrier Reef specimens.

No. 273 is of much looser build, long branches with only occasional fusions and comparatively inconsiderable broadenings of their ends; it leads on to 279A, in which the fusion of parallel plates is so marked, and 279B, with its palmate branches. This short series illustrates the essential unity of plan in these so different growth forms, *viz.*, the fusion of adjacent branches resulting in plate formation, not merely of isolated branches but of the coralla as wholes, and the broadenings by branchings remaining fused, leading to the palmate ends of 279B.

The variation in minute structure is even more interesting. No. 300 is smooth to the naked eye, like Bernard's figs. 1 and 3, the other specimens showing quite distinct foveolation in places, as in the upper parts of Bernard's fig. 2, while No. 275 is deeply foveolate all over. Under a lens a slight foveolation can be made out in 300A, the ridges being low and rounded, but here and there thin, with sharp, fringed edges. In one place there is a low mound (Plate XXVII, fig. 4) in perfect continuity with the rest of the branch, and showing no trace of a parasite or other cause of abnormality, in which the foveolae are deep, funnel-shaped and frequently sharp-edged and fringed with spicules. The characters of the calices and coenenchyme differ greatly between the upper, middle and lower parts of the branches. In the upper 1 or 2 cm. the coenenchyme is loose, walls of calices absent or indistinct, septa thin and reaching only to half the radius, as in Bedot's (1907) fig. 255 on pl. 46 (under the name *palmata*) and Vaughan's (1918) pl. 62, fig. 1*a*. Lower down, the walls are well made and slightly projecting, septa thicker and broader, and slightly exsert, directives nearly meeting, coenenchyma solid, with low blunt spicules. The difference is greater than that shown in Thiel's (1932) two figures (pl. xvii, figs. 2 and 3). In the low mound referred to above, the thickening of the walls reaches a maximum, so that there is a space between the calyx-opening and the surrounding ramparts: probably the reason for the sharpness of their edges.

This character is frequent in the more deeply foveolate parts of the other specimens; it is the chief characteristic of *M. palmata* Bernard (*not* Dana), which is thus a synonym of *ramosa*, separated from it by Bernard (p. 66) because it is foveolate, whilst *ramosa* is glabro-foveolate; but this series shows that this division cannot, in this species, be maintained.

The foveolations in the upper parts of 273 and 279 have an upwardly directed appearance to the naked eye, due to the greater development of the ramparts and calyx-walls on their lower sides. They are often broken, so that three calices may lie in a valley, or a portion of a rampart may be isolated like a pyramidal papilla. This might seem to lead on to the papillae of *M. palmata* (Dana), but they never resemble those shown in his figure (1849, pl. 44, 2*c*), in which they are shown as quite isolated and with round tops. Otherwise Dana's species is remarkably like this. No. 279A is almost completely foveolate, only the main stem near its base being smooth on one side ; the other side is foveolate all over, deeply over the upper half, moderately in the middle area, and not very clearly at the bottom. All the other specimens are smooth at the base and have one side more deeply foveolate than the other.

No. 271 is a crust over other corals, probably partly of the same species, very irregular and covered with aborted branchlets from 0·5 to 2 cm. high ; the character of their tops, with fully developed calices, indicates retardation of growth. There are also growing branches at each end of the corallum up to 5 cm. high, and a few between up to 2 cm. Foveolation visible under a lens on the branches, with ramparts rounded or sharp, but it is ill developed elsewhere, *i.e.*, over most of the corallum. No. 295 is encrusting a branched coral probably *M. fossae* ; the crust is thin but knobby, with only rudiments of branches. It is not possible to be certain which of the two species the crust belongs. No. 275 is a collection of branches which I am unable to fit together. Some are much thicker than the preceding, the largest piece being 10 mm. thick and up to 22 mm. wide ; others, on the same piece, are only the usual 5 to 8 mm. thick, and nearly round. The large expansion 22 mm. wide, is not made of fused branches.

Synonymy.—It has already been shown that *M. palmata* Bernard is synonymous with this species. Vaughan (1918, p. 151) gives *fruticosa*, *compressa* and *divaricata* as synonyms, and is followed by Thiel, though, as Thiel says that all his specimens are like the very slender form of Bernard's fig. 2, they can hardly afford any evidence. For *M. fruticosa* see under that species ; *divaricata* is a lobed, smooth form, showing nothing of the characteristic flat fusions of *ramosa*, and its septa are in two cycles. *M. compressa* is slender and with palmate ends to the branches, and therefore like *ramosa* in shape, but the projecting thecal walls make *promiment* rings such as I have not found in any of these specimens, and there is no trace of foveolation. Bernard's figure on pl. 3, fortunately a collotype, shows these walls clearly under a lens, even on the upper ends of the branches where walls are but slightly developed, if at all, in *ramosa*. "As a rule the septa, very irregular and feeble at the margin, become more prominent deep down," whereas in *ramosa* they are always level with the wall, and, where better developed, slightly exsert. Esper's figure of his *M. compressa* (tab. x, fig. 1) is like B.M. 279B of this series, while his fig. 2 is probably *M. fruticosa* ; and fig. 3, but for the prominent rings, might also be of *M. fruticosa.*

Another synonym is the foveolate *M. indentata* Bernard (1897, p. 65, pl. v, fig. 5 ; pl. xxxii, fig. 5).

Distribution : Throughout the Malay region to Fiji and Palao. Not recorded from Samoa, Tahaiti or the Red Sea. In the Indian Ocean, Ramesvaram and Cocos Keeling I. Always recorded as abundant on the shoreward side of coral areas.

Montipora fossae, sp. n.

(Plate XXVI, fig. 2.)

This is the species named *M. ramosa* in the ecological reports, and which forms so important a constituent of the moat fauna (hence the specific name). It differs from

Bernard's *M. ramosa* (three forms are illustrated on his pl. v) so greatly in its growth form that, in the absence of intermediates, they cannot be united.

The species is figured, in its natural surroundings, by Stephenson and others in five photos on pls. ix, x and xvi, all of which agree in showing the same thick, blunt vertical branches with trifling variation, quite evidently the same as Samples 6 and B.M. Nos. 286 and 282. The uniformity of the species shown in these photographs strongly supports my considering the species as distinct. True, the habitat is a special one, but we have no evidence that this has caused so remarkable a variation from an allied species, especially when we find that other corals of the moat are not particularly affected.

The species belongs to the glabro-foveolate group, No. 6 being distinctly foveolate all over, No. 7 has smooth areas, while B.M. 286 and 282 are smooth but for small areas of weak foveolation. These areas in No. 286 are discoverable under a lens, but in 282 are, here and there, visible to the naked eye, as in the other specimens.

These two specimens correspond with the photographs above mentioned by Stephenson and S. Manton, No. 286, with pl. ix, fig. 1 on the left, consisting of two upright branches, fused together through the lower halves, and ending in smaller branches, partly fused with the typical blunt conical ends. The fused base is about 34 mm. × 20 mm. ; exact measurements are impossible owing to irregularity and rounded or conical swellings. The free branches are rather flattened, 25 mm. × 20 mm., and 20 mm. × 17 mm.

No. B.M. 282 has a thinner stem, 13 mm. thick at the base, where it is dead, broadening and flattening where it is overgrown by living corallum from above, and still more so higher up. It is too irregular for measurement. This main branch appears to have grown at an angle of 45°, and bears 5 vertical branches about 20 mm. thick, ending in blunt cones ; in both specimens these seem to be more slender than those shown in Stephenson's and S. Manton's photographs.

Calices small, near the base 0·5 mm. across, distally a little more. The thecal wall is moderately distinct, septa $\frac{1}{2}$ to $\frac{3}{4}$ of the radius, but irregular in breadth and often also in thickness ; a pair of directives often more prominent. Six primaries and one or two rudimentary secondaries are present, but one or two primaries may also be narrow. They are continuous plates and may be slightly exsert.

Besides being distinctly foveolate the calices of Nos. 6 and 7 are different, 0·75 mm. across, primary septa broader and more regular ; they do not meet centrally but join a columellar mass lying below their inner ends. Directives generally distinguishable, often broad, but not meeting.

These specimens might be a variety of *M. ramosa*, and Nos. 6 and 7 have been so labelled by Matthai, but proof is lacking. Compare Bernard's pl. v, fig. 1, in which the lower stems are as thick as those of the present specimens, but note that in *M. fossae* it is the lower parts of the stems that are the thinner. In Bernard's the upper parts are a cluster of thin branches, which are not conical at their ends. Compare the note on growth form in the Introduction.

Eguchi (1938, p. 376) mentions *M. palmata* (Dana). As he gives *M. palmata* Bernard as a synonym this may be *M. ramosa*, but he goes on to say : " It is easily distinguishable from the typical *M. ramosa* by having much stout[er] branches, which is usually irregularly united with the neighbouring branches and sometimes forms more or less massive corallum." This is almost certainly *M. fossae*. How many other records, *e.g.*, Baker's* and Umbgrove's are really this species there is no direct evidence.

* This appears to be a reference to Proc. Zool. Soc. London, 1925, pp. 1007–19.—[A.K.T.]

Foveolate Montiporae.

Montipora foveolata (Dana).

1897. Bernard, p. 54, pl. vi, fig. 1 ; pl. xxxii, fig. 12.

Specimen 303 (outer moat, June Reef) corresponds exactly with Bernard's description and the left-hand figure on pl. vi ; but fig. 12 on pl. xxxii does not show the interior of the calyx, which is deep, the 12 septa (nearly of the same size) running down to the bottom, and thinning below. When there are one or two thicker primaries they are not opposite : *i.e.*, they are not directives.

Bernard does not mention the columellar mass, which is generally present, very irregular in shape and size. (The calices of this specimen often contain sand grains, but the real columella can often be made out clearly.) Sometimes it is represented by thickenings of the inner ends of the septa.

Distribution : Tongatabu and Fiji ; now G.B.R.

Montipora socialis Bernard.

1897. Bernard, p. 56, pl. v, fig. 4.

Specimen 318 is, like the preceding, from the outer moat of June Reef. I am doubtful whether this species is really distinct from the preceding, but two small and incomplete specimens afford no evidence for uniting them. According to Bernard the species differ as follows :

M. foveolata.	*M. socialis.*
Calices large, to 1·5 mm. . . .	Calices less than 1 mm.
Calices each surrounded by ridges. .	Several calices in one valley.
Young calices on meeting points of the ridges.	Calices as " swallow nests " on sides of ridges.

These two specimens differ distinctly in these respects, but in *foveolata* there are occasionally two calices surrounded by one ridge, and the difference between young calices on the meeting points of the ridges and on their sides is not always definite. The structure of septa and columella is identical. The fact that Bernard had seven specimens of *foveolata* and three of *socialis* is against their identity.

Distribution : Great Barrier Reef and the Gloriosa Islands. These are off the north-west end of Madagascar.

Foveolate-Papillate (" Irregular papillae ") Montiporae.

Montipora venosa (Ehr.) var. *angulosa* Klz.

(Plate XXVI, fig. 5 ; Plate XXVII, fig. 5 ; Plate XXVIII, fig. 7.)

1879. *M. verrucosa*, Klunzinger, p. 35, pl. vi, fig. 10 ; pl. v, figs. 14, 15 ; pl. x, fig. 7*a*.
1897. *M. venosa* (part) Bernard, p. 69, pl. xxxii, fig. 15.
1906. ? *M. venosa* Marenzeller, p. 63, pl. 21, figs. 66–68 ; pl. 23, figs. 66*a*–68*a*.
1907. *not M. venosa* Bedot, p. 274, pl. 46, figs. 260–262 ; pl. 47, figs. 263-266.
1918. *M. venosa* Vaughan, p. 153, pl. 63, fig. 3.
1918. *M. venosa* Mayer, pl. xix, fig. 46.
1925. *M. venosa* Hoffmeister, p. 50, pl. vi, figs. 2*a*, 2*b*.

The two specimens of this species are remarkably uniform, in contrast to those described above. They correspond well with Klunzinger's figures mentioned above.

Bernard (p. 35) includes Klunzinger's species with *tuberculosa*. But the latter is quite distinct, and, as Marenzeller points out (p. 61), is *M. monasteriata* F. Bernard's only figure, a drawing, does not elucidate either species. Bedot's *M. venosa* is totally different, notably in the looseness of the reticular surface, absence of calicinal walls, and irregularity of the septa. Marenzeller's description and figures are unconvincing, especially in the abundance of thick rounded ridges. Vaughan and Umbgrove accept Bedot's identification; Vaughan and Hoffmeister that of Bernard without question; and none of them refer to Klunzinger.

The most interesting feature of the present specimens is the absence of free papillae. Either the calices are level with the surface on smooth areas, or they are surrounded by coenenchymal ramparts which make shallow funnels. The correspondence with Klunzinger's figures, pl. v, fig. 15 and pl. vi, fig. 10 (left hand), is exact, except that in the former the rampart round one calyx is divided into 5 papillae, and, in the latter, more or less free papillae can be seen here and there. A point mentioned only by Vaughan is that the secondary septa often bend towards or meet and fuse in a straight " V " with an adjacent primary, and there is often a columellar mass.

No. B.M. 394 is completely foveolate, except in depressions, where it is smooth. The surface is knobby, and on these knobs and on lower elevations the foveolation is perfect, the ridges being sharp-edged and enclosing a shallow, funnel-shaped depression, at the bottom of which is the calyx. This specimen was growing on a mangrove-root in Pool 3, Low Island. The root had decayed away except for some of the bark, and the corallum forms a hollow cylinder with edges turned outwards below, very little free, as the main lamella shown on Plate XXVI follows a branch root; but at the top the lamella turns over the top of the cylinder and downwards inside it for 1 or 2 cm.

A fragment tied to this specimen, but not part of it, is from a basal expansion. Its characters are the same as the corresponding parts in B.M. 394. No. G.B.R. 424 is a small crust growing over unidentifiable coral; its calices are smaller and more numerous, the ramparts form ridges in places, and are, here and there, broken into single papillae, not in a group round a calyx. Otherwise it is like the other fragment.

The calices and their variation deserve fuller description. All are 1·0 mm. across, or a little over. Those on the smooth areas are immersed, with up to 12 narrow but very distinct septa, the primaries broader, but a deep open fossa is often left. The directives may be distinguished by being thicker; or they may be broader also, when one may bear a columellar thickening, or both may join one, or (where the columella is broad) all the primaries may join it. Calices have well-marked walls, which may project as a low ring. Round the calices which are surrounded by the funnel-shaped ramparts the wall is naturally less conspicuous, but it is clearly present. The septa are as above. Even on the upper surface of the cylindrical corallum, where the coenenchyme is loosely reticular, walls, though thin, are distinct, and the septa (also thinner) are straight and well developed. On the foveolate basal expansions some of the fossae are deep and open, and at the edges calices tend to run in rows and the ramparts to form ridges.

The coenenchyme is spicular and densely reticular: on the " back " of the cylinder nearly solid. It throws up very delicate, branched spicules round the funnel edges, which often broaden into plates; these, of course, are not comparable to tubercles.

G.B.R. 14, a fragment of a crust, is probably of this species. The hummocks of the surface are low, separated by smooth valleys in which are well separated calices about

0·75 mm. across. These have 6 primary and a few secondary septa, with columellar plugs. Most of the hillocks bear low, pyramidal, separated papillae, but in places they fuse together to form ridges and the usual funnel-like walls round the calices.

This specimen is also very close to *M. elschneri* Vaughan from Fanning Atoll (1918, p. 154, pl. 64, figs. 1, 1*a*).

Distribution: Red Sea, Northern Celebes, Murray Islands, Samoa; now G.B.R. Bernard's record from Fiji is doubtful, though it must occur there.

Foveolate-Papillate Montiporae (papillae fusing to ridges).

Montipora prolifera Bernard.

1897. Bernard, p. 93, pl. xviii.

I identify sample No. 10 with this species, with the proviso that I think it possible that a considerable series of whole coralla might prove its identity with *M. foliosa.* According to Bernard's classification the species are widely separated, *foliosa* being a tuberculate form and *prolifera* papillate; but this distinction is not absolute. Of *prolifera* Bernard says that in young fronds the papillae may be quite small, and indistinguishable from tubercles. In this specimen the surface has overgrown two older growths, the whole being a plate in three layers, so that it is probably young. The tubercles are much more abundant than the papillae, which are so "proliferous," and so overgrown by tubercles and plates as to be hardly recognizable as such. The ridges in this specimen are conspicuous only 1 cm. or so from the edge, and on the tops of the larger processes. They are very thin, and less than 1 mm. high.

The great majority of the calices are immersed, with only one or two tubercles standing near their walls. Some, on the processes, may be surrounded by tubercles, but the ring is very rarely complete, or regular.

Bernard says that there are 12 septa: I find this rare; 6 plus 3 or 4 is more usual, the secondaries being small, while the primaries may exceed half the radius in breadth. There is often a minute columella-like body.

Distribution: Ponape (Caroline Islands) and Amboina (Netherlands E. Indies). Now G.B.R.

Montipora undans sp. n.

(Plate XXIII, fig. 3; Plate XXVIII, fig. 2.)

The name indicates a likeness to *M. undata* Bernard (1897, p. 98, pl. xxi, fig. 2 and pl. xxxiii, fig. 9). This latter figure, a drawing of enlarged calyx and ridges, contradicts the text, as do others of these drawings.

Specimens 13 and 187 agree closely; they are small, nearly complete and partly encrusting coralla of irregular outline, saucer-shaped, but with the edges turned downwards; major diameters 65 and 45 mm. There is no information as to localities of either.

The thick continuous ridges rise into crests and meet occasionally as shown in Plate XXIII. The valleys between are much narrower than in *M. undata*, Bernard's figure of which, it must be remembered, is reduced to half size. The central area is covered with short plates and round papillae. In the valleys are no small papillae or tubercles, but occasional short plates and thick rounded papillae.

The calices are 0·5 mm. across, with clearly circumscribed margins; septa 6 plus

2 to 4, rather thick, broad, symmetrical, not meeting. The walls and septa may project a little. Many calices are borne up on smooth processes resembling the papillae to various heights not exceeding 2 mm.; these are always more or less oblique, even in the central areas, though those only slightly projecting are level, even in the marginal areas, where the tubular ones are procumbent.

The coenenchyme is divided sharply into three layers; the middle a delicate open reticulum bounded above and below by very thin layers; the upper of very short, close-packed trabeculae; the lower stony and not distinct from the epitheca. The ends of the trabeculae cover the upper surface of valleys densely, and are like minute upright plates, usually set at right angles to the ridges or radially to papillae. The surfaces of the ridges and papillae are closely granular. There is no reticulum on the surface such as characterizes *M. undata*, nor is any of the surface spicular as shown in Bernard's fig. 9, pl. xxxiii.

It is tempting to consider these as possibly only young coralla of *M. undata*. The valleys might broaden out as growth extended, and even the papillae and plates of the central area become continuous serpentine ridges; but the differences in the calices and their supports, the presence of an epitheca, and the character of the coenenchyme are among the features not likely to change with age.

Montipora sulcata sp. n.

(Plate XXVIII, fig. 6; Plate XXIX, figs. 2, 5.)

Specimen 16 is a curved segment of a circle, measuring 15 cm. radially (the actual centre is unfortunately missing) × 18 cm. across the chord. The right-hand edge looks as if it were broken, but the appearance is due to a sharp downward bend of the straight edge of the plate on this side.

The name refers to the long, comparatively regular ridges which cover the upper surface from close to the centre to the edge.

The characters in which the species differs from other species with somewhat similar ridges are:

(1) Absence of epitheca.

(2) Height, thinness and continuity of the ridges.

(3) Small and very small papillae (tubercles?) between the main ridges.

(4) Small, inconspicuous, immersed calices, very few in number; those on the underside very small.

(5) Septa in one cycle, sometimes one or two of the second cycle present.

The plate is thin, from 4 to 5 mm. thick centrally, 1·5 mm. at the edge. The ridges are equally well formed, though not so high near the centre of the plate, but here are serrate, showing their origin by fusion of flat papillae. But over most of the corallum they are only slightly sinuous. The ridges are from 2 to 3 mm. high, but only from 0·5 to 0·75 mm. thick below (the upper edge much less), almost quite smooth above under a lens, but their sides are finely spinulose. For details of their junctions and endings see Plate XXVIII. Between them (never upon their sides) lie the calices and small, nearly cylindrical papillae, much smaller than those which, by their fusion, give rise to the ridges; many are quite minute. These papillae are scattered, but often one stands immediately proximal to a calyx. The surface of the coenenchyme is rougher than that of the ridges and papillae.

All calices are completely immersed, there being no projection of the wall, which is not visible as a distinct structure. They are small, measuring 0·5 mm. and less across, rather far apart, and so inconspicuous that they have to be searched for with a lens. Septa well defined and broad, but second cycle at most represented by two narrow septa.

The surface of the underside is smooth (a lens reveals minute blunt spinules) but raised into numerous warts, on one side near the base developing into short root-like processes. Some of the warts bear calices at their points like those of the upper surface, and others may be found on the flat surface. Over most of the corallum, however, the calices are almost obliterated by thickenings of the septa : over the proximal half they can hardly be made out at all. The coenenchyme is excavated by linear, bent pits, the remains of the original reticulation.

In section the coenenchyme shows two layers only, a thin solid layer beneath, above which is an irregular network rising into the papillae.

The species resembles *M. pulcherrima* Bernard (1897, p. 91 ; pl. xvii, fig. 2 ; pl. xxxiii, fig. 7) but *M. sulcata* has (1) no epitheca, (2) continuous ridges, (3) calices all immersed, (4) small papillae, or tubercles, between the ridges, besides other differences.

Montipora tertia sp. n.

(Plate XXV, fig. 2 ; Plate XXVIII, fig. 4.)

Specimen No. 11 (no locality) is thus named as it is the third species known in which both the directive septa are highly exsert ; the other two are *M. exserta* Quelch, the peculiarity of which is shown in his pl. viii, fig. 5*b* (Bernard in pl. xxxi, fig. 13 does not attempt to do so) and *M. saxea* Bernard (p. 180 in the appendix) from Gardiner's Funafuti Collection. *M. exserta* is glabrous, in *M. saxea* the septa are only half the width of the radius and irregular in shape, the papillae " small pimples without any definite association with the calices." This specimen No. 11 is a half column, evidently grown vertically, formed of an incrustation loosely overgrowing a cavernous mass of the same species, some parts of which are continuous with the living layer ; the hollows and spaces of this mass are due to the mode of growth.

The living side of this specimen is made up of irregular vertical branches fused together and bearing numerous abortive branchlets as shown on Plate XXV. The papillae are low and rounded, often directed upwards and elongated in this direction, sometimes forming low rounded ridges. The branches seem to begin as fusions of papillae and ridges.

Except on smooth, depressed areas near the base the calices are hardly visible to the naked eye, being only 0·5 mm. across. Seen under a lens directly from above, the 6 primary septa with two broader and thicker directives are conspicuous ; these latter nearly meet at the centre, and are nearly joined by the lateral primaries, but fusion is not visible. Seen slightly obliquely the exsertion of the directives is striking, and sometimes some of the others are exsert to a less extent. Some very thin short secondaries are often seen. There is a not very distinct " petaloid " wall.

Most calices are immersed, the adjacent coenenchyme smooth with minute spicules. Other calices lie at the base of a papilla which forms a hood over it ; or they may open on the side or summit of a papilla, or on a ridge. They are well developed on the spongy upper surfaces of the corallum.

A small portion of the under surface is visible ; it is smoothly reticular with small spicules, calices, all immersed, some with thick slightly projecting walls. In another part small, aborted, spicular papillae occur.

The vertical, trabecular layer takes up most of the section ; the middle layer is narrow and spongy, in places absent ; the lowest layer may be of short thick vertical trabeculae, or, where the under surface is not living, a thin solid plate. An epitheca is not visible.

Foveolate-Papillate Montiporae (papillae regularly nipple-shaped).

Montipora verrucosa (Lamk.).

Two specimens ; No. 9 identified by Matthai, and No. 12, neither with locality. Both are typical, lamellate in form, with none of the remarkable variation figured by Vaughan (1907, pls. 53 to 59.) Vaughan's specimens came from Hawaii, a marginal belt island where possibly variation is extreme. Even Bernard's series was more uniform.

Distribution : Great Barrier Reef to Hawaii, including Fanning and Funafuti Atolls ; but not recorded from Samoa or Tahaiti. There is a form very like it in the Red Sea (not *verrucosa* Klz.), but Bernard thinks this is distinct.

Tuberculate Montiporae.

Montipora erythraea Marenz.

(Plate XXIV, figs. 2, 3, 4 ; Pl. XXVII, figs. 1, 2.)

1906. Marenzeller, p. 58, pl. 22, figs. 73, 74 ; pl. 23, figs. 73*a*, 74*a*.
1935. Manton, p. 294, pls. vii, xi.
1939. Umbgrove, p. 55.

Marenzeller says, " Diese *Montipora* steht der *M. foliosa* (Pallas) Bernard's nahe, und ist vielleicht nur eine lokale Form derselben." The species, after much consideration, seem to me quite distinct, and its discovery in the Bay of Batavia and on the Great Barrier Reef corroborates this. The two specimens are widely different. No. 319, from June Reef " Int. Mad. Zone," is heavy, humpy and rough, and its surface recalls that of *M. prolifera*. No. 30 is a thin plate covered with ridges over the whole 10 cm. which it measures radially. No. 319 is heavily wrinkled. In the proximal part it is as much as 18 mm. thick, but at the edge thins down to only 1·5 mm.; it measures 12 cm. radially and 9 cm. across. It is deeply concave below, the hollow 3·5 cm. deep, and correspondingly raised into humps and ridges on the upper side as shown in Plate XXIV, fig. 4. The literature later than Marenzeller's work supports his contention that this irregularity and flatness of the leaves is a distinction from *M. foliosa* ; but no part of Marenzeller's specimens was so old and heavy as this, nor so completely covered with ridges as is No. 30. Neither bears upright branches ; but the presence or absence of these is certainly not a specific character in other foliose species.

The main distinction from *M. foliosa* and other species is the way in which many calices are completely surrounded by tubercles. As they increase in length the tubercles carry up the calyx with them, forming tall pillars. These are described by Marenzeller, who duly emphasizes the fact that their ends remain free, fusion taking place only low down. All stages in this remarkable growth are shown in this specimen, No. 319. It is quite different from the formation of a calyx on a papilla, or from the compound arrangement in *M. composita, n. sp.* described on p. 111, or from the fused collars, or imperfect rings of *M. foliosa* referred to in my note on that species on p. 112. On the distal ridged part of the corallum the pillars are less conspicuous, and generally oblique.

As I have remarked before, it is a real misfortune that Marenzeller's photographs are so coarsely printed, thus making necessary the fresh illustrations on Plates XXIV and XXVII.

Calyx walls everywhere distinct; septa well developed, 6 plus 6 or 4, breadth about half the radius, secondaries narrower, directives not prominent.

In this heavy specimen (No. 319) the lowest layer of the coenenchyme is quite solid and measures 1·5 mm. in thickness at the middle of the radius, but 2 mm. nearer the centre. Specimen 303 consists of two fragments, (1) from the edge and (2) from near the edge of a leaf. The pillars are therefore short.

Specimen 30 is included here because I can make out no clear difference between it and the distal edge of *M. erythraea.* but, in his specimen, these conditions hold for the whole 10 cm. which it measures radially. The calices are surrounded by similar tubercles in the same way, but are little, if at all, elevated. The underside is covered to 25 mm. of the edge by lithothamniae and brown weed, more thinly than in No 319, the whole plate being evidently much younger. It is deeply wrinkled, maximum thickness 8 mm., but mostly much thinner, 4 mm. on the average, 2 mm. near the edge. Structure of section as in the preceding. Free part of the underside smooth, without tubercles or papillae; here and there a rudimentary calyx can doubtfully be made out. It is possible that several large and complete colonies would complete the connection between these specimens and those of Marenzeller, or, on the other hand, show them to be distinct species. In the absence of such material I content myself with a figure which will be useful in the future.

Specimen 136 from Traverse II, Deep, is an irregular column, 13 cm. high, 8 cm. wide; the base encloses a mass of *Porites*, and there is little doubt that this gives the shape to an incrustation which is not likely to be anywhere thicker than the section exposed at the base, *viz.*, 4 to 8 mm.

As there are no free edges there are no long ridges, but neither are there short ones elsewhere. In No. 136, as in 319, the tubercles are much reduced in the hollows and near the base, where they become small groups of mere spicules. Sometimes in such areas the calyx wall may stand up as a glassy tube independently of the surrounding reduced tubercles. Bare spaces showing a reticular coenenchyme are found here and there.

The calices on the sides stand out horizontally, and are not inclined upwards. There is one giant theca, with 12 nearly equal septa, all of which reach a broad flat columellar mass. The hard layer of the coenenchyme is somewhat thinner than in 319 but, as in that specimen, the middle layer is very narrow where it is present at all, and the trabeculae of the upper layer thick and glassy.

Distribution: Red Sea, Bay of Batavia and now G.B.R. only.

Montipora foliosa (Pallas) Bernard.

This species is recorded by Bernard from several localities between Mauritius and the New Hebrides; by Vaughan from Cocos Keeling; by Faustino from the Philippines;

by Umbgrove from the Bay of Batavia ;* and by Eguchi from Palao where it may reach 3 m. across. It may thus be expected to be common on the Great Barrier Reef, but it has not been recorded from this region except for a doubtful mention by Saville Kent ; and it is not present in this collection. Nevertheless I think S. Manton was probably right in giving the name to many of the foliose forms she met with, though many species are hardly distinguishable until closely examined. I attribute the absence of the species from the collection to the quite unavoidable but regrettable limitation of the packing and transport facilities available in such a place as Low Isles, and to the size of the launches used for expeditions. Most of the older records probably refer to several foliose forms, but we have the following reliable descriptions and figures.

Bernard (1897, pp. 156 to 162) describes specimens marked " *a* " to " *w*," and figures "*f*" on pl. xxx. Pl. xxxiv, fig. 13 (a drawing of a single calyx) contradicts the text which says (p. 158): " they are mostly protuberant, that is, surrounded by rings of tubercles within which they rise." One tubercle per calyx can be seen in some cases in Vaughan's (1918) pl. 65, fig. 2*a*. (Vaughan gives no description.) Bedot's (1907) pl. 50, fig. 276 is similar : the rings are neither complete nor do they form pillars. Faustino's figures on pl. 82 show thin tubular calices without distinct tubercles.

This shows how distinct is *M. foliosa* from *M. erythraea* apart from the marked differences in the arrangement of the ridges, etc.

Montipora informis Bernard.

1897. Bernard, p. 133, pl. 27, fig. 3 ; pl. 34, fig. 3.†
1918. Vaughan, pp. 156, 158 ; pl. 64, figs. 3, 4, *a–c* ; pl. 65, figs. 1, 1*a*.

Sample 181 from " Traverse I outside " is a portion of a plate measuring 12 cm. radially and 19 cm. across the chord. It is slightly wrinkled, and bears two small vertical branches, the longer 24 mm. high. It is like the specimens described by Vaughan : rather more like his *M.* aff. *informis* than the typical form. In brief the main character of the species is that the tubercles are confined to small groups of 3 to 5, generally proximal to certain of the calices, in very few cases forming a ring round them. Most of the surface is covered with spicules rising from the delicate reticulum of the coenenchyme.

This specimen differs from both Bernard's and Vaughan's in that the epitheca is confined to a thin line along the edge where it is growing over a dead part of the plate ; the whole under-surface bears very numerous, smaller thecae, 0·5 mm. to 0·75 mm. across, corresponding exactly to Vaughan's description and figures. There are small scattered protuberances carrying a small proportion of these calices. Those of the upper surface are very nearly 1·0 mm. across, as in Vaughan's variety.

Distribution : Cocos Keeling ; N. Celebes ; Murray Islands ; and now the G.B.R.

Montipora composita sp. n.

(Plate XXVIII, figs. 1, 5 ; Plate XXIX, figs. 1, 3, 4.)

Two specimens (Nos. 23 and 186) are given this name, in spite of their widely different appearance ; it refers to the arrangement of the tubercles into fused groups, as seen in

* But, like *M. ramosa*, *not* from the Togian Islands, though carefully searched for there.

† This figure shows a ring of widely-spaced tubercles. In this specimen 181, as in Vaughan's, they are close together ; though not fused. I have ceased to expect accuracy in Bernard's drawings of calices.

section, which form warts on the upper surface, whence their free ends project. Between these warts single tubercles cover the surface.

No. 23 is a young leaf, thin and delicate, 3 mm. thick near the edge (average 4 mm.). Longest radius 13 cm., chord 18 cm. No. 186 is much larger and stouter, 6 mm. thick (peripherally 4 mm., at the edge 3 mm.), measuring radially 21 cm., chord 25 cm. It grows over an older sheet which is 10 mm. thick centrally.

In the young piece the warts are low and crowded, the tubercles short, and there is no great difference between those on the warts and those standing alone, so that the surface has a remarkably uniform, smooth appearance. The large specimen, No. 186, is on the other hand rough, the plate itself being wrinkled and hummocky, warts and tubercles higher and less regular; and the general aspect recalling *M. prolifera* and *M. erythraea.* It resembles the latter in having calices raised on "pillars." These are completely surrounded by tubercles, the ends of which are free. The tubercles are remarkable for being compound, *i.e.*, composed of other tubercles around and below those immediately surrounding the calices. There is also no formation of plates centrally, or of ridges peripherally, except for a small area near the edge of the big specimen, where they are extremely thin, perforate and jagged: their origin from tubercles is obvious. The warts may be arranged in irregularly circumferential lines in the small specimen, in the larger in no particular direction. No. 186 is infested with numerous small balanids, which have no share in the formation of warts. Though they seem to prefer to settle on warts their effect is to shorten and flatten them; and uninfested warts are in a great majority. The young leaf, in which the warts are small, is free of all parasites.

The tubercles are long and slender, round with rounded tops; and though covered with fine spicules the general effect is smoothness. A few are larger and flattened—I presume what Bernard calls "flame-shaped." Those between the warts are shorter, but like the others so closely placed that little (or, in the smaller specimen, practically nothing) can be seen of the coenenchyme. What can be seen of the surface appears solid in the small specimen: in the larger reticular, with small rounded meshes.

Calices numerous; many not supported, but immersed between the warts, some of which have no relation to tubercles. Many of the calices are oblique (to be seen only by tilting the plate), and may point in any direction over the central area, but in the peripheral part generally towards the edge. They are 1·0 mm. across, with 6 broad primary septa and several narrower secondaries. The primaries may nearly meet, and apparently do meet low down, or there may be a columellar nodule. In some places directives clearly marked; in others all primaries about the same size.

The underside is smooth, solid, with very fine spicules. There are numerous small calices with degenerate septa borne on conical protuberances. In the old specimen the peripheral calices become elongated, in one part up to 5 mm. long, and adpressed to the plate.

The young specimen, No. 23, shows no epitheca. In No. 186 it extends to 7 cm. from the edge, with some small patches further out. It is much overgrown, part of it by irregular layers of coral, differing from the rest in its immersed calices. These are crowded, have reticular coenenchyme between, and slightly projecting walls with well developed septa. In spite of all these marked differences there is no doubt that these layers belong to this corallum, as in one place a patch is continuous with the rest of the surface.

M. composita may be compared with Bernard's description of *M. aequituberculata*

(p. 130, no figure) : "Single calices or small groups are raised up by the tubercles so as to form small excrescences on the surface." But this seems hardly equivalent to the wart-formation of my species ; nor can the tubercles, with their rounded tops, be compared to "erect cylindrical flames."

*Montipora angularis** sp. n.

(Plate XXV, fig. 3 ; Plate XXVIII, fig. 3.).

Specimen 137 is from the anchorage, presumably at Low Isles : No. 5 has no locality but one concludes from its number that it was collected long before the other, making it unlikely that they are parts of the same corallum. Both consist of a thin crust, growing over dead plates and branches of the same species. This soon gives rise to lobes, plates and thin branches, which fuse again into plates in all kinds of irregular ways. The top of the corallum is composed of free slender pointed branches, 5 to 8 mm. thick. On them are long ridges separating areas of tubercles which give them an angular shape. The ridges are always bent and some are broadened and flattened near their ends.

The tubercles, apart from the ridges which show their origin from fusion of longer tubercles quite clearly, are generally cylindrical, of various lengths and thicknesses, with frequent flattenings and fusions into plates. Many of the shorter tubercles form incomplete rings proximal to the calices ; on the branches these are longer and turn the calyx upwards. Even these tubercles are often broadened, and the direction of the flattening may be either radial or tangential to the calyx.

Calices mostly lie in the flat, and generally smooth, valley-bottoms, where tubercles are low or absent, and areas of finely spicular and solid or reticular coenenchyme are left bare. None are to be found within 1 cm. or so of the tips of the branches. They are 0·75 mm. across, with 12 septa ; the primaries reach nearly to the centre and the directives meet, but without fusion ; there is no columella, nor do the septa swell at their inner borders. Secondary septa often turn to join the adjacent primary ones, or they may form a straight "V." The lower part of the corallum (where it forms a thin crust over dead branches) is quite smooth, has no tubercles, is solid looking, and has closely placed spicules. The calices are smaller, placed often at the tops of conical protuberances, their septa irregular and narrower. In passing higher up the corallum one can see these cones gradually changing into groups of tubercles.

Sections of branches show a reticular central strand, but the outer layer is very solidly made. In branches low down on the corallum the reticular part becomes small ; in one place in the crust the section is nearly solid throughout, though the fusions of the vertical trabeculae can be made out. The glassy under-layer is thin, and an epitheca is visible in one place.

A group of species described by Bernard shows resemblances to *M. angularis* which differs from *efflorescens* (p. 150, pl. xxviii, fig. 1) in having pointed, not rounded terminal stems, though the figure shows pointed and looser branchlets lower down the corallum. *M. angularis* differs in the regularity of its uniform tubercles, which leave no bare areas, and primary septa reach only to half the radius. *M. ellisi* (p. 151) has shorter rounder

* My Latin Dictionary (published 1711) : "angularis, crooked, having corners." Both attributes apply to this species. There is no risk of confusion with *M. angulata* (Lamarck), which is a "very markedly foveolate" form (Bernard, p. 63).

tubercles which form the whole surface, and the calices have columellae. *M. striata* (p. 154) seems closer ; in this the branches rise from a saucer-like plate, but this, in some other species at least, is not always of specific value. One cannot be sure what Bernard means by "striated." The drawing of pl. xxxiv, fig. 12 shows longitudinal bars of the reticulum, and pl. xxviii, fig. 3 is too coarsely printed to help in detail. The branches are pointed, but straight, and do not fuse except basally ; they are like those of *M. angularis* in having no calices on the uppermost 4 or 5 mm. Septa differ in being thin, slightly swollen at their inner margins ; the fossa is clear and deep.

Genus *Acropora.*

This is the largest genus of the corals, and the most abundant reef-former. In my experience, as in that of the Great Barrier Reef Expedition, it is the most abundant and varied in clear water along the reef edge, where its species often crowd out nearly all other genera. Vaughan mentions Bernard's 74 species from this region, but adds that about half of the names are probably synonyms. Mayer's Murray Island Collection contains only 18 species, of which five, including one new, are not recorded by Bernard.

Forty species are described here, of which five are new (a number attributable to the richness of the area and the skill of the collectors) but it is clear that, however much Bernard's number of 74 species may be reduced by further research, this collection does not contain even all the known species from this area. The fewness of the species common to the Great Barrier Reef and the Red Sea and Indian Ocean is remarkable.

In working out these species I have acquired a great respect for Bernard's work. Before 1893 the great variability of corals with their surroundings was hardly known, or only hinted at. What was known was the fact that among plants every slight ecologic change has a distinct species to fit it, and it was only natural that the same should have been supposed to apply to the corals. Gardiner was the first to emphasize the difference and some of his successors seem to me to have possibly carried the merging of species beyond what is, at present at any rate, capable of proof.

Bernard's work is open to criticism mainly on account of the number of species which are not illustrated, and the absence of enlarged photographs, but it must be remembered that he had to take his own photographs, and seems to have been unable to obtain them from foreign museums. The day when all coral illustrations published will be actual photographs, like Klunzinger's, is still in the future. The fact that the species are, in my text (not in the index list), arranged in the order Bernard uses, does not imply complete acceptance of his classification. Many species fall into related groups, which do not always correspond with the usual subgenera, but attempts by earlier authors to classify *all* the species have not succeeded. Compare, *e.g.*, *A. cancellata*, *A. clavigera* on p. 225.

Some species show remarkable adaptations for resistance to surf by flattening out into plates, with the shortening or disappearance of the stem of corymbose forms. As an illustration of this Crossland (1928, p. 723) describes the extreme forms due to the almost complete absence of tide in Tahaiti ; but even here the species are always recognizable as derived from the normal forms growing in the lagoon. This is one indication that the extreme variability of many species under changed conditions has its limits, which could be worked out by observations on the reefs.

Brook (1893, p. 8) gives a long description of the septa in his introduction, yet, like other authors, often omits them from his descriptions of species. In many species they afford little help, but in others the differences are constant and afford clear distinctions, not likely to be affected by external conditions. For instance directives may or may not be broader than the other septa in the axial calices. It is perhaps worth mentioning that the septa, in these and other corals with more or less translucent walls, cannot be properly seen unless the theca is shaded, by the finger or a fragment of opaque material.

Brook was the first to discuss the priority of the name *Madrepora*, concluding that its use was justified in practice, like that of, *e.g.*, *Holothuria*. The later change to *Acropora* has no practical justification whatsoever, but, as it has been adopted by later authors, there is now even less advantage in changing back again.

Umbgrove (1940, p. 303) gives a list of the species from Batavia provided by Dr. Verwey, in which several of the names used here are regarded as synonyms. As the list is provisional, and, after full consideration, I find that the names I use are, pending Dr. Verwey's expected monograph of the genus, the correct ones, I treat the synonymy here instead of taking each case separately. The names I use are marked with an asterisk in the list.

1. *A. virgata* (Dana) = **A. pulchra* (Brook), 3 specimens in the Batavia Collection. Brook p. 40. Figure by Dana, pl. 39, figs. 1, 1*a*.

Brook places the two species under separate divisions, thus :

C, p. 38. *Prominent radial corallites, ascending, tubular.*

D, p. 41. *Short, erect tubulars unless near apex of a branch.*

A. virgata shows the ascending tubulars very markedly in Dana's figure. Brook says " none are immersed."

In *A. pulchra* they are equally conspicuous and erect ; and there are sub-immersed and fully immersed corallites among them.

Brook had 11 specimens : this collection has 13, with wide variation, but *A. virgata* is not found among them.

2. **A. aspera* (Dana) = **A. hebes*, and two other of Dana's species. 4 specimens.

For *A. hebes* see Brook (p. 128) ; Dana (pl. 35, fig. 5) ; Vaughan (pls. 73 and 74) ; and Hoffmeister (p. 57, pl. 9).

The two species are kept distinct by Brook, Dana, Quelch and Gardiner. I agree that they are not easy to separate, but the following characters of *A. aspera* constantly differentiate it from *A. hebes*.

(1) Irregularity in sizes of radials, giving a rough appearance.
(2) " Funnel-shaped " cavities of axials ; septa deep down.
(3) Thin, as well as perforated walls ; and pointed shape of radials.
(4) Thin, wavy or bent septa of axials.

This collection contains 5 specimens of *A. hebes*, and 6 of *A. aspera*. Vaughan had several specimens, and figures Dana's type. Hoffmeister had " a very large and excellent suite." Both consider their variation.

3. *A. millepora* (Ehr.) = **A. squamosa* (Brook) and four other species. 2 specimens only.

Brook, p. 116, says that *Heteropora millepora* Ehr. is not *M. millepora* Dana : he had seen Ehrenberg's type in Berlin. There is no figure of this species in existence. On p. 117 Brook repeats this, says that Dana's type is lost, but takes his species as synonymous with his own *M. squamosa.* There is thus complete uncertainty about the name *A. millepora* and Brook is justified in substituting a new name, *squamosa.*

The species falls into Brook's class " A " (*Radials gutter-shaped, thin walled*), which includes *M. convexa* Dana, *M. prostrata* Dana, *M. subulata* Dana and *M. selago* Studer, all of which Verwey regards as synonyms. Brook himself says the first three hardly differ. Dr. Verwey's discussion and figures of the types will be interesting, but the name *squamosa* stands, for the reason given above. The description of these other species, if their names are synonymous, has not been found sufficiently complete for use by subsequent workers.

4. *A. hyacinthus* (Dana) = **A. patulata* and 4 others, including *A. bifaria* (Brook), *A. kenti* (Brook) and *A. capillaris* (Klz.)

The difficulty here is to know exactly what Dana's *M. hyacinthus* is. I am not convinced by Hoffmeister's identification, in spite of his photograph of Dana's type; or, perhaps, because of it.

A. bifaria almost certainly owes its peculiarity to having been overturned without being killed, and so having become two-faced, like examples I have seen in Tahaiti. But *A. kenti* shows a difference on its two sides similar to those of normal growths, and the number and size of the branches of the underside, as well as the characters of the radials of the upper, distinguish it at once from both *patula* and *hyacinthus.* I remark that Verwey had only two specimens in place of the long series collected by Mayor. As for *A. capillaris* (Klz.) of the Red Sea I can see little resemblance.

A. hyancinthus, which was so conspicuous in Tahaiti, I have not seen in the Red Sea.

5. *A. acervata* (Dana) = **A. gemmifera* = **A. spectabilis.* There are 9 specimens.

Vaughan describes variation in *A. gemmifera* and compares it with the closely related *A. scherzeriana,* but does not mention *A. spectabilis* as a possible synonym. Verwey had 9 specimens, Vaughan " a fair suite " and the Great Barrier Reef Collection 6.

The differences given by Brook seem to be constant. As for *M. acervata* Dana the figure suggests *A. brüggemanni,* but certainty is not possible. It is caespitose, and " acervate " at its apices. *A. gemmifera* and *A. spectabilis* are, I believe, always massive and corymbose, as described by Brooks but Vaughan figures specimens which appear to be caespitose, though one is certainly morbid, partly overgrown by lithothamnia.

Acropora intermedia (Brook).

(Plate XXXII, fig. 1.)

1893. Brook, p. 31, pl. 1, fig. c.

Specimens 312, 89, 366σ, 309, 78, 71, 377σ and P3σ differ greatly in appearance and mode of growth. Some of them show the lax branching of several species which grow into areas of tangled stems, in which the lax branches from several main stems form a hardly extricable tangle—a tangle in which the lower parts are dead. As is expected, a free-growing corallum exposed to water movements on every side has a more closely branched and bushy form, and the characters of the corallites typical of the upper ends of branches extend further down, or even to the bases of their branches.

There are no fusions of branches in any of these 9 specimens.

As this is the best represented of this group of species in the collection, and the one with the strongest branches (2 cm. thick), it is probably this and not *A. hebes*, which is the main constituent of the "platforms" found near the exits from the moats at Low Isles and near the ends of the outer barrier reefs where they dip a little under the surface, as in pl. viii, fig. 3, and pl. xxvi, fig. 4 of Stephenson and others. The former shows bushy growths in the lower left-hand corner on the edge of the main mass, quite probably the same species as the crowded masses behind.

These are extremes of growth-form. The intermediates are 377σ, apparently a complete corallum; and 71, a single branch 23 cm. long, alive for 18 cm., and 2 cm. thick at the base and for most of its length. It divides into two main branches 13 cm. long, each of which bears a number of smaller branches. No. 377σ resembles a main branch of No. 78, (Plate XXXII, fig. 1), but is twice as long and has better developed branching.

As regards structure all agree with Brook's description, but his single figure is of a rather deformed, laxly-branched stem, in which the corallites typical of the upper parts of the stems extend but a little downwards, as in No. 366σ of this series. The length Brook gives for the radials, 3 mm., holds for these specimens, but in the great majority in No. 366, some branches of 377 and the fragment P3 and in 89 they are confined to the summits of the long branches. The forms of the radials vary, though keeping to the same type.

No. 309: Radials very prominent, erect and thin-walled; openings oblique; septa narrow, but 6 + 4 or 6 + 6 in number. Buds on bases are frequent.

No. 312 similar, but walls thicker; openings circular and very little oblique. Septa as above, but usually broader. These tubulars extend practically to the bases of the two branches (16 cm. long), becoming a little shorter, and the septa thicker and meeting. Nos. 71, 78, and 377 are similar. In all these the upper directive is the longer.

Nos. 366 and 89, with shorter but thin-walled tubulars, have their openings a little compressed. Septa 6 + 0 in number, but distinct. Upper directive usually the broader but the two may be equal. They may or may not meet.

No. P3σ is a fragment, a single branch 13 cm. long and 2 cm. thick, prolonged by a side branch for 5 cm. The main branch ends bluntly, and its terminal calyx cannot be distinguished. On the smaller branches, which are not so blunt, the terminal calyx is scarcely exsert. Septa 6 + 6 in number, primaries nearly meeting. There are no tubulars so long as 3 mm. anywhere; and over the whole of the main stem they are only 1 mm. in length and adpressed, the inner wall visible but fused to the stem, the opening facing upwards. Calices of this type cover the stem thickly and evenly. Immersed ones are rare and inconspicuous. In all the radials the septa are conspicuous, 6 + 6 in number, primaries nearly meeting. The walls are thick and spongy, except a small portion next to the stem, the surface peculiarly "woolly." This specimen is so unlike the others as perhaps to deserve a varietal name.

Two specimens are marked by Matthai "c. f. *pharaonis* and *grandis*." They are separated at once from *A. grandis*, the radials of which are "practically without septa," and while odd pieces of *A. pharaonis* strongly resemble *A. intermedia*, if the coralla, and the series of coralla, are considered as wholes the resemblance disappears. I may remark that I shall continue to regard Marenzeller's account of *A. pharaonis* with distrust until it has been worked out again *on the reef*.

Distribution: Recorded only from the Maldives, now Great Barrier Reef.

Acropora pacifica (Brook).

(Plate XXXI, fig. 2 ; Plate XXXII, fig. 2.)

1893. Brook, p. 39, pl. xxx, fig. B.

There are four fragments of this interesting species : No. 270 (Outer Barrier, June Reef, outer ridge π 2), a large horizontal branch, 25 cm. long, 35 mm. thick at the base, with seven branches curving upwards and three terminal branches nearly horizontal ; No. 345 (Ribbon Reef, outer moat, also marked π 2) essentially similar, 10 cm. long, 33 mm. thick at the base ; No. B.M. 60 (marked P.5, Batt Reef, surf zone, S.W. side of S.E. corner) ; and No. 333 (other indications illegible,* marked δ 2.).

The first corresponds best with Brook's description and the growth form is similar, *viz.*, " subarborescent, stout and spreading." All the details of the calices, etc., are the same, but I should add that there is an irregularity in the direction of the openings of the calices, which is visible in Brook's photograph. The next two specimens show fusions between horizontal branches, amounting to a flat plate in part of No. 345 (Pl. XXXI, fig. 2.) The upright branches are more slender, but retain their characteristic proportions. Only in this specimen No. 345 are the axial calices exsert (2 mm.) as in Brook's specimen : in the other two they are 1 mm. and less in length.

No. 333 is a small scrap, consisting of a group of five little branches rising from an encrusting base. Its well exsert axials and more regular radials give it a somewhat different appearance, but the peculiar characters of its details are the same.

From these specimens with fused branches it is evident that the long branches are broken from a massive plate. Some whole colonies, which have never been collected, would be very interesting. It is probable that the two specimens drawn diagrammatically by S. Manton on her pl. xv, and provisionally named *A. decipiens*, really show the growth form of this species, which, so far as I know, is unique.

Distribution : According to Brook, China Sea and Samoa. The latter locality may be doubtful, as missionaries used to trade in corals as curios, and it is not mentioned by Hoffmeister. This is the first record from the Great Barrier Reef region.

Acropora grandis (Brook).

(Plate XXXI, figs. 1, 3, 4).

1893. Brook, p. 42, pl. 1, figs. A and B.

Samples 266 from June Reef and 457 (locality not given) correspond well with Brook's description and fig. A, but the cluster of branches shown in fig. B is not here represented. These two specimens differ considerably, chiefly in the longer radials and more tapering branches of No. 457. The result is that No. 266 is on the whole smooth, whilst No. 457 is rough. The June Reef specimen No. 266 is 41 cm. long, though the base and the ends of the branches are lost. The two main branches are slightly oval in section, at the bottom measuring 30 mm. × 27 mm., and decrease very gradually to the tops. They are slightly bent.

The species is rare, and the distinction from others, *e.g.*, *A. robusta*, needs emphasis. I therefore add to Brook's description.

* Appear to read, " Hefty outer moat."—[A.K.T.]

The main characters are : (1) Size and thickness of the stems, with which is correlated ; (2) a solidity which is complete at the base, and remarkable even in the breaks a few centimetres from the ends of the branches ; (3) a surface reticulation so coarse as to be visible to the naked eye ; (4) the curious grouping of the radials ; (5) radial calices are short, cylindrical or slightly compressed, and very thin walled, of irregular lengths and opening in various directions ; (6) the blunt ends of the branches, on which the apicals are small and hardly distinguishable from the radials (in No. 266) ; (7) almost complete absence of septa from the radials.

The larger specimen, No. 266, probably lay near the ground, since the longer branches all rise in one direction, though some stumps rise near the base on the supposed lower side, and the calices on this side are shorter and less crowded than on the other. On both sides they become much shorter basally than distally, as in all species, but here they project only about 0·5 mm. for the lower two-thirds of the main stems. In the four stumpy branches of the base, and in one 24 cm. above and pointing upwards, the axial calyx cannot be distinguished ; probably these branches ceased growth some time ago. In the remaining few ends it is just distinguishable.

For the curious irregularities of the radials I refer to the figures. A few near the ends of the branches attain a length of from 2·5 to 3 mm. and give some appearance of regularity ; but even here there are shorter and immersed calices, irregular in size and direction. These downward or sideways projecting tubulars are not mentioned by Brook, but can be made out in his figure. Similarly another peculiarity, the placing of the calices in groups or lines of three to six, in which their walls actually fuse, can be seen under a lens in Brook's figure. This grouping leaves small areas of coenenchyme free, exposing its characteristic coarse reticulation. The costal ridges are thin, but broad and continuous, not spinulate, extending on to the lip of the theca. They broaden as they pass downwards, so that the corallite appears slightly conical, but do not spread out on to the coenenchyme. Such spinules on the coenenchyme as there are, are broad and blunt : there are none on the costae.

The smaller specimen, No. 457, is only 19 cm. long. The apicals of 7 branchlets are present, those of the three main branches being lost ; though no larger than the adjacent radials they are distinct. These young branches are more slender and more pointed than those of the large specimen, though still blunt. In addition there are more pointed branchlets and longer tubulars, aborted branchlets, along one side of each main branch. These, and the irregular lengths of the same elsewhere give the corallum a very rough appearance, compared with which No. 266 is smooth. Otherwise the structures of both are the same.

Distribution : Great Barrier Reef only. Saville Kent collected five specimens ; not seen again till now.

Acropora pulchra (Brook).

1893. Brook, p. 44, pl. 28, figs. A, B, C.
1918. Vaughan, p. 162, pl. 66, figs. 1, 2, 3, 3*a*.

The collection contains 13 specimens, of which no two are even approximately alike. Evidently they have been carefully selected to illustrate the variation. Eight specimens have been labelled by Matthai, one each as variations *alveolata* and *stricta*, and four others with a ? mark. One is not named. The usual colour is given by Stephenson and others as brown, with pale blue tips ; but No. 217 : " 0. outside Low Isles. yellow tipped." This is an extreme variety, but colour may or may not be a specific distinction, as noted in the introduction, each case should be considered separately.

Only one specimen (No. 370, Lizard Island, A. Reef) corresponds exactly with Brook's description and his and Vaughan's figures (though Brook's is a mere fragment and he gives no enlarged photographs.) It is a curved stem, 23 cm. long showing numerous round, open and nearly immersed calices, especially in the lower half. Here also, in some cases, septa are fairly developed, whereas in the upper parts one directive alone, the upper, is usually conspicuous, the other septa rudimentary, as in the type. The calices are ridged outside, the ridges passing into a reticular coenenchyme, broken up on the surface into " dot and dash " granules. At the base of the stem this granulation becomes more regular, but never fine and even, as in the form described later.

Acropora pulchra var. *alveolata* Brook.

No. 91, thus labelled by Matthai, is like the type in having branches that ascend at about 30°, but differs in its " nariform or half tubular " radial calices ; these are much less like those of the type in Vaughan's figure than of this specimen. Brook also says that the inner directive is often broader than the outer, which is very rarely the case here. In short, the characters upon which Brook founds his variety are variable.

Acropora pulchra, var. *stricta* (Brook).

(Plate XXXIV, fig. 2.)

No. 92 is thus named by Matthai and with it I consider No. 280, from the reef crest, at the north end of June Reef. They differ from all the other specimens in being more frequently branched, the branches thinner and set at a wide angle with the main stems. They are " more slender and tapering " but the larger calices are not more distant : in fact in No. 92 they are rather crowded. " The septa are better developed in the radial corallites " in some cases ; in others no better developed than in the type. The larger radials in No. 280 often run in rows. They are nariform, as in var. *alveolata*, but a few on the backs of the branches are tubular.

The differences between the variety and the type are probably ecological (see Mayor's experiments given by Hoffmeister, and here quoted under *A. hebes*).

Acropora abrotanoides (Lamk.)

1893. Brook, p. 56 (no figure).
1918. Vaughan, p. 166, pl. 68, figs. 1, 1*a*, 2.

Specimen No. 286 corresponds with Brook's description and Vaughan's figures, the only ones existing. I add that the axial septa, though broad, are thin, and that the secondaries tend to bend and fuse to primaries ; of these septa, the directives and sometimes two others meet. Radial directives may meet deep down, with a thickening at the junction. Immersed calices with a low, ring-shaped wall ; septa represented by directives (which may meet) and rudiments of others, or all may be rudimentary. Axials with small buds near apex ; long tubulars with small buds, or forming short branchlets.

Specimen B.M. 293 (no G.B.R. locality) consists of two thick stems, one now lost rising from a broad incrustation, 4·5 × 5 cm. on one side, and about 4 × 3 cm. on the other. The remaining branch is 25 mm. thick—the lost one 22 mm.—and 60 mm. high. Half-way up it gives off three branches and some small stumps. The specimen is evidently a surf-swept dwarf.

The interesting part is the incrustation: this bears 3 stumps, 1 cm. high and thick, but elsewhere is closely covered with thick-walled, short, tubular calices, generally 2 mm. thick, but varying to small and nearly immersed. Here and there can be made out indistinctly little rosettes, in which an axial is surrounded by, or bears, a few irregularly placed radials. All these calices, even the asymmetrical ones, but not the very small immersed ones, in which the septa are very narrow, have well developed septa meeting a columellar mass. Septa in the calices of the branches may meet, but there is no columellar mass. The species is near to *A. danai* and *A. decipiens*; but Vaughan finds it distinct, as did Brook.

Distribution: Singapore; Great Barrier Reef; Tahaiti.

Acropora affinis (Brook).

(Plate XXXIV, fig. 1.)

1893. Brook, p. 60, pl. xxviii, fig. F.

This species, though very distinct and conspicuous, is recorded only by Brook. This is true also of his allied species *A. gravida*, which is doubtfully the same as *A. brachyclados* (Ortman). The collection contains two remarkable specimens, of special interest, since all Brook's nine specimens are either very young or only terminal branches.

The Great Barrier Reef Expedition's specimens are massive branches; No. 356 (without locality) 50 cm. long, 6 to 8 cm. thick; No. 384 (from June Reef) 43 cm. long 8 cm. thick near the base, about 6 cm. over most of the rest. These branches are irregular both in direction and thickness; in No 384 the lower 6 cm. is decayed, and only 3·5 cm. thick at the bottom. It seems likely that these are branches from large growths which must have been very conspicuous. A peculiar feature of both, most marked in No. 384, is that forks of the main branches grow parallel and close together without fusing before diverging, so that the fork is divided by a deep and narrow slit.

Probably because these are fully grown specimens there are some divergences from Brook's description. In No. 356, but not in No. 384, the branchlets of the main stem, but not those near the apices, are often in groups of 3 to 5; or the branchlet thickens, and bears branchlets of nearly equal size at its base.

Secondly, both in axials and radials of both specimens, the septa on the twigs on the main stems and those near the apices are quite well developed, though narrow, as in *A. gravida*. In all other respects, however, both correspond exactly with *A. affinis*, as described by Brook.

Distribution: Great Barrier Reef and Macclesfield Bank only.

Acropora aspera (Dana).

(Plate XXXIII, figs. 2 and 3.)

1848. Dana, p. 468, pl. 38, fig. 1.
1893. Brook, p. 62.
1886. Quelch, p. 156.

The six specimens, Nos. G.B.R. 285, 66, 304 and B.M. 299, and two unlabelled, are low bushy growths, probably from shallow water (localities are not given). No. 304 is a remarkable contrast, consisting of long branches, more gently tapering, evidently grown under more free conditions. This is from the outer barrier of June Reef, presumably from the "madrepore field" where the end of the reef dips into deeper water. It affords an exact parallel to the experiment Mayor made in Samoa with *A. hebes*.

Dana's is the only figure, but he was interested only in the expanded polyps: the branchlet showing the skeleton was merely sketched in. It is therefore advisable to expand the description, particularly of the septa.

The blunt-ended branches are given as characteristic, but, as noted, this is not invariable. Besides in No. 304 there are some tapering branches in Nos. 0, 1* and 285, in which most are typically blunt-ended. The thin-walled, generally fragile (Dana's term), short, rounded, labellate radials are characteristic. They are never tubular, or even partly so, the upper wall being at most a mere ridge, though in No. 304 they are longer, and some have the upper wall distinct. Many are small and sub-immersed, on the lower parts completely so. A peculiarity of these smaller radials, not hitherto noted is that they are often placed in close relation to the bases of the larger calices, and in many cases a little way up their walls, but usually one only is so related to, or budded from, a larger radial. The axials are described by Brook (in Quelch's specimen) as "often with a large deep funnel-shaped cup." I find that though a few are almost without septa they generally have six primaries and a variable number of secondaries. No. 66 *e.g.*, has axial septa as follows; they are all very thin, and often bent.

Axial calices.	Septa.
5	6 primaries, meeting.
2	6 primaries, meeting; also some rudimentaries.
1	6 quite regular primaries, meeting; and 6 smaller.
2	6 primaries and 10 others, all very narrow.
2	Too irregular to count.
2	7 irregular.

In No. 304 the arrangement of septa is :—

Calices.	Septa.
3	Quite irregular.
1	8 long and 6 short, the former with irregular fusions.
1	6 plus 6, all short.
1	6 plus 0, all short.
1	4 short and 2 directives.

In No. 285 the septa are irregular and very thin, often so deep down as to be hard to see. In a few calices they number 6 plus 6, with primaries meeting; but generally none meet.

Dana says (apparently of the radial calices), "star very short rayed, the directive septa prominent." In No. 285 most radials appear empty, or with narrow directives, but low down the larger calices can be seen irregular, not countable septa. Sometimes

* An unlabelled fragment. [A.K.T.]

there are very narrow ridges at the tops of the cups. The immersed calices of the lower parts of the specimen generally show very narrow septa ; but they are irregular in size and number. In other respects, *e.g.*, character of the coenenchyme, the specimens agree with Dana's and Brook's descriptions.

Distribution : (as given by Brook) : Philippines ; New Hanover ; Great Barrier Reef ; Fiji ; Rotuma.

Acropora digitifera (Dana).

(Plate XXXV, fig. 2.)

1846. Dana *Madrepora digitifera*, p. 454.
1893. Brook *M. digitifera*, p. 75.
1902*a*. Verrill *Acropora digitifera*, p. 228 ; pl. 36, fig. 12 ; pl. 36B, fig. 3.
1918. Vaughan *Acropora* (*Tylopora*) *digitifera* (Dana), p. 175, pl. 76, figs. 1, 1*a*, 2.
1918. Mayer, pl. 13, fig. 7.

This species has been thoroughly described by the above authors. Neither Dana nor Brook give figures, but Verrill photographs portions of the type, correcting Dana as to the thickness of the axials. Vaughan and Mayor figure Murray Island specimens. Vaughan's fig. 1 shows a more straggling bush, with rather more tapering branches than the specimen here, which is more like Mayer's figure.

The present specimen, No. 308 ("Lizard Island, 3.6.29. A. Reef. Mad. L.") is a compact bush, with stout upright branches, 15 mm. thick and 7 to 8 cm. long, corresponding exactly to descriptions except that the immersed calices among the ordinary radials are few, and generally not completely immersed. It is labelled by Matthai "*Acropora gemmifera* (Brook). This is really *A. digitifera* (Dana)" In spite of the close resemblance of the upper parts of the branches above the characteristic lateral branchlets to those of *A. gemmifera*, the different form of growth alone is a real specific distinction from that species. This view is supported by Stephenson and others' photograph on pl. 24, showing numerous specimens of *A. spectabilis* (or *gemmifera* ?) growing in sheltered water behind the edge of Yonge Reef, none of which show a bushy growth. By contrast S. Manton's pls. xiv and xv show both corymbose and bushy specimens of "*A. gemmifera*" scattered over exactly the same habitat, proving that the different forms are not due to any influence of the habitat. The bushy forms are in fact, a distinct species, *vis.*, *A. canalis.*

Distribution : Great Barrier Reef (Murray to Capricorn Islands), Madagascar ; not recorded east of the Great Barrier Reef.

Acropora haimei M. E. and H.

(Plate XXXIII, fig. 1 ; Plate XXXV, fig. 1.)

1860. Milne Edwards and Haime, p. 151.
1879. Klunzinger, p. 21, pl. i, fig. 9 ; pl. v, fig. 4 ; pl. ix, fig. 16.
1893. Brook, p. 77.
1906. Marenzeller, p. 51, pl. xvi, figs. 45–48.
1918. Vaughan, p. 164, pl. 66, figs. 4, 5.

Klunzinger regards his identification of the Red Sea specimens with Milne Edward and Haime's three-line description as safe. Brook mentions the type, but says nothing of the "orifice ovalaire ou même presque linéaire" : he only says that in some specimens it is circular on the edge of the colony. None of the three, nor Marenzeller, say anything about the septa. Klunzinger's figure shows a surf-swept dwarf, though he says, " Die Kolonie hat verscheidenen Habitus ; bald ist sie (das häufigste) rasen oder rosetten-formig und meist viel sprossig. . . . " That the turf-like forms are the most common is what would be expected at Koseir : they are not common at other places where there is shelter. more bushy growths are illustrated by Marenzeller, who, as usual, gives no reason for his inclusion of these widely differing forms in one species. (His fig. 46 shows a dwarf form again, but it is recorded from Sherm Sheikh, Sinai, which is completely landlocked. Probably it is really from outside the Sherm.) In Vaughan's specimens, both of the species and of its variety, the radials are " very slightly or not at all compressed." He mentions the presence of two complete cycles of septa in the radials, which I find a somewhat striking feature of the Great Barrier Reef specimens.

These two specimens, named by Matthai, Nos. 296 and 234, are, to the naked eye, as different as two species could well be, both in growth form and in the regularity versus irregularity of calices and branches. No. 234, labelled "T2 shallow Bush," is a single stem 18 cm. long and 10 mm. thick throughout its length, with branches at angles of 15° to 30°. It is most like Vaughan's pl. 66, fig. 4, while No. 296 rather resembles pl. xvi, fig. 48 of Marenzeller. As the differences are so very striking and resemblances to published figures not complete I give a figure on Plate XXXV, and remark that I cannot feel satisfied with these determinations without having the evidence which Marenzeller withholds, and that to be gained by further work on the reefs.

Distribution : Apparently common in the Red Sea ; but, in spite of its wide distribution, rare elsewhere. It is not recorded from Samoa, Malaysia or the Philippines, nor from the Great Barrier Reef until 1918.

A. tubigera (Horn).

1902*a*. Verrill, p. 239, pls. 36, 36A and 36F.
1893. Brook, p. 79.

Specimen 65 is complete, spreading horizontally from a base on one side, and is 17 cm. long, 18 cm. wide, and 9 cm. high.

This specimen is not translucent, as were Verrill's Singapore specimens, but the coenenchyme is hard and strong, though broken branches show circles of spaces radiating from the distinct, imperforate wall of the axial calyx. " The main branches . . . branch dichotomously." As there is no figure of the whole corallum I do not feel sure that " dichotomous " is here used in its strict sense ; if it were the corallum would be I think, unique in the genus. That " the distal calices are about as large as the axial, or even larger," is another apparently abnormal state of things, but the figures show nothing unexpected. Otherwise the description is thorough and good.

I am doubtful whether the distinction Verrill makes between his specimens and Brook's is valid. This one seems to be intermediate in the solidity of the coenenchyme, and there is little difference between a short, adpressed, tubular radial and a round, nariform one. The inconspicuousness (not absence) of the second cycle of septa in the radials is, in this species, a minor detail, since, though most radials show them distinctly, in some others all the septa are much reduced.

Distribution : (including Brook's specimens) : Singapore to Louisiade Archipelago, (just east of Papua). Now Great Barrier Reef.

Acropora quelchi (Brook).
(Plate XXXVI, figs. 1–3.)

1893. Brook, p. 90, pl. 32, figs. D, E.
1907. Bedot, p. 256, pl. 41, figs. 225 to 234.
1932. Thiel, p. 119, pl. 14, fig. 3.

Quelch (under the name *M. effusa*), Hoffmeister and Faustino also record the species, but without description or figures.

The species is not very easily distinguished from *A. loripes* except by growth-form though Brook places them in different sub-genera (*Polystachys* and *Conocyathus*); but these are separated only by details of the axial calices, which are often variable, as in, *e.g.*, *A. rosaria*.

A. quelchi is " half vasiform from a lateral stalk." Only one of this series of 9 specimens, No. 272, is complete, and this is more bushy than vasiform, (Plate XXXVI, fig. 3), but it evidently grew on the side of a vertical support, its branches bending upwards at an apparent angle of 80° with the horizontal. At the other extreme are specimens which are clearly portions of flattened horizontal growths in which long and comparatively simple branches are connected by flattened fusions, the ends of which turn up at an angle of 30° or so. No. 305 is intermediate between these extremes, but is much nearer to the bushy form, No. 272.

I divide the series into four forms; they may, in fact, be distinct species, but only evidence from the reef can decide. Almost all are like var. *paradoxa* Brook (which Brook thought might be a separate species) in having " swollen hemicotyloid " instead of wart-like theca among the adpressed tubulars of the lower parts. But I find no axial rods formed by fusion of primary septa in immersed calices in any specimen; in fact none are perfectly immersed, all having more or less projecting rims.

Form A.—A more or less prostrate bush, with numerous long, upwardly bending branches, bearing few lateral branches, and those very short. Long, spreading radials, in distinct rows, over most of the upright parts. In specimen 272 the branches are from 5 to 7 cm. long, tapering, and with fairly prominent axials projecting from 2 to 2·5 mm., 2·5 mm. thick externally, with cavity 1 mm. deep.

No. 305 is distinctly of the corymbose form, very like Thiel's figure; branches shorter from 4 to 5 cm., and reaching to the same level above; underside with numerous short branches, the ends of which are more or less horizontal (more so than in 272). Axials exsert only 1·5 mm., *i.e.*, " scarcely prominent " as Brook says for his var. *paradoxa*, 3 mm. thick, cavities 1 mm. deep.

The axials differ from those in *A. quelchi* as described by Brook, both specimens having only 6 primary septa, as in Thiel's specimen, rarely with from 1 to 3 rudimentary septa of the second cycle; but the primaries do not meet, and are " subequal and not very prominent." The septa of the radial calices usually consists of directives, and narrow, almost rudimentary laterals formed of rows of spines; sometimes some of the second cycle also present

Coenenchyme finely echinulate, everywhere in rows.

Form B.—Specimen 279; growth form resembling No. 305, but branches longer in proportion, and the development of branchlets on the lower side much less marked. The whole specimen is very light and fragile; horizontal branches 12 mm. thick, those bending towards the vertical only from 7 to 8 mm. at base and 5 mm. at a point 2 cm. below their finely tapering ends.

Axials 2·5 mm. exsert, 2·5 mm. in external diameter; owing to the long tapering branches they appear much more prominent than in any other specimen. Their septa number 6 plus 6, are thin and often bent, and may or may not meet, and directives are distinguishable.

Radials thin-walled, much compressed and lips not rounded; their openings long and narrow, but tubulars with short openings are also common. Septa well developed, the second cycle well represented. Radials stand well out from the stems and are in distinct rows.

There are a few incompletely adpressed tubulars with round openings at the bases of the stems, but no hemicotyloids, and the rims of the subimmersed calices project well.

No. Z3 comes nearest to this specimen in delicacy of build. Like all the others, except No. 272, it is unfortunately only a fragment. The underside is distinguishable by a few short horizontal branchlets. The main stems are short and give rise to from 1 to 4 terminal branches, which are straight or only very slightly curved, so that the form is not markedly corymbose. Branches taper, from 8 to 10 mm. thick at base, from 3 to 5 mm. above.

Axials 2·5 mm. thick, only 1 mm. exsert, and so not at all prominent; cavities 1 mm. deep. Their septa generally number 6 plus 4, occasionally 6 plus 1 to 3, none meeting; directives not distinguishable. Radials long, spreading and in distinct rows, and mostly distinctly tubular with short oblique openings. Their septa well developed, though laterals may be rows of spines, usually 6 plus 0, but there may be from one to three secondaries; the outer directives are the larger. In the lower calices the arrangement is the same, but directives not prominent in the subimmersed calices, some of which appear almost empty. I have found only one " swollen hemicotyloid " in this piece, and, even on bases of branches, the shorter tubulars are not completely adpressed and the free tubulars are to be found almost to the bottom of the colony.

These two specimens, though differing so much, seem to agree on the whole. I keep them as a form of *A. quelchi* out of deference to Matthai's labelling, being myself inclined to regard them as distinct species. Only work on the reef can decide.

No. P.4 may come here, but there is not enough of it to show the mode of growth. It has completely immersed thecae basally, and for some way up the branches which are practically straight.

Form C.—includes Nos. 34, 35, 80, and 284*x*. They are all distinguished by their thick horizontal branches, crowded with adpressed or partly free tubular thecae, which, in No. 284*x* are mostly " swollen hemicotyloids." This specimen is from June Reef anchorage, and is much larger than the others, which have no locality record and so may be presumed to be from Low Isles: They have none of the broader, basal stems. In none of the four are any of the branches nearly vertical, the main stems being bare almost to their ends. The undersides of 35 and 284*x* bear blunt, abortive, horizontal and flattened branchlets with fusions, thus approaching the completely corymbose form much more closely than do the preceding forms. The same structures are less marked in Nos. 34 and 80, but they may have been equally well formed in other parts of the coralla. On the uppersides near their ends the horizontal branches bear a few slightly raised branches, only a little thinner than themselves, and somewhat blunt.

The axials of the first three are 2·5 mm. in outside diameter, and exsert from 1 to 2 mm., but No. 284 has axials 3 mm. in diameter, exsert only 1 mm., the internal diameter of all calices measures 1 mm. as usual. Their septa number 6 plus 6, secondaries being very thin. The radials are thick-walled (especially the lower lip) ascending, tubular, and not clearly in rows. Mouths on upper radials compressed oblique, well enclosed by the swollen lip ; round or oval in the lower radials ; some half-free tubulars occur among the compressed mouths low down the stems in No. 35 (the smallest fragment, only 55 mm. long, so that the real basal stems are missing) but hemicotyloids occur in all. The septa number 6 plus 0, sometimes with two of the second cycle. Laterals all narrow, formed of rows of spines. Coenenchyme well spiculated, usually in lines, and thecae striate throughout their lengths.

Owing to the great variation in growth-forms according to habitat, there has arisen a tendency to regard growth form, *in all cases*, as of little specific meaning. This tendency may have been exaggerated, and I am inclined to regard it here, along with other details, as quite possibly sufficient grounds for specific distinction.

Form D.—Three specimens, Nos. 70, 81 and 101, are fragments distinguished by their thick blunt branches and short and greatly thickened radials, though the axials are of the usual proportions. This general thickening involves the septa, which are thicker and longer than usual, the primaries of the axials and the directives of the radials almost meeting.

In the absence of ecologic or other information I do not feel any certainty that these fragments are really of this species ; two of them are labelled *A. quelchi* by Matthai.

Distribution : Amboina, Banda, Solomon, Philippine and Samoan Islands. Now Great Barrier Reef.

Acropora corymbosa (Lmk.).

Specimen No. 375 (June Reef, Patch No. 1, square 12) corresponds well with Klunzinger's description, but the axials and the tubulars of the underside are longer, 4 to 8 mm. and 8 to 10 mm. respectively. It is most like his fig. 2b, Taf. ii, but this specimen is of regular shape, and the ends of the branches on the upper surface all of the same length. It does not correspond well with any of Marenzeller's figures, or those of Hoffmeister, Vaughan or Thiel. The large number of twigs and tubular axials on the sides of the branches near their summits seem to indicate that it is a young specimen which would have grown into a corymbose shape.

The septa are described only by Brook ; this specimen corresponds. The shapes of the radials are as the outlines of Klunzinger's Taf. ix, fig. 19, except that the curious form " *c* " has the narrow end distal, not proximal as in Klunzinger's sketch. Otherwise they are so similar and so striking that the difference is evidently due to a slip on Klunzinger's part.

Marenzeller gives few details of his specimens, and, as in some others of his determinations, I consider that his work needs confirmation—work best done on the reefs.

Distribution : One of the few species found throughout the whole Indo-Pacific, including its extremes, the Red Sea and the Tuamotu Atolls.

Acropora armata (Brook).

(Plate XXXVII, figs. 1 and 3.)

1893. Brook, p. 100, pl. 10, figs. A, B.

Two specimens are both labelled *A. delicatula* by Matthai, and I have difficulty in distinguishing these species by following Brook's descriptions, the main difference being the form of growth. *A. delicatula* is bushy, without a stem, and with long curving branches of irregular length. Should further research bring these species together (and, from what is said on development under *A. hyacinthus*, this is not very likely) the name *armata* would have the priority as it was the first described species.

Only specimen No. 238 is complete with the stem. To it the plate-like portion is eccentric and oblique, corresponding with Brook's figure and description. I may add that the tubular axial calices thereon are up to 4 mm. thick, those of the underside of the oblique branches at most 2·5 mm., while those of the upperside measure only 2 mm. Their openings measure 2 mm., 1·5 mm., and less than 1 mm. respectively.

The stem of No. 76 is unfortunately missing, but it seems to have been oblique. I regard specimen No. 76 as belonging to the same species as No. 238, though it differs markedly in several ways :

(1) In general appearance of the upperside the axials long, slender and exsert in No. 238 are not prominent in No. 76, but it is to be noted that these axials are not so much exsert as they appear, as all bear minute buds 1 mm. or less from their apices. In a few cases those of No. 76 are exactly similar.

(2) A much more important difference is in the upright branches, which, in No. 238 are often 1 cm. thick at the base, thickening still further higher up (Plate XXXVII, fig. 3), where they divide into from two to five very slender tapering branchlets. The appearance of these thick bases suggests fusion of a group of long slender branches such as those of No. 76.

(3) The thicker, downwardly directed, tubular axials and abortive branchlets of the underside are much longer in No. 76, being from 7 to 10 mm in length.

The septa of the axials are not mentioned by Brook for either species ; in No. 238 there are two cycles nearly complete, but in No. 76 only the primaries ; in both, primaries are about half the radius wide, and one directive is broader.

In other details, such as the very distinct straight costulae, correspondence with Brook's description is complete. The inturned lips of the upper radials are characteristic. Seen from the side they give the radials a claw-like outline. Brook had eight specimens, apparently all in good agreement.

Distribution : Singapore, Diego Garcia (Indian Ocean), ? Tahaiti. Now Great Barrier Reef.

Acropora armata Brook var.

(Plate XXXVII, fig. 2.)

Certain small bushy specimens are referred to by Stephenson and others on p. 83, under the name *A. delicatula* as follows : " Apart from these more or less solid forms of *Acropora* on the outer ridge of Yonge Reef a totally different species occurring particularly on the sides of clefts, makes small rounded bushes of branches so slender and brittle that an entire specimen can with difficulty be obtained—yet this form can withstand the breakers."

Three of the four specimens are from June Reef, Nos. 335 and 359 from the outer moat, and 326 from the outer ridge; but there is no doubt that these are the same as those referred to. They are all labelled *A. delicatula* by Matthai, and it is certainly likely that they are stunted specimens, modified by the environment. At the same time there are differences not likely to be due to conditions, and it is quite possible that more than one species would be modified in the same way, and so converge by simplification.

Besides the fact that the branches rise more or less vertically from an encrusting base, with no trace of a stem or main horizontal branches (though there are long tubular calices and abortive branchlets round the edge of No. 326), the axial calices are thick-walled and costulate, costulae forming only fine lines in the ordinary way. The openings of all calices measure 1 mm. in diameter; but externally calices are 3 mm., 2·52 mm. and 2·3 mm. thick in Nos. 326, 359 and 335 respectively, the thicker axials corresponding to rather thicker branches. The septa differ in No. 326 numbering in the axials 6 plus 1 to 3; in Nos. 359 and 335 there are often 6 secondaries. In all, the directives meet low down and are nearly joined by the lateral primaries. The radial calices are fairly thick-walled, lamellate or nariform above, *elongated*, adpressed, tubular below; immersed calices found only quite at the bases of the branches. They contain 6 septa, all narrow, and in No. 359 some secondaries. These details seem to indicate that we are dealing with another species, but it is not possible to be certain on the evidence. I can only point out that in other corymbose forms the disappearance of the stem from exposure to the rush of spent waves (not to the breaking waves, under which, in Tahaiti, *Acropora* does not live) does not result in a bushy growth, but in the fusion of horizontal branches and reduction of the length of the upright branchlets.

Acropora glochiclados (Brook).

(Plate XXXIX, figs. 1–2.)

1893. Brook, p. 104. (No figure.)

This species, represented by one specimen, No. 64, differs from *A. aculeus* Dana in its larger branches and much larger radial corallites, and in that the "surface and walls are striate and echinulate," the echinules being fine and pointed. Whether these characters are specific cannot be said without further evidence. The fact that this specimen, in the sizes of the radials, comes nearer to *A. aculeus* is not sufficient alone. The radial calices are 2 mm. in diameter and 3 mm., rarely 4 mm. long; walls moderately thick except near the stem, apertures nearly round; with 12 septa so well developed as to be visible to the naked eye: directives meet deep down, the other primaries nearly meet. Axials hardly 1 mm. exsert, their outside diameter 2 mm., inside 1 mm.; walls spongy, costulate, 2 cycles of septa well developed.

As this species has never been figured, and *A. aculeus* not since Dana's time, I give two photographs on Plate XXXIX.

The branchlets below the main branches are much longer than in Dana's figure of *A. aculeus*, and so, presumably than in his specimen of *A. glochiclados*, I should emphasize the striation of the thecal walls, with their fine-pointed echinulae, both of which become coarser on the coenenchyme of the main branches. The thecae "shorter and subimmersed below " according to Brook, on the main branches are completely immersed but for a low rim proximally.

Distribution : Brook had only one specimen, from the Indian Ocean. If *A. aculeus* is synonymous with *A. glochiclados*, add Philippines, (?) Fiji, (?) and China Sea. Now Great Barrier Reef.

Acropora surculosa (Dana).

(Plate XXXVIII, figs. 2–5.)

1848. *Madrepora surculosa* Dana, p. 445, pl. 32, figs. 4 and 5.
1893. *M. surculosa* Brook, p. 104.
1893. *M. recumbens* Brook, p. 106, pl. xxvii, fig. F.

The three specimens of this species, Nos. 287, 288 and 339 (all with the additional mark W.2), form a very interesting series showing the variation in solidity of the base of corymbose species and the structure and delicacy of the branches and calices induced by exposure to the surf. This series begins with a netted plate ; then one with slits remaining between the branches ; and finally a solid mass, 28 mm. thick at a distance of 5 cm. from the edge, with 3 slits 3 cm. long near the margin. (cf. Crossland, 1928, p. 723, pl. ii.) These effects are sufficiently shown on Plate XXXVIII, but those of the detailed structures of calices, etc., need verbal description. The figures show, however, the great variation in the thicknesses of the branchlets.

I have no direct information of the conditions under which these specimens grew. No. 287, the most open form, is from a " Nigger Head " off June Reef, while Nos. 288 and 339 are from the outer moats of June and Ribbon Reefs, all parts of the outer barrier. These more massive forms have the more delicate thecal walls ; in 288 they are very delicate and perforate, in 339 less so, in 287, though still delicate and porous, the lower ones are distinctly thicker. Similarly the development of the septa : in all the axials there are six rather narrow septa, of which the directives are broader ; with, sometimes, representatives of the second cycle, best developed in No. 287, where the directives may meet. In the radials twelve narrow septa are well developed, the lower directives not much broader. In No. 339, the most solid, most radials are quite empty, or with a narrow lower directive, though a few show rudiments of the others. In No. 282 very few radial calices show any traces of septa.

Matthai has labelled Nos. 287 and 288 as *A. arcuata*, apparently regarding this as a synonym of *A. surculosa*. Brook's description of this species is overmuch occupied with its horizontal growth form, but there are differences in the shapes of the radials, etc., which separate the species, at least until a more complete comparison is possible. No. 339 Matthai labels *A. baeodactyla*, a caespitose form differing also in similar details. This specimens corresponds well with *A. recumbens*.

Distribution : From Mergui (Indian Ocean) to Tahaiti.

Acropora macrostoma (Brook).

1893. Brook, p. 105, pl. xix, fig. B.

Specimens No. 240 "i W moat" and 99 are too young for certain identification, and the group of species to which this belongs needs revision. We know little about the possible changes which occur during later growth. Both these studies can only be properly done on the reef.

The correspondence with Brook's description is, however, exact, except that only the youngest corallites have walls very thin, though all are spongy, and the growth form of these young examples is purely caespitose, the base being nearly as broad as the area covered by the branches.

Distribution: Recorded only from Mauritius, but probably already brought from The Great Barrier Reef of Australia under some other name.

Note on *Acropora hyacinthus* Dana and *A. cytherea* Dana.

1849. Dana, pl. 32, fig. 2.
1925. Hoffmeister, pl. 13, fig. 3, and pl. 14.
1924. Mayor, pls. 2, 3, 5, 12, 19 and 20.

Neither species is present in the collection, though Stephenson and others mention the former on p. 83, and on pl. 24 show very large corals given this name ; and S. Manton has a number of references. Dana's species differs from the above figures not only (1) in the branchlets of the lower surface but (2) in having thicker and shorter branchlets above, also (3) in the radial calices which are " not fragile, lip not at all flattened," and (4) in the axials being short.

Stephenson's (1931) beautiful photograph (pl. 24) of the top of a Paradyce pillar to leeward of Yonge Reef is very suggestive of *A. cytherea*, apparently showing the branchlets in the little clusters characteristic of that species. In Tahaiti both *A. cytherea* and the species figured by Hoffmeister and Mayor are common. *A. cytherea* alone grows to sizes similar to those in Stephenson's photograph, *i.e.*, usually 1 to 2 metres and more across, the species figured by Hoffmeister and Mayor to a foot or two at most. Hoffmeister describes the young colonies of his species as bushy, but Mayor's figures as well as his own show that the future formation of an excentric stem is indicated at a very early stage : there is nothing like the small bushy or caespitose forms tentatively included under *A. armata* here. One of the distinctions of *A. cytherea* is that the corallum begins as a stout pillar, in which fusion of branches is merely indicated by grooves. (My specimen of this stage from Tahaiti is at Cambridge.) The species differ also constantly in colour, *A. cytherea* being uniformly lilac pink, *A. hyacinthus* " brown purple with pink tips " (Mayor).

Hoffmeister's species is very near to *A. armata*, but differs (1) in having much more fusion of the branches, and especially (2) in that the tubulars of the underside are adpressed, and (3) the projecting branches of the stems, with their specially developed tubulars, are not found.

Acropora patula (Brook).

1893. Brook, p. 111 ; pl. ix, fig. E.

Sample No. 62, without exact locality, corresponds in every way to Brook's description except that the septa in the radials are more prominent. In the lower radials, where they are well developed both here and in Brook's specimen, it is the *upper* directive which is the broader.

The species is very near *A. latistella*, but differs distinctly in the nariform radials which " remain more or less slightly prominent quite to the bases of the branches " (Brook). On the main stems immersed corallites, 1 mm. and less across, are rather far apart, on the underside still more widely scattered. Tubulars bearing small buds are conspicuous on the underside, or on part thereof, and may be 9 mm. long, against 4 mm. in Brook's specimen, but this specimen, No. 62, is only from the edge of a specimen. I do not find the distinction Brook makes in "the condition of the surface." Both are strongly striate and somewhat porous. The Great Barrier Reef specimen of *A. latistella* perhaps is more echinulate, but there is no real distinction. A long series might lead to the merging of the species, but on present evidence they are distinct.

No. 63 may be this species. Branches much more slender; stouter, more adpressed radials; in this more like Brook's figure. Radials of equal size, meeting. No tubulars on underside.

Distribution: Like *A. latistella*, *A. patula* is known only from the Great Barrier Reef.

Acropora latistella (Brook).

1893. Brook, p. 112, pl. ix, fig. B.
1898. J. S. Gardiner, p. 261.
1925. Hoffmeister, p. 65, pl. 15, figs. 1*a*, 1*b*.

No. G.B.R. 85 is easily recognized by the naked eye from the characters and distribution of the radial calices alone. Further examination shows complete agreement with Brook's description, especially since the strongly developed septa are in two cycles in the radials—a rather rare character; suitably lighted the septa are often visible to the naked eye.

Brook says, "Radial walls of moderate length, but becoming reduced to a crescentic rim near the base of the branchlets." In most cases the crescent is a complete circle, the inner wall generally well formed, as is quite well shown in Brook's figure. The projecting labellate radials are found only near the tops of the branches. As their walls are thin the subimmersed calices are very open and conspicuous.

Distribution: Great Barrier Reef of Australia, Funafuti and Samoa.

Acropora squamosa (Brook).

1893. Brook, p. 120, pl. xx, fig. B.
1918. Vaughan, p. 173, pl. 72, figs. 1–3.

Seven fragments broken from the edges of corymbose plates, and showing underneath the short irregular horizontal branchlets the fusion of which forms the plate; and one larger fragment, possibly the fourth part of the colony. The numbers are P.12, 90, 105, 336, 236 and 285, the larger specimen being No. 107. No. 396 is from A. Reef, Lizard Island. No. 109 is complete though small, 13 cm. across.

For relationship to *A. sarmentosa* see Vaughan, p. 174, and to *A. hebes* under that species on p. 133.

In No. 285 the branches are thinner than usual, and there are no plate-forming branchlets beneath; but the stems are procumbent, and all calices on the underside are immersed. Higher up branches fuse twice; they are not in actual contact, but the narrow space between them is bridged by outgrowths. The specimen is thus more like Brook's than Vaughan's, and so less like *A. sarmentosa*.

No. 107, the larger piece, and No. 396 correspond well with Brook's figure. Brook says: "Axial corallites cylindrical, 2·5 to 3·5 mm. in diameter, wall thick, star very well marked, the directive septa rarely more prominent than the others." In specimen No. 107, in which none of the more central branches are present, the axial corallites are fairly regularly 3 mm. in external diameter, the mean of Brook's measurements, but the thick walls reduce the thecae to 1 mm. internal diameter. The axial septa are distinct but narrow: usually the primaries alone are present, and even this cycle is sometimes incomplete; but, on the other hand, rudiments of the second cycle are sometimes visible. I have seen broader directives only once in No. 107, but they are usual in No. 396.

The septa of the radials are always narrow, sometimes quite rudimentary, and the lower directives not always prominent; so in this specimen the conditions that Brook found only on the central branches are here present on the outer ones.

Certain branches on the central side are remarkable in having the axial calyx filled up with coenenchyme. They are not otherwise deformed or stunted in any way. The same thing is found in some specimens of, *e.g.*, *A. variabilis*.

Distribution: "East Indies" (Dana), Great Barrier Reef of Australia.

Acropora hebes (Dana).

1848. *Madrepora hebes* Dana, p. 468, pl. 35, fig. 5.
1893. *Madrepora hebes* Brook, p. 128 (no figures).
1918. *Acropora hebes* Vaughan, p. 174, pls. 73 and 74.
1925. *Acropora hebes* Hoffmeister, p. 57, pl. 9, figs. 3*a*, 3*b*.

Five small specimens correspond to the above descriptions and figures, *viz.*, Z.7, Low Isles moat; B.M. 278; B.M. 294; B.M. 288 (the last three have no G.B.R. number or locality) and G.B.R. 294 (B.M. 35) with long lax branches.

No. Z.7 (B.M. 50) is especially interesting, as it corresponds very closely with Dana's figure, and to Vaughan's photograph of Dana's type. The fact that it has been labelled *A. squamosa* by Matthai shows that these two species differ only in (1) mode of growth, (2) the greater regularity of the arrangement of the radial calices, and (3) the absence of immersed calices among the usual exsert ones in *A. squamosa*. The present specimen appears to be complete: four main stems (one now lost) rise from a common base and the whole is 8 cm. high, being thus, as well as in detail, very like Dana's type. But his type has more regularly arranged radials and fewer immersed calices among them, thus being more like *A. squamosa* than is this G.B.R. specimen Z.7.

In larger specimens the form of growth is a decisive specific difference. Such a colony as Z.7 might be imagined to grow up into a corymbose form; but this is no reason for merging branching and corymbose species until evidence *for each case* has been produced, since it is the rule throughout nature that almost identical young forms differentiate as they grow older.

Sample 294 (B.M. 35) differs remarkably from the above in its long lax branches, resembling Vaughan's pl. 74, fig. 2 of a specimen from Murray Island. Both Vaughan's figures and Hoffmeister's account of Mayor's experiments show that the ends of the branches may be blunt or tapering according to conditions of growth.

Vaughan's photograph of an apical calyx shows only twelve short septa, the description stating that the primaries meet deep down. I find that, though all six may meet, usually only four do, and they occasionally meet quite near the surface. For example, in specimen B.M. 294 there may be the twelve narrow septa shown by Vaughan; or the septa may be much broader at the top; from three to five primaries may meet quite a short distance down.

Distribution: Malacca, Murray Islands, Great Barrier Reef, Fiji, Samoa.

Acropora palifera (Lamarck).

1893. *Madrepora palifera* Brook, p. 131 (no figure).
1893. *M. hispida* Brook, p. 133, pl. ix, fig. c.
1907. *Isopora hispida* Bedot, p. 262, pl. 42, figs. 235–239.
1918. *Acropora palifera* Vaughan, p. 178, pls. 78 and 79 (all figs.).
1925. *A. palifera* Hoffmeister, p. 69 (no figs.).

The identity of *A. palifera* with Brook's *A. hispida* is shown by Vaughan who discusses other possible synonyms which might be proved by further collecting, but he had a good series of this species and, so far, finds it distinct.

Stephenson and others (p. 83, 85 and 88) refer to this species. Dr. and Mrs. Stephenson found it as encrusting sheets yards in extent on the outer ridge of Yonge Reef, in the anchorage coral zone ; and common " under several growth-forms " (some of which may be separate species) on most parts of the reef. It is a massive encrusting or lobed form unlike the other species of the genus. " Also on a reef near Lizard Island." S. Manton (p. 305) found it also in the moat of Yonge Reef and anchorage zone, her plates xv and xvi showing growths 27 cm. and 54 cm. across.

In comparison with these the samples brought home are very small, the larger 12 cm. and 14 cm. high. They are all from parts of the Outer Barrier, and all of the same species, though one (No. 322) is labelled *A. plicata* by Matthai. This is a solid plate with narrower plates at right angles. It resembles *plicata* in bearing low ridges, along some of which run lines of tubular calices resembling apicals ; but they are in contact with one another, have nothing resembling rosettes around them, and all the other calices have decidedly reduced upper walls and thick lower lips, the typical *palifera* type. There is little doubt that a larger collection would have contained *plicata*, which both Brook and Vaughan record from the Great Barrier Reef.

No. 317 is a cushion-shaped incrustation, 42 mm. thick (and therefore not a young corallum), very closely covered with short tubular thecae. It is labelled by Matthai " ? *Acropora ocellata* (Klz.) " but there are ecological as well as morphological reasons for regarding it as a form of *A. palifera*. It is unlike any of the numerous figures published. *A. ocellata* is a stumpy bushy form, and this specimen No. 317 *might* be a very highly modified surf form. If such forms occur in the Red Sea, Qoseir, where Klunzinger collected, would be an excellent locality for it, but apparently Klunzinger did not find it ; nor have I seen it, or anything resembling *palifera* at either Ghardaqa or Dongonab. Again, were such a reduction of branches possible under the influence of surf it would surely be found on the Tahaitian barrier edge, *where this influence is at its maximum ;* but from what I have seen there the utmost reduction would be to a form like *plicata*, with terminal calices and rosettes round them well traceable, as shown by me (1928) in pls. ii and iii. (Neither *A. palifera* itself nor any of its related species occur in Tahaiti, though *palifera* is recorded from Samoa.) I can only conclude that this specimen, No. 317, in spite of its numerous thecae with completely circular walls, among which those with incomplete walls on one side are less conspicuous, is a part of those encrusting bases referred to by Hoffmeister and the Stephensons. In this connection note Hoffmeister's remark on the variation in the septa ; in this specimen all the calices are practically empty, only small teeth at the margins perhaps indicating 12 septa.

Distribution : Diego Garcia (Indian Ocean) to the Philippines, Rotuma and Samoa. Murray Island and now Great Barrier Reef.

Acropora canalis Quelch.

1886. *Madrepora canalis* Quelch, p. 150, pl. ix, figs. 2, 2*a*, 2*b*.
1893. *M. canalis* Brook, p. 136.
1927. *A. canalis* Faustino, p. 275 (who only quotes Brook and copies Quelch's figures).

The species is characterized by a rather loosely arborescent growth, the main branches procumbent bearing upwardly curving branches. These are blunt, with thick-walled axials, 3 to 3·5 mm. in diameter, 1·5 mm. internally, hardly at all exsert. The radials are peculiar, in typical examples the lower lip projects beyond the narrower part containing the septa, is thickened and porous as drawn by Quelch, and this outer part is usually wider than the inner. The septa are well developed, two cycles even in the radials, though the second is usually incomplete.

The present collection of eight specimens varies in an interesting way. No. 100, the largest, 17 cm. across, is quite typical. Near it is No. 253, in which the radials have rather thinner lips and septa that often meet an irregular nodule representing a columella. No. 341 is also procumbent, as shown by the more immersed calices of one side ; but above has numerous short branches, only 15 to 20 mm. long, and thinner than in the type : the radials are smaller with thinner walls ; radial septa 6 plus in number and not meeting ; there is no rudiment of a columella. This specimen No. 100 is from the Outer Barrier, Ribbon Reef, inner moat (the preceding presumably from Low Isles), and probably owes its bushy form to rougher water.

No. 106 seems to have grown in an upright position. The branches are of normal thickness but more elongated and pointed. A few of the axials appear exsert, but they have radial buds close to the tops. The septa of the radials nearly reached the edge of the lower lip and are 6 plus in number ; but the *upper* directive is often prominent, and sometimes, deep down, a columella rudiment may be seen. No. 293 (" June Reef, outer Madrepore field, *Madrepore* E ") has four long (5 to 7 cm.) branches with prominent axials, which, under a lens, are seen to bear minute buds. The lower lips of the radials are generally thin, but still a little thicker than the rest of the wall ; the septa are degenerate, but the *upper* directive is the largest. No. 455 (E. Moat, Low Isles) is normal, except that the crowded radials and their short lips give the branches a peculiar appearance, almost like a honeycomb.

No. 282 (Outer Barrier, Ribbon Reef E. Anchorage) is peculiar in the thinness of its upright branches, and smaller calices. The axials are well exsert, but as in the preceding bear small buds, and their walls are rather thinner than usual. Radial septa well developed, 6 plus in number, upper directives sometimes conspicuous. Lower lip of radials as in preceding specimen.

No. 72 is abnormal, consisting of a branch which, having been broken off, continued growth and fused to the broken pieces upon which it fell. This fact may account for some irregularity in the sizes of the radials over a part of the specimen, their regularity elsewhere being a feature of the species. Its main branch is only 15 mm. thick (against 20 mm. in the type), apical branchlets 4 to 5 mm. (against 7 mm.), radials 2 mm. wide and long (not 3 mm.), axials 3·5 mm. and internal diameter 1·5 mm. as typical. Small radial buds appear immediately below the top of the axial calyx.

The thin branches of these two last specimens give them a resemblance to *A. aspera*, but the septa, among other details, show a constant difference.

Distribution : Philippines ; and now Great Barrier Reef.

Acropora fruticosa (Brook).

1893. Brook, p. 138, pl. xviii, fig. A.

Specimen No. 387 is thus determined by Matthai. It corresponds with the above description exactly, except that the axial calices are narrower, usually 3 mm. instead of from 4 to 5 mm. across, but, as we have seen in the case of *A. pacifica*, this feature is sometimes variable.

Brook says " Radial calices . . . a little compressed." This refers to their external shape, but the thickening of their walls makes their openings quite elongated and narrow, as may often be seen in his figure, though perhaps they are more so in this specimen.

Distribution : Recorded only from the Great Barrier Reef and Samoa.

Acropora spectabilis (Brook).

1893. Brook, p. 141, pl. xviii, fig. B.

The five specimens of this species fall into three sets. Three specimens labelled by Matthai are more like the type than the others in having thicker lower and side-walls of the radials : Nos. P.14 and 98 have the walls of the usual thickness, while those of No. 104, in which some of the branches are dead at the top, are only 1 cm. thick, and the radial septa are generally so narrow as to be difficult to see. In the other two the radial septa are much better developed, and a second cycle is visible. In No. 98 the primaries generally meet and the secondaries, though narrow, are complete ; in P.14 the colony seems to have grown in a crack, and is deformed into a vertical plate, and the two cycles are complete, but narrow. Two other specimens, Nos. 204 and 372, have slightly thinner walls to the radials ; and the septa of the radials, except the directives, are narrow, though quite distinct. They are small colonies, and less regular and flat on the upper surface, which may be an effect of youth, but the type specimen probably owes its short and regular branches to a surf-swept habitat. Compare pl. xxiv, fig. 2 of Stephenson and others, which most probably shows this species (not *A. gemmifera*), but with far longer branches than any brought home, the habitat shown being sheltered from the surf.

Distribution ; " The habitat of the type-specimen is unknown " (Brook). Now Great Barrier Reef.

Acropora gemmifera (Brook).

1893. Brook, p. 142, pl. xxi.

Specimen No. 337 (labelled by Matthai " ? *A. gemmifera* (Brook) may be *A. spectabilis*") comes from Outer Barrier, Ribbon Reef, outer moat, L.2. It is a fragment with a very solid base, evidently surf-swept.

The differences between this species and the preceding are small, but apparently constant. The axials are much narrower, and their twelve septa narrower and irregular, directives often meeting. Outsides of axials and radials striated. In this specimen the septa of radials are fairly distinct, but are usually made of rows of spines. For " radial corallites stouter and more proliferous " I should write " more irregular in length and thickness."

Distribution : Brook gives six records from the Great Barrier Reef. Also Fiji and Arafura Sea ; not recorded further east.

Acropora humilis (Dana.)

1848. Dana, p. 483.
1849. Dana, pl. 31, fig. 4; pl. 41, fig. 4.
1893. Brook, p. 145.
1925. *A. samoensis* Hoffmeister, p. 60, pl. 11, fig. 4.

This species has a great resemblance to *A. digitifera*, in its growth form; thickness, length, and bluntness of branches, and proportions of the axials, so that it is very easy to confuse them. They differ in the form of the radials, absence of immersed calices except right at the bottoms of the branches, and especially in the well developed septa, which in *A. humilis*, are so well formed, so as to be visible even to the naked eye. Dana's drawing of them shows the complete bilateral symmetry of the oval apertures due to the nearly equal directives coming close together centrally: but it is peculiar in showing 8 primaries, a mistake which is probably due to the fact that, in some cases, one of the secondaries may be enlarged, though usually they are narrow, and the cycle incomplete. Dana also states " star scarcely distinct," which is at variance with his drawing; but perhaps he means that the *radial symmetry* is quite lost.

The axials have 12 septa, of which 6 almost meet, and the secondaries too are broader than usual. They are thin and somewhat irregular, may be turned at a sharp angle at their inner edges, and sometimes bear an appendage that stands, as noted by Brook, at an angle with the plate. Directives are distinguishable, but not usually prominent.

The two specimens of this collection are larger than Dana's type, which is obviously young, and have branches up to 8 cm. long, and rather more tapering. No. 73 (no locality, presumably Low Isles) is complete but for one lost branch. No. P.10 is a forked branch with three short branchlets, and differs from both the type and No. 73 in having shorter and thicker radials, and more regular septa in the axials. Both show occasional arrangement of the radials in rows, as in Hoffmeister's photograph.

Distribution: Fiji, ? Samoa (Hoffm.), Great Barrier Reef.

Acropora brüggemanni (Brook).

1893. Brook, p. 145, pl. xxiv (with synonymy).

Three small coralla, of which the largest (No. 256) is 11 cm. high, and therefore very much smaller than Brook's figured example, and seems to be the whole of a young colony. Nos. 247 and 257 are about the same height, but consist of only a few branches each. They are all labelled by Matthai.

This is an easily recognized form, and is mentioned by Stephenson and others but not by S. Manton. It is therefore rare or absent from Low Isles, and Dr. and Mrs. Stephenson write of Three Isles: " Only one common coral species was noted as a form not familiar to us at Low Isles. This was an important form ecologically—a species of *Acropora* (*A. brüggemanni*) occurring in quantity on part of the flat adjacent to the anchorage, and making platforms like those of *A. hebes* at Low Isles (the latter species was also present)." This, like the occurrence here of three alcyonarians, is another of those unexplained differences between reef faunas already noted. Three Isles is a long way north of Low Isles, but it is similar in structure and similarly situated on the Barrier platform.

All these specimens belong to the typical blunt-ended form, but No. 256 has springing from its base, three short branches (the longest 3 cm.) which are tapering and pointed.

Brook does not mention the irregular broadenings of many branches ; the species clearly leads on to the *Isopora* group, and a branch in this specimen 35 mm. broad and 38 cm. high carries on the resemblance, especially as this is one of those branches in which an apical theca is not distinguishable.

The septa differ from Brook's description in that (1) the primaries are often narrow, and so do not differ greatly from the secondaries, and (2) the directives may be broader in both axials and radials. Their edges are curiously wrinkled.

Distribution : Not recorded since Brook wrote, and only from Singapore besides a number of localities on or about the Great Barrier Reef.

Acropora variabilis var. *pachyclados* Klz.

(Plate XXXVIII, figs. 1, 6.)

1879. Klunzinger, p. 17, pl. ii, figs. 1 and 5 ; pl. v, figs. 1*a*, 1*b*, 3 ; pl. ix, fig. 14.
1893. Brook, p. 161.
1906. Marenzeller, p. 49, pl. 15, figs. 40 to 44.
1918. Vaughan, p. 181, pl. 80.

Three specimens, Nos. 343, 344 and 348, correspond closely with Klunzinger's description of his thick-stemmed variety ; of his figures pl. ii, fig. 5, pl. v, fig. 1*b*, and pl. ix, fig. 14 afford good illustrations, the last giving the shapes of the calices. Of Marenzeller's figures pl. 15, figs. 41*a* and 43 are nearest to these specimens. Vaughan's figures are of a thin-stemmed form.

The significance of the name *variabilis* is shown in these samples by the existence, among the thick stems, of some much thinner. In No. 344 the stems are mostly from 2 to 2·5 cm. thick, but counting only those *springing from the base*, there are two averaging only 1·5 cm. In No. 348 the thicker stems are only about 1·5 cm. thick, and four are only 1·0 cm. In this specimen there is a tendency for the larger radials to fall into rows, as in Marenzeller's figure 43*a*. This is a peculiarity, which reaches an extreme in No. 343, where, not only are the rows quite definite, but there is a fusion of the bases of the radials, (sometimes almost their whole lengths are involved), so that they form almost plate-like structures, bearing also small buds and half immersed calices. This arrangement is curious and unique, deserving illustration, and perhaps even a varietal name, but unfortunately only three detached branches are present.

In Nos. 344 and 348, especially in the latter, some of the tubular radials taper towards their tops ; in the latter many of the adpressed tubulars low down on the stems are almost bulb-shaped.

The axials are up to 6 mm. thick, with rounded, smooth, finely-granulated walls, and their internal diameter 1·0 mm. and less. In No. 348 all but two of the main axials are filled in with coenenchymal matter, leaving only a trace of the cavity, or none at all. In No. 344 the cavities are usually 0·75 mm. across, or may be oval, 1·0 mm. × 0·75 mm.

The septa have not been described. In the axials two cycles are complete, directives broader, nearly, but not actually, meeting ; laterals well developed, in the two axial calices available in No. 348 the septa are broad but thin, and rather irregular ; in No. 344 some calices have narrow septa.

In the tubular radials again there are two cycles of septa, the second not always complete. In No. 343 the lateral septa are well developed, but in the others this is rare, laterals being usually narrow or even rudimentary. The immersed calices have also two cycles of septa, all very narrow (no directives) so that they look like open holes: these are very conspicuous in No. 343, but less so in the other two, in which they are surrounded by a low, ring-like wall. The characteristic buds on the larger radials figured by Klunzinger are not always present in No. 348.

Distribution: Red Sea: Philippines, to Tongatabu, but not further east. Vaughan gives Samoa, but Hoffmeister does not record it.

Acropora exilis (Brook).

(Plate XXXIX, figs. 3, 4.)

1893. Brook, p. 172, pl. x, figs. C, D.

The species is quite abundant at Low Isles since S. Manton referred to it on pp. 287, 295 and 296, and on pls. iv, vii and viii, and shows numerous examples on pl. xi. It is common at the seaward ends of all three traverses; on Traverse I "The most abundant species as measured by the number of separate colonies. It forms bush-like growths 3 to 12 inches across." On Traverse II "particularly abundant at the seaward edge of the reef." This local abundance is striking, considering that the species has not been recorded anywhere else since Saville Kent's time, and is a good instance of the way in which coral faunas vary from one area to another.

Of four specimens labelled by Matthai, Nos. 69, 83 and 199 ("T1 outside") are typical, Nos. 69 and 83 corresponding to Brook's figures of bushy and long-stemmed ("virgate") forms, while No. 199 is intermediate. These two long-stemmed forms show that this is one of the species which, like *A. elseyi* and others, may grow up from some depth, dying below as they extend upwards in a crowded mass of branches. It would be interesting to know whether the lower dead parts differ in any way from the living bushes above. The bushy specimen has made a fresh start, though growing on a broken and dead fragment of its own species.

The fourth specimen, No. 45, bears little resemblance to the others. The branchlets consist of stout, tubular axials bearing a few small short buds, but are naked for the distal 3 or 4 millimetres. On the main branches the radials are mostly long tubules pressed to the stem except near the ends of the branches, where their upper ends are free. (Plate XXXIX, fig. 3.) The septa are fewer, 6 in number plus 1 to 4 or 5 secondaries. Nevertheless the identity is clarified by the basal and some inner branches of the bushy specimen, the only one with basal branches in which similar conditions are found, though not including the long adpressed radials. However, as intermediates to these radials occur on normal branches we may consider this curiously abnormal form as belonging to this species. It is unfortunate, however, that the whole colony was not brought home.

Distribution: Brook records it from the Great Barrier Reef, the China and Arafura seas. Though a very beautiful and easily recognized species, it has not been recorded again until now.

Acropora elseyi (Brook).

1893. Brook, p. 172, pl. xi, figs. E and F.

No. G.B.R. 307 (June Reef Anchorage, coral zone, μ) is one branch with three divisions. No. B.M. 33 is a small but complete colony growing upon broken pieces, probably of the same stock. As Brook's fig. F also suggests, this is one of those species of which specimens die off below as growth proceeds upwards.

These specimens are about half the size of those figured by Brook, and No. 33 seems to be young, as the upper radials nearly all have clean-cut edges; but in No. 307 they are nearly all thick and rounded. Below the radial calices thicken and finally become "verruciform," or rather conical, with very small apertures which sometimes disappear altogether. In these peculiar basal corallites, as in the septa and the densely echinulate coenenchyme, the species differs from *A. polymorpha*, to which species there is a strong naked-eye resemblance. A few other basal corallites are immersed, wide open (1 mm.), with *slightly* projecting walls.

There are six well-developed axial septa.

Distribution: N. Australia and Torres Straits. Saville Kent collected it from Rocky Island, the position of which I am unable to find.

Acropora rosaria (Dana).

(Plate XL, figs. 1, 3 to 4.)

The species, usually rare, is referred to by S. Manton on pp. 287, 295, 305, and plates vii and xiv: the last figure shows a single small specimen on the crest of Yonge Reef. On Traverses I and II it is one of the rarer species in the deeper parts.

The series of 7 specimens:—No. 310, Ribbon Reef; 334, June Reef anchorage; 368, Ribbon Reef; 108 and 77 no locality; 207 and 216, "T1 outside"; and 276, June Reef "Inner moat, 0 2"; (the first three and the fifth and sixth also bear the sign θ). All but Nos. 206 and 334 have been labelled *rosaria* by Matthai, but No. 108 is labelled "*A. spicifera* (Dana) may be *A. rosaria* (Dana)," yet seems quite clearly to belong to the latter species.

These 7 specimens fall into three well-marked forms. That the species is variable is noted by Brook, who describes three forms, the first divided into two varieties, only the last of which, forma *dumosa*, he illustrates: it is not found in this collection. I therefore cannot identify them here, but Nos. 368 and 108 may be his forma *rosaria* var. *diffusa*; and Nos. 206, 216 and 276 may be his forma *pygmaea*, of which S. Kent brought four specimens from Low Woody Island. None here are exactly like Dana's type, a photograph of which is given by Vaughan, in pl. 82, fig. 2.

I therefore describe the series afresh. *Form* I.—(Plate XL, fig. 3.) Nos. 310 and 334 are alike; both are from the outer barrier, Ribbon and June Reefs. They have the typical growth form with the ends of twigs standing out nearly at right angles to the main stems. Axial septa 6 plus 6, primaries nearly meeting, secondaries comparatively broad; directives generally distinguishable. Radial septa also 6 plus 6, all narrow, directives the broader, the upper one usually best developed. Septa of immersed calices have both series of septa, also narrow; but being thicker, they are more distinct. These immersed calices are frequent more than half-way up the branches on the fronts of the specimens, nearly to the tops on their backs.

In these characters the specimens are typical, but they have some additional characters the most striking difference being that the axial calices are extraordinarily broad—4 to 5 mm. (generally the latter) in No. 310, 3·5 mm. in No. 334. As in other specimens (the exceptions are noted below) the cavities of the axial calices are only 1·5 mm. wide.

The walls of the radials are also thick; many are short tubules, 2 mm. long, pressed to the stem. Coenenchyme porous, with echinulae in rows, thecae finely striate, but scarcely costulate. In both specimens the backs have thinner, shorter branches with narrower axials, and little but immersed calices on the main stems.

Form II :—Nos. 108, 368 and 77 (Plate XL, fig. 1.) are complete colonies, bushy growths 10 and 17 cm. high, with encrusting bases overgrowing dead coral—in the case of No. 108 probably of the same species. In spite of their irregular bushy forms one side is flatter than the other, with thinner branches and axials; in No. 108 and on the back of 77 these are quite long and slender, some of the branchlets being long, tubular axials bearing only a few small buds; but none are quite naked as in Brook's forma *dumosa*. In these specimens the normal axials are 3 mm. thick, with cavity 1·25 mm. across. Radials are also thinner-walled than in the preceding, and many are short, adpressed tubules. Immersed radials are numerous at a point more than half-way up on both sides of the colonies.

Axial septa not always 6 plus 6. In twelve main axials examined there are four with this formula, one with 6 plus 5, two with 6 plus 3 and one with 6 plus 2, the remaining one having 10 septa rather irregularly arranged. The radial septa are arranged as before. Thecal walls porous, but thecae not striate; coenenchyme with echinulations in lines, but compact.

Form III :—Specimen No. 216 (Plate XL, fig. 4) and especially the fragments No. 276 and 207 differ in that most of the radials are 4 mm. long, and pressed to the stems. Axials narrow, 3 mm. externally, and only 1·0 mm. internally, as are the radials. In No. 216 the lower branchlets have, especially on some dead branches at the base, small radials and elongated axials which have an appearance quite unlike those of this species. Many of the adpressed tubular radials have broad septa like the axials, as though the distinction between axials and radials were not developed. In No. 207 the septa of the second cycle are few, often absent in the radials, in which the directives are often prominent.

These three specimens have faintly striate thecal walls, prominent echinulae on ridges over the coenenchyme, which is sometimes dense, sometimes reticulate. *A. murrayensis* Vaughan is only distinguished from this species by a denser coenenchyme, involving thecal walls without costulae, and, in view of the above, this seems hardly enough for a specific distinction.

Distribution : Fiji and Great Barrier Reef.

Acropora cancellata (Brook).

(Plate XLI, figs. 3 and 4.)

1893. Brook, p. 166, pl. xxxii, fig. c.

A fine specimen of this species was dredged from Stn. XXVII. It is a contrast to the small piece figured by Brook, the only known specimen, which was dredged over 90 years ago from 15 fms.

The correspondence with Brook's description is exact, except that, being fully grown, the branches at the base are much thicker; but I give figures of the complete specimen, and details. The density of the corallum is noticeable as soon as it is taken in the hand. This applies to the walls of the tubular corallites, as in *A. clavigera*. The coral, though growing from an encrusting base, differs on its two sides as does Brook's specimen, and therefore may be supposed to have grown out horizontally, or nearly so.

Distribution : Louisiade Archipelago, and now Great Barrier Reef.

Acropora clavigera (Brook).

(Plate XL, fig. 2 ; Plate XLII, fig. 3.)

1893. Brook, p. 183, pl. ix, figs. A, A′.

A fragment dredged at Stn. XXV differs somewhat in growth form from Brook's specimen. No branch is quite so like a rhizome of *Caulerpa racemosa* as is Brook's fig. A′, and the base does not form a network though the branches are flattened. Different parts of the colony naturally differ in these respects. The Expedition piece is from the edge of a growing corallum. The correspondence with Brook's figure is otherwise complete ; but I should emphasize the inconspicuousness of the buds on the sides of the tubular calices due to their being small and " hemicotyloid," and the thickness and solidity of the walls of the tubulars even close to their ends—a very rare thing in the genus. There is a ring of about 16 costal ridges surrounding the apical orifices ; the 6 primary septa are thin, but not narrow ; of the directives one or both maybe conspicuous sometimes neither. The secondaries are short and distinct, and may be two only is complete.

As this is only the second fragment to be collected, and Brook's figures are obscure, I illustrate it again on Plates XL, XLII. The locality of the original specimen is not known.

These last two species are described by Brook, the one under the subgenus *Conocyathus* the other under *Rhabdocyathus*. As a matter of fact the species are strikingly similar, the main difference being the greater prominence of the smaller radials and number of immersed calices in *A. cancellata*. Indeed the separation of the two species is probably only provisional until more specimens can be compared.

Acropora prolixa (Verrill).

1868. *Madrepora prolixa* Verrill, p. 22.
1902*a*. *Acropora prolixa* Verrill, p. 237, pl. 36, figs. 3, 3*a* ; pl. 36 A, figs. 3, 3*a* ; pl. 36 F, fig. 14.
1925. *Acropora prolixa* Hoffmeister, p. 65, pl. 16, figs. 1*a*–*c* (with synonymy).

Hoffmeister's is the only figure of a complete colony, and should be supplemented by Verrill's of small branches. The single branch dredged from Station XXVII is more loosely growing, and, as one side bears fewer and less developed branchlets it may have been more or less procumbent. It is 11 cm. long, and 8 mm. × 12 mm. at the base (which is irregularly elliptical, as the break passes through the thick bases of a pair of branchlets).

A marked peculiarity of this specimen is that its echinulations and the ridging of most of the main stem (there are no ridges on the thecae) are more conspicuous than on any other species I have seen—far more so than Verrill and Hoffmeister describe. In places the large, closely-placed granules are seen to be thicker at the top than below ; the striations are well separated by deep groves. The explanation is found in the section of a branch ; the main stem is nearly solid, but that of a smaller branch is built of several solid rings surrounding the imperforate walls of the axial calyx, the rings connected by stout bars ; and outside all are the echinulate plates. Evidently the stalked granules and deeply separated plates are only a stage in the growth of the coenenchyme.

The septa are as described by Hoffmeister, but the whole of the second cycle is not often present. In some cases the upper directive is much the larger than the other. I agree with Hoffmeister that this species is distinct from *M. echinata* Dana and the other species listed by him. It is near to *M. procumbens* Brook, and just possibly identical.

Distribution: Samoa, Sulu Sea, now Great Barrier Reef. (Verrill's "Ousima" cannot be found in the largest atlases.)

Acropora jeulini sp. n.
(Plate XLII, figs. 1–2, 4–5.)

Specimen No. 330 (no locality) is a horizontal growth, of three main branches, 2, 2·5 and 3 cm. thick, joined by a base 5 × 3 cm. in section. The ends of two branches are dead and overgrown, but they widen to 3·5 and 3 cm. where stumpy side branches are given off. The underside bears stumpy branches, more or less horizontal, as shown on Plate XLII, covered with somewhat conical calices, distally tubular, proximally mere warts without openings; a few calices are immersed with projecting ring, generally thicker and higher on one side. The axial calices of the proximal branches are hardly distinguishable.

The upper surface bears short conical branchlets, two of which are 2 cm. long and wide, and others range from a mere central tubular calyx with a rosette of radials round it to branchlets 1 cm. long × 1 cm. thick.

Axials thick-walled, walls very rounded, spongy without costulae, 3·75 mm. thick; cup 1 mm. across, very little exsert, and bearing small buds near their margins. Septa 12, of which the primaries join an irregular columella-like body. In one case the cup is 1·6 mm. wide, but this is a giant calyx, having 16 septa all of the same size, joining a rough columella.

The radials of the branchlets are all tubular; inner walls thick, the outer very thick and rounded; apertures round, facing upwards, and therefore oblique. Septa in two cycles, the two lower laterals nearly as broad as the directive between them, the upper directives and upper laterals being much shorter. Walls spongy, only the lower third finely striated.

The flattened surface of the main branches is crowded with similar calices, many facing in all directions, but more often distally: in any case they face so far outwards that the openings are conspicuous in a view from above (Plate XLII, fig. 5). Some of the larger, though not cylindrical calices, bear small buds. Among these are completely immersed calices, in which the 12 septa are all equally narrow.

Some of the calices become closed up, partly by thickening of the septa, but also by ingrowth of the walls. This is particularly frequent on the lower surface where, proximally, many become mere warts with no trace of an opening. The coenenchyme is reticulate in places, but generally striate and echinulate, with holes in between the striate. The echinulae are flat-topped and bear minute spines, visible under a lens but best seen by binocular. On the proximal part of the main branches these are very numerous, so that their flat tops fit together into a mosaic.

This species resembles *A. decipiens* (the specimen shown by Vaughan (1918) on pl. 67*) *A. smithi* (Brook) and *A. plicata*, but is at once distinguished by its thick-walled

* Crossland in his typescript did not indicate what figure of Vaughan's he had in mind.—[A.K.T.].

and never gutter-shaped radials, besides other structures. It might be a surf-flood modification of some form like *A. secaloides* Verrill or *A. abrotanoides* (Brook), but this is not likely. The effect of the surf-flood in the Astreans certainly, and in *Acropora*, etc., so far as my observations go, is not to thicken or shorten the calices (rather the reverse), but to shorten branches and solidify the basal plate only. (Crossland, 1928, p. 723, pl. ii. For Astreans see Crossland, 1931, *e.g.*, pl. v, fig. 9,† and its explanation.) I have named the species after M. Jeulin, who worked as an amateur of corals at Ghardaqa and in the Gulf of Suez.

Acropora brooki sp. n.

(Plate XLI, fig. 2; Plate XLV, fig. 3; Plate XLVI, fig. 1.)

Specimen No. 290 (? June Reef, outer moat) is a fragment of a corymbose plate, measuring 13 cm. radially and 10 cm. across. Viewed from the underside the branches are flattened and fused, leaving small holes proximally, elongated slits distally, as shown on Plate XLI. The surface is largely smooth, but for scattered warts and immersed calices, but distally completely adpressed tubulars abound. The sides of the branches, however, bear long tubulars 2 mm. thick, which proximally form triangular branchlets, often fusing to the adjacent branches. The upper side bears branchlets 2·5 to 3 cm. long and about 0·5 cm. thick, the proximal nearly vertical, the distal curved upwards. These are placed further apart then usual, their apices 1·5 to 3 cm. distant; probably in correspondence with this the immersed calices of the plate are very numerous, and nariform radials continue on to the plate in lines from the bases of the outer branchlets.

The axials are long, 4 mm. × 2 mm., but lower down the branchlets are others 8 mm. long bearing a few small buds, or becoming aborted twigs. They are 2 mm. thick, cavity 1 mm., wall strongly striate and porous. Axials with 6 narrow septa, and small representatives of the second cycle, sometimes complete. Directives sometimes smaller.

Radials nariform or compressed, tubular, quickly attaining their full size; projecting at an angle of 45° to the stem; walls thin. As they are 4 mm. long they are conspicuous; width 0·75 mm., shape of opening like a Canadian canoe, and with thin lips; the opening does not reach the stem, but sometimes is close to it; in the larger and lower radials it is separated by a variable distance increasing to nearly the length of the calyx in the the tubulars, in which the opening is oval. Walls, like those of the axials, very distinctly striate, the striae continuing over the lips.

About half-way down the branches the radials become nariform, with much wider oval openings, and finally become round, subimmersed and immersed.

Septa of the radials reduced to the outer directive, which is, at its best, a thin line along the bottom of the "canoe"; and even this is often difficult to distinguish. Tubulars with buds have small laterals as well as narrow directives.

The large, immersed calices of the plates have slightly raised walls; some, near the bases of branches derived from the short nariforms of the lower parts of the branches, are only subimmersed. They are quite open, without septa or with the slightest rudiments.

Coenenchyme reticular, echinulate, the prominent striae of the thecae not extending beyond their bases.

† Crossland had written "pl. ix," which shows *Lobophyllia*. It seems likely that he meant "figure 9," which shows a *Leptastrea* of the barrier edge series.—[A.K.T.]

Acropora lutkeni sp. n.

(Plate XLI, fig. 1 ; Plate XLVI, fig. 2.)

Specimen No. 271, from the Outer Barrier, June Reef, Nigger Head, is a complete colony, consisting of a solid conical base 11 cm. high, 6 cm. wide at the bottom, with a more or less flat top about 20 cm. across. This bears a number of simple upright branchess about 3 cm. thick, regularly tapering, bearing on their lower halves numerous branchlet, up to 1 cm. long and thick, but mostly much smaller. At one side of the base are branches 4 cm. long, 1 to 1·5 cm. thick, obviously homologous with the branchlets of the main stems. Where the branches come near together they are flattened, so that sections are oblong or triangular. The striking character of the species is the extreme compression of the more prominent radials, 3 to 4 mm. long, the cavities of which are usually deep slits, opening outwards distally and not quite reaching the stems proximally. In other words the radials have greatly thickened side-walls, but their ends are not, as in many species, specially thick. These openings, and the upper surfaces of the calices, are nearly at right angles to the stems, but the lower walls slope upwards slightly. Among these are shorter calices with oval openings, and immersed with ring-like walls. The longer radials bear small buds, and, about 3 cm. down the stems, these buds enlarge to form rosettes, the beginnings of the branchlets of the lower parts of the stems ; but though these radials have now become axials they retain the slit-like shape of their cups. Even the axials of the main branches are oval. The immersed calices with ring-walls are found up to 1 cm. from the tips of the branches ; but lower down they become numerous, occupying most of the space between the branchlets. As their 12 septa are all very narrow their calices are open and conspicuous. They are accompanied by adpressed tubular radials, with thick outer walls and small (0·5 mm.) openings, upwardly directed and close to the stem.

The axials of the main stems are 3·5 mm. thick, their cavities 1 mm. longer in diameter ; they have 12 septa, all short, but in most cases accident or abnormal growth make them difficult to see. In the radials only the directives are conspicuous, the lower as a long ridge in the bottom of the trough, the upper as a wedge-shaped tooth on the proximal wall ; laterals are present, but rudimentary.

The walls of the thecae and the coenenchyme are finely and closely echinulate, not striate, echinules long and pointed.

I name this striking species after the late Professor Lütken, in recognition of his labours in collecting and arranging the corals of the University Museum of Kóbenhavn. Prof. Lütken did not publish his results, but I hope to give some account of his work later.

Acropora otteri sp. n.

(Plate XLIII, figs. 1–2 ; Plate XLIV, figs. 1–2.)

The three specimens Nos. 306 Ψ2, 338 Ψ2, and 60 (the two former from the outer barrier, Ribbon Reef, inner moat ; and June Reef, outer moat respectively) differ greatly in appearance and largely in structure, but undoubtedly belong to the same species.

The growth form is corymbose, with arching upright branches. But while No. 60 is decidedly lax, with no fusions of branches beneath, and only a trace of flattening, the upper branches somewhat irregular, up to 11 cm. long, Nos. 306 and 338 have flattenings and fusions beneath, the former with regular branches 7 cm. long, of which the radials are all approximately the same length, the latter with stout branches, made irregular by numerous long tubulars bearing buds and aborted twigs—an effect which is even more marked in No. 60. These differences are so curious that all three specimens are photographed. These three specimens are the syntypes of the species.*

All are alike in having thick, axial calices, walls spongy above, inconspicuous striae on the sides, and moderately wide cavities. External diameters are 3 mm. in No. 60, 3·5 mm. in the others ; internal diameter 1 mm. in all. Septa number 6 plus 6, thin but straight, narrow above except the directives, but broad below. Axials exsert about 2 mm., but may have minute buds within this distance of the apex.

The projecting radials are of two kinds, (1) shorter, nariform with oval or nearly round openings, inner wall always distinct, though short, and (2) tubular, with straight or nearly straight-cut ends, the longer of which bear buds. These larger radials tend to fall into rows, straight or somewhat spiral. Lower down the nariforms become adpressed the outer lip thickening and the opening becoming round, the whole becoming like short adpressed tubulars. Among these are numerous immersed and subimmersed calices, some of which are to be found 1 or 2 cm. from the tips of the branches.

In the upper radials only a narrow, lower directive is visible, but, lower down the other septa appear and are often well developed, some of the second cycle being present.

The long, tubular radials, with others which are shorter and bear small buds, are a characteristic of several species, *e.g.*, *A. abrotanoides* ; but the combination of these with the adpressed tubulars and sub- and fully-immersed calices of the lower parts of the stems are a special feature of this species (Plate XLIII, fig. 2). In No. 306 tubulars occur, but are not prominent, and rarely bear buds ; and the lateral twigs are short and stumpy. Exactly the reverse is true of No. 60, in which long tubulars bearing buds are conspicuous, and the lateral twigs are long and thin, often hardly thicker than the axial calyx itself. In No. 338 they are often prominent, but lateral twigs are short.

The coenenchyme is finely striate and echinulate, but more coarsely than the thecal walls.

The species is near to *A. abrotanoides*, but its corymbose form is not the only difference. It is not proved that caespitose and corymbose forms occur in the same species when adult : the form of branching of the specimens of *A. abrotanoides* in this collection and Vaughan's figures (1918, pl. 68, figs 1, 1*a* and 2) make it especially unlikely in this case.

Acropora laevis sp. n.

(Plate XLV, figs. 1–2.)

Nine specimens, though widely differing in detail among themselves and all differing from *A. pulchra*, agree in a general smoothness to the naked eye, which is due to (1) the smoothly rounded and thickened edges of the calices, (2) the fine and uniform granulation of the coenenchyme, (3) having well developed stars of septa in the radials, and (4) the conical shape of the half-immersed radials of the lower halves and backs of the branches. Branching is lax, side branches at angles of 30° to 45° to the main stems, and varying

* Crossland wrote : " All three constitute the type." But in accordance with the recommendations on International Rules of Nomenclature, No. 338 is hereby designated holotype, and Nos. 306 and 60 paratypes.—[A.K.T.]

in thickness from 12 mm. to 8 mm. basally. Radials well separated (No. 79) or crowded (No. 93), usually tubular, and sometimes at right angles to the stem, or inclined (compare figs 1 and 2 on Plate XLV). There are also conical and immersed calices high up the stems, but the latter reach their characteristic form 5 cm. or so from the tops, and are the only kind for the lower halves of the stems (Plate XLV, fig. 1). The walls of the longer calices are ridged, if at all, only near their bases, and the upper parts are slightly thicker and finely granular. The lower directive is usually the largest septum, but is not so prominent as to prevent the septa making a star.

For other characters I refer to the plates, but Nos. 33, 212 and 217 deserve special mention for their large, thick-walled calices, of which the largest are remarkable for their narrow bases : some might be called club-shaped.

Holotype : B.M. Reg. No. 1934. 5. 14. 349. G.B.R.E. Sample No. 79.

[Family Poritidae.]

Genus *Goniopora*.

S. Manton mentions (p. 289 and graph xi) that species of the genus occur in minute colonies on the muddy rocks of the seaward slope of Traverse I. On pl. xvi she shows a single, small specimen on the inner part of Yonge Reef. Stephenson and others give four references (pp. 67, 86, 89 and 90) listing it as characteristic of seaward slopes and the anchorage at Low Isles, of Yonge Reef, the reef patch at Lizard Island and Batt Reef.

In many cases I cannot make out the mode of growth by layer over layer which Bernard so elaborately describes as characteristic of the genus (indeed he implies that it is invariable). Such layer-over-layer formations are found in any genus when a colony is successful in resisting periodical partial burials in mud or sand ; and it is particularly common in this genus, which, as noted also by S. Manton, often inhabits muddy areas. Gardiner (1939, p. 242) also finds that Brook's " description is inapt ; for the central part, perhaps inches thick, has no epithecal plates one over another, but is a mass of trabeculae, as described above." He is speaking here of *G. stokesi*, but the same thing is true of three of the species about to be described, and in *G. columna*, which is common at Ghardaqa, the tall columns, say two feet long, are continuous from top to bottom. Gardiner continues, "Clearly there is no true 'epitheca,' based on a 'primitive epithecal cup' as Bernard expressed it (p. 18), but a later secondary formation," a protective adaptation to the special surroundings in which many of the species live.

The genus occurs from the Red Sea to the Pacific. It is recorded as far east as Samoa by Brook, but the record is doubtful ; and Hoffmeister does not describe any species from Mayer's collection. J. J. Lister, however, found three species in Tongatabu.

As my identifications of these specimens with Brook's 12 numbers from the Great Barrier Reef are all marked " probably " I omit them.

Goniopora tenuidens Q.

1918. Vaughan, p. 186, pl. 84, figs. 1, 2.

No. 254 is the greater part of a fair-sized colony, 12 cm. across × 9 cm. high, smooth and originally hemispherical. The mode of growth is not layer over layer, but it is a thick (max. 4 cm.) sheet folded to a horseshoe section. A delicate epitheca covers part of the base. The specimen corresponds well with Vaughan's variety 2 on p. 187 over most of the surface, but there is rather a sudden change near the base, illustrating Brook's quaint remark that all Gonioporas are Rhodaraeas near their bases: the calices change from being more lightly built than Vaughan's fig. 1 to the shallow, thick-walled, solidly built calices with huge pali of his fig. 2.

Distribution: Great Barrier Reef; Amboina; Philippines.

Goniopora lobata M. E. and H., Bedot.

(Plate XLVII, figs. 1–3.)

1907. Bedot, p. 267, pls. 43 and 44, 3 figs.

Specimen P.37 is part of a hemispherical colony 6·5 cm. across; No. 57 is a fragment of a large colony; and the third, dredged from Stn. XVI, is complete, but only a flat crust measuring 4 × 2·5 cm.

These three specimens differ greatly in structure. No. P.37 is the most like Bedot's typical examples, which he says are absolutely like those of Milne Edwards and Haime. Bedot's description is excellent, but the looser structure of the columella in the present specimen enables me to describe an interesting point in its morphology (Plate XLVII, fig. 2). It is large, occupying most of the bottom of the calyx but for holes round the edge representing the loculi, and is flat except a small area in the middle, forming a floor. It has two origins, the central part being made of trabeculae from the edges of the septa in the usual way, this part being about one-third of the diameter of the calyx, and bearing the characteristic upright spinules. Outside this and below the edges of the septa, the columella is formed of distinct synapticula, standing more or less at right angles to the septa. Being at a slightly lower level they appear only occasionally in the published photographs, and also are often obscured by greater development of the upright columellar teeth.

The specimen dredged from Stn. XVI is very different, having shallow, flat calices divided by flat-topped walls 1–2 mm. thick. The columellar teeth become, in some cases, indistinguishable from pali, plate like or double: the columella is narrower, but its parts distinct. This specimen shows the typical fusions of the septa described by Bernard (1903, p. 21) in which tridents alternate with simple primaries, with unusual distinctness.

Sample No. 57 I identify with some doubt, as it is only a fragment of a large colony. It has exceedingly delicate walls, which have been much rubbed, and the large, flat columella is obscured by fusions, but the columellar septal teeth are essentially the same.

On the broken edges of these specimens I can see delicate tabulae in P.37 similar to those in Bedot's figure, but not everywhere in the section. In No. 57 I can see none at all, and of the dredged specimen no section is available.

The synonymy of this genus is in a hopeless condition. Bernard's obsession with growth forms naturally led himto abandon attempts at synonymy, and spoils his descriptions. Consequently we have sound descriptions, such as those by Bedot and Vaughan, for very few species. Bedot says the Paris specimens of *G. lobata* and *G. savignyi* are not distinguishable, but Savigny's drawing and I find in such cases as I know that his drawings are very accurate) represents another (species, so that it seems as if there had been some confusion of labels. Klunzinger's *G. planulata* is, apparently, a stunted specimen of Dana's *G. columna*, such as one would expect to get at Qoseir. In sheltered water at Ghardaqa this species is found in large convex masses, made up of closely fitting columns. This is quite different to the present species, and is not at all like Bernard's pl. xiii, fig. 12, which he calls (p. 100) Red Sea (6) 1,—*G. lobata.* In *G. columna* there is no " expanding column consisting of a thick sheaf of lamellae "—there are no lamellae.

Distribution : Red Sea (?) and Amboina. If the synonymy were worked out I should probably include the Philippines, but no place further east as yet.

Goniopora minor nom. n. for *G.* " Great Barrier Reef (12) 5."

(Plate XLVIII, figs. 1, 3.)

1903. Bernard, p. 52, Great Barrier Reef (12) 5, pl. ii, fig. 6.

Bernard's specimen was " only a chip " but corresponds well with No. 56, which is a smooth oval dome, with two little domes attached. The main mass is 8·5 cm. long and 4·5 cm. high, not in layers. The thecal tubes are continuous from top to bottom.

The salient features are small calices, usually 2 mm. across, often 1·5 mm., deep for their size and open ; the 12 thick but narrow septa descending vertically, rudiments of third cycle sometimes visible, occasional junctions of septa before reaching the columella. Columella occupies most of the bottom of the calyx, and is much fused, but 4 to 6 septa run on to it and bear small spinulose pali. On the surface on the main dome these septa are thin and the pali very irregular, but on the small domes and at the edges of the large ones, they are always six in number, vertical and symmetrical, often joined by synapticula and making a low cylinder above the columella. These pali are borne by 6 thicker primary septa. The walls are thin, but appear thicker by being crossed *at right angles* by the septal edges. This is one distinction from Bernard's G.B.R. (12) 8.

Distribution : Known only from the Barrier Reef, at least until the synonymy can be worked out.

Goniopora hirsuta sp. n.

(Plate XLVIII, figs. 2, 4.)

A minute colony which I should decline to describe were it not strikingly different from any other species in having the septal edges covered with fine compound spinules, giving them a hairy appearance.

This was found on a mass of shells, *Chama* sp ?, heavily overgrown with lithothamnia,* dredged from Stn. XVI. It is a crust 3 mm. thick, yet in several layers, triangular in shape, 20 mm. along the side. It is probably one of those corals which never reach a much larger size, like *Stylaraea punctata* and *Stylophora armata.* Unfortunately only one-third of the area was alive when collected, the rest apparently overgrown by a crust of lithothamnia, which is, however, so thin as to let the structures be seen.

All calices are shallow, living calices 2·5 mm. across, the older ones, in the dead part, 3 mm. Walls of the former generally very thin, loosely made, and confused by compound spinules similar to those of the septa ; where walls are thicker septa cross them at right angles, and, in the older calices, this is always clear.

Septa 12, equal ; sometimes from one to three fusions before the centre is reached ; and there are occasional rudiments of a third cycle. They are rather thick, and with their

* I follow Stephenson, J. Linn. Soc. Zool. ' 1939 ' p. 500. " In this paper the word ' lithothamnia ' (not italicised and without a capital) is used to indicate the encrusting Corallinaceae belonging to *Lithothamnion* and related genera." " Lithothamnioneae " is more correct, but is cumbrous, and implies the presence of more than one genus.

spinulose processes, tend to fill up the theca. The columella is visible only as one or two spinulose points. There are no pali.

In the older calices pali are distinct, generally as six conspicuous points, but they may be double, and such pairs may be connected to form a plate. The columella is rudimentary or an irregular fusion, bearing one or two upright spinulose points. In these older calices the septa are conspicuously thickened in and near the walls.

Genus *Alveopora*.

The long controversy over the relationships of this genus is given by Bernard (1903), pp. 4–9, and at length in J. Linn. Soc. Zool. XXVI, 1898, and XXVII, 1899. In those days morphology was occupying our minds rather to the exclusion of ecology, etc., and the attempt to make the epitheca and other coral parts into strictly defined morphological entities tended sometimes to unnecessary obscurity. In simple fact *Alveopora* is scarcely distinguishable from *Goniopora*, from which it is directly derived by reduction of building power, in walls and septa. Compare, *e.g.*, Bernard's (1903) division " *b* " of *Goniopora* (p. 179), calices with high thin walls, and note at foot of page, "at the sides of all these colonies the calices revert to the primitive type with thicker walls; but for this they would be indistinguishable from true *Alveoporae*," and other species have spinous septa also. (See, *e.g.*, Bernard, 1903, pl. ix, figs. 1 and 2.)

Yet in the Catalogue (p. 8) he maintains the position he took up in his earlier papers, in which, while agreeing that *Goniopora* is much like an enlarged *Porites*, these two genera making the family Poritinae. *Alveopora* has no relationship, and belongs to another family. This arises from his obsession with the epitheca, which, when looked at simply, is seen to be merely an ecological adaptation, certainly not of the overwhelming morphological importance Bernard attributes to it. With this Gardiner and Waugh (1939, p. 242) under " *Goniopora* " in the John Murray Expedition corals, agree.

Alveopora irregularis, sp. n.

(Plate XLIX, fig. 2; Plate L, fig. 1.)

A single specimen, No. B.M. 607, dredged at Stn. XIV.

Growth form columnar, with expanded top, the lower, constricted part tightly bound by a firm mass of *Halimeda* combined with sponge. This and the base of the expansion also wrapped in a stout wrinkled epitheca. A vertical section, to one side of the centre, shows no epitheca within the corallum, and the horizontal layers shown on Plate XLIX do not indicate pauses in growth, or increase by layer-over-layer formation, such as Bernard postulates in similar coralla of *Goniopora*.

The species is very like *A. allingi* Hoffmeister from Samoa (1925, p. 81, pl. 23, figs. 2*a*, *b* and 2*c*) in the sizes of the calices, their walls and columellae; but the septa, as seen in his fig. 2*c*, are distinctly different. Hoffmeister's species has 12 nearly equal, distinct though narrow septa, not spines, of considerable breadth at the bottom, where they all join the columella. In *A. irregularis* they are 20–24 in number (in the larger calices) but most of them are low, toothed ridges or rows of very short, close-set spines, but, here and there, from one to three of them may broaden out into long spines. Such broader septa often meet in groups of two or three before joining the columella. The irregular network forming the columella is like that of *A. allingi*, but even broader, practically forming a bottom to the cup in the larger calices. In the smaller it is of more normal size, and irregular in shape. Very few of the septa reach the top of the theca, though all approach it.

It is possible that this species is merely *A. allingi*, which has suffered a degeneration parallel to that I have described (1931) in *Leptastrea* of Tahaiti.

Alveopora mortenseni sp. n.

(Plate XLIX, figs. 1, 3–4.)

A single specimen was dredged from Stn. XXIII, but by the kind permission of Dr. Mortensen I am enabled to enlarge the description of the species by comparison with six dredged by him off Mauritius (Stns. 44 and 45, 15 and 16 Oct., 1929, the former from 25 fms.) Some of these are exactly like that from the Great Barrier Reef; others show variation in the direction of what Bernard (p. 101) calls " that mysterious coral " *Porites clavasia*, Aud. et Sav. of the Red Sea. While at Ghardaqa, Dr. Mortensen trawled a large number of corals of exactly this peculiar growth form, and it seems likely that an examination of the series would connect this species with that of Savigny. These were from 30 fms. near Ashrafi lighthouse, at the entrance to the Gulf of Suez, and were accompanied by a number of species of gorgonians.

As Plate XLIX, figs. 3–4 show, the growth of " epitheca " characteristic of the genus here reaches its greatest development. The branches lie loose on the muddy bottom, liable to burial, so that only their tips are alive, and even the dead stems would probably decay very rapidly if unprotected.

Calices round, variable in size up to 3 mm. There is a slight tendency for some on the sides of branches to be drawn out in the direction of the branch, which is more marked in some of the Mauritian examples. As the figure shows, buds are very numerous, wherever there is any space between calices there a bud develops. Rarely can a place be found where the walls are double, but they do occur, for parts of the circumference of a calyx. Otherwise the walls are extremely thin and highly perforate.

The septal spines are, in this Barrier Reef specimen, so thin and irregular that no cyclic arrangement can be made out from them, but the number of short processes on the lip of the wall is twelve, indicating two cycles, and there are indications of a third ; within the calyx the upper parts of the walls bear a few short spines, scattered or more or less in vertical rows, lower down they become long, bending and fusing so that the original rows are quite confused (Plate XLIX, fig. 3). Generally they are very thin, almost hair-like, but thicker in calices low down in the colony. Deep down they meet and cross in the centre, and may form a tangle vaguely resembling a columella ; only in a few cases does this become a definite structure.

Dr. Mortensen's specimens might possibly be considered a variety, but having only one specimen from the Barrier Reef it is impossible to say whether the small differences observed are constant. While some calices are not distinguishable from those of the Barrier Reef specimen, the septal spines are usually thicker and more generally fall into rows ; sometimes a primary cycle can be made out, in rare cases it is very distinct and alone forms a definite columella. A tertiary cycle exists only as small spines alongside those of the secondary cycle. As for columellae, one specimen and two scraps have none, another and a scrap none or rudiments ; in a third thick primaries and some secondaries quite often make a distinct columella.

The single small specimen from Mauritius (Stn. XLIV, 25 fms.) is even more delicate than the others ; the fine long spines rise from the walls at a higher level, making the theca appear shallower, though most are extremely irregular, some are in definite rows.

Distribution : Besides the Great Barrier Reef only from Mauritius, and possibly, the Red Sea.

Genus *Stylaraea* M. E. and H.

For a discussion of the rightness of separating this genus from *Porites* see Bernard (1905), p. 11. I resuscitate it against the opinions of both Milne Edwards and Haime and Bernard ; though agreeing that it is a modified *Porites* its peculiarities warrant the distinction. I do not agree that the specimens before me, any more than those of Klunzinger, show imperfection due to youth, and I believe that their small size is normal for the species, as it is in *Stylophora armata* (?), of which I saw many specimens, all very small, in Tahaiti. It is always small, like Klunzinger's specimens, in the Red Sea also.

Stylaraea punctata Klz.

(Plate L, fig. 2.)

1879. Klunzinger, p. 44, pl. v, fig. 27.

The species is generally attributed to Linnaeus and Esper, but to go behind Klunzinger is to land in the quagmire described by Bernard which I do not propose to enter (Bernard, 1905, p. 11, and under *Porites Red Sea* 9 and *P. molluccas* 1, pp. 161 and 243). To alter the attribution to Klunzinger is the only way to find footing without adding to the confusion by giving a new name.

Eleven specimens were preserved, all labelled " Mangroves, Passage 62, Low Island, Miniature Favia." The largest, and one of the smallest, are on a fragment of a heavy shell, completely riddled by sponge, etc.; the other six are on a living *Melina** shell ; and three on an *Arca* shell, accompanied by a small colony of *Porites stephensoni* sp. n. (p. 241). They are accompanied by minute colonies of *Leptastrea* and *Cyphastrea*.

The colonies of *Stylaraea* form cushion-shaped crusts, with a thin line of " epitheca " appearing round their bases. The largest is 15 mm. across and about 7 high ; most are not much smaller, but the smallest is only 7 mm. across and has 12 calices and some buds.

As in Klunzinger's example, calices are of uniform size, just under 1 mm. across. There are some details of importance to add to Klunzinger's description, " Die Septa sind sehr schmal, springen sehr wenig vor, sind leistenartig oder trabeculär," but, as seen in Klunzinger's photograph when examined under a lens, in many calices one, more rarely two or three, reach the columella at a high level in the calyx. Rarely all six of the first cycle may be seen to join the columella low down, but generally such regularity, if existing, is obscured. Two cycles of septa can usually be distinguished among the 12 little ridges or beams at the top of the wall. Costal ridges frequently cross the walls. The columella is not always a single style ; it is often double, or, more rarely, ends in three small points ; in the former case it may be a flattened plate. It is to be noted that in very young buds the stylar columella is already prominent.

* Dr. Bruun informs me that the shell is correctly named, but that *Pedalion* (Solander) is more generally used.

The resemblance to *Stylophora* mentioned by Klunzinger is very superficial. All the above variations can be made out by careful examination of Klunzinger's photograph, but, as it is very small, and in my copy fading, I give another. This shows details such as wall-structure ; and the minute spinules of the septa and tops of columellae, which may never have been visible in Klunzinger's. These spinules are always present, but conspicuous only in the largest specimen. Walls are more loose and irregular in smaller examples, but the septa and their costal ridges always rise above it. Whether they reach across it to the next calyx or not in the largest specimen they are always thickened over the wall, very much as in Klunzinger's photograph.

Distribution : Only known hitherto from the Red Sea. Earlier records, if any, are without locality.

Genus *Porites*.

Stephenson and others (1931) refer fourteen times to the genus, well illustrating its adaptation to all habitats, from pools and passages into the mangrove swamp, in the "Mangrove Park," reef flat, the moat, seaward slope and anchorage.* S. Manton's traverses of the moat, shown at the tops of her pls. i to iii, illustrate an extraordinary disproportion between *Porites* and *Montipora ramosa*, the latter being vastly predominant. In only one part of the moat is *Porites* noted by Stephenson and others as predominant. There is also a "Porites pond" at Three Isles, and an abundance of small colonies on Yonge and Batt Reefs. The only place where colonies of a normally large size are recorded is the reef at Lizard Island, where much of the reef and its outer slope are made of colonies two yards across. This, it should be remembered, is a lagoon reef.

Dr. Umbgrove (1939, p. 10) notes how this preponderance of *Montipora* (both *foliosa* and *ramosa*) in the moat of Leiden Island, in the Bay of Batavia, resembles conditions at Low Isles, but here, in deeper water, "the largest corals are doubtless enormous *Porites* colonies (according to Verwey, 1931, p. 206, *Porites lobata*)", and there are other interesting differences. Umbgrove and I agree that "we are only at the very beginning of having an idea of the true distribution of species, which abound on one reef but seem absent in other reefs." I have given large scale examples under *Pavona* and *Coeloria*, but of the reasons for this and other phenomena of coral-growth we have no idea whatever.

All this distribution of *Porites* is quite unlike the reef-areas I know in Equatorial East Africa, the Red Sea, or Tahaiti, and even the Marquesas, where colonies 6 feet × 6 feet and larger are striking objects everywhere.†

S. Manton gives details. She also found the genus ubiquitous, but never saw or drew a colony of any size, her largest being 30 inches across, found in deeper water (see her graphs on pls. iii, vii and viii).

Her criticism of Wood Jones on the formation of flat-topped cylinders is borne out by everyone who has ever seen a coral reef, and Wood Jones should not be quoted in future. She also quotes Marshall and Orr on removal of sediment, which, they say, is always done more effectively by large polyps. Yet here we have a genus in which the polyps are of the smallest, yet which is peculiarly resistent to muddy water. The explanation is, as S.

* It is here marked with an asterisk as characteristic of vertical or overhanging surfaces, surely a printer's error ; cf. S. Manton.

† A colony of ordinary size is shown on pl. i of the writer's "Forskaal's Collection of Corals," Univ. Mus. Zool., København, 1941. Mr. Otter's photograph in P.Z.S., 1935, p. 504, shows an extensive growth of *Synaraea convexa* in a Tahaitian lagoon, but the large colony is by no means one of the largest.

Manton says, that *Porites* removes mud easily, while unable to deal with coarser sediment. Another is that laboratory experiments do not last long enough to be comparable with nature ; at Ghardaqa the death of corals damaged by sediment was spread over several years.

Whether this ubiquity of the genus applies to any of its species we have not enough evidence to decide.

In this genus the usual difference between lighter calices on the upper, and stouter built on the lower sides of colonies is particularly striking. The phenomenon is usually explained by saying that the former are growing the more rapidly, but this could only be true if the resulting mass is to be columnar ; it cannot be true in the case of a regular dome. The fact is that the vast majority of museum specimens of *Porites*, as of other corals, were collected from reefs drying at the level of low water spring tides, where upward growth has ceased, or is about to cease. I call to mind innumerable colonies of *Pocillopora*, in which this difference reaches its extreme, the upper parts of the branches resembling empty honeycomb, wherever the branches have reached as high as they can, and are deformed by this fact. We find no thinning of the walls in the apical thecae of *Acropora*, where upward growth is at its greatest. Dredged specimens of massive *Porites* are rare ; we have one in this collection, and in this the difference between upper and lower calices is much less than usual.

I suggest that what we need for the proper determination of species in *Porites* are series of examples of (1) young colonies, such as that of *P. stephensoni* of this collection, only more of them and from various habitats, (2) larger colonies, such as those described by Gravier and Vaughan, and (3) the full-sized colonies, however large. The last would, of course, be examined by means of small samples, say 10 cm. across, of which a large number would be needed, 6 to 9 from each mass, *viz.*, one or two from the top surface, and six or eight from the sides, from near the top and low down, the latter collected in many cases by means of a diving hood. Drawings would be made showing the relations of the colonies to the reef and other surroundings, to currents, waves and light, and the samples numbered to correspond with the positions on these drawings. This would mean handling a mass of material difficult to bring home to European or American museums, and to store on arrival. There would therefore be a preliminary examination on the spot, and a careful selection made of the samples to be brought home. In some species it might be found that there is little variation in response to conditions ; in others results seem likely to be quite surprising, and likely to lead to general conclusions. Experiments would, of course, go on concurrently. This task would be a heavy one, quite outside the programme of such an expedition as the present one, which was occupied fully in more useful ways ; I suggest it for such a biological station as that of Ghardaqa in the Red Sea, where the semi-fossil corals of the raised reef would of course be included.

Solid Forms.

Porites stephensoni sp. n.

(Plate L, figs. 3–4.)

1918. *Porites haddoni* Vaughan, p. 197, pl. 87, figs. 1–1*b*.
1931. *Porites haddoni* Stephenson, p. 129, pl. 1, figs. 1, 3–4 ; pl. iv, fig. 1 ; pl. v, figs. 1–3, 5–9, 11.
1933. *Porites haddoni* Marshall and Stephenson, p. 236.

The species is most readily distinguished from *P. haddoni* by the absence of the columellar tubercle, which is never present unless as a mere rudiment, and by the proportions of " the triplet."

Six of the specimens were some of those used by Stephenson and Marshall in experimental breeding. Having this very special importance I describe these specimens first, and then five others of the same species. These six are Nos. B.M. 232, 262, 305, 373, 377 and 381. They are all very small, columnar in shape, but narrower at their bases and tops; the largest 85 mm. high × 70 mm. in greater diameter ; the smallest 30 mm. high × 55 mm. in diameter. The narrower tops are bluntly pointed in four specimens ; No. 373, though narrower, is flat on the top. No. 262 has grown abnormally : the surface has small monticles, indicating that the fused columns of the colony are smaller than usual. There is much variation, No. 377 being covered with small, upwardly directed mounds, while No. 381, the other extreme of this series, has them much lower, broader, and therefore fewer. These growth forms are similar to those in Bernard's (1905) pl. xii. fig. 4, or to those in Quelch's (1886) pl. xi, fig. 8, which are very like Nos. 232 and 381, but No. 377 is unique, and is therefore illustrated on Plate L.

The surface appears smooth to the naked eye but for a polygonal reticulation due to the thin walls being raised a little above the level of the contents of the calices, which appear shallow through being filled up by the septa and pali ; they are, in fact, when seen under the binocular, distinctly deep except, of course, those near the bases of the colonies.

Taking No. 381 as an example, the walls are very thin, much perforate, and bear large granules, generally one above each septum, and flattened usually in the plane of the wall. The septa originate well below the edge of the wall, and bear a granule near it ; here may be an incomplete synapticular ring. The septa may run nearly horizontally to the pali, the free part of which is then comparatively short, or, more typically, the septa dip, leaving the pali as long, free, slender pillars. Sides and edges of septa, and especially the tops of the pali, finely spicular. Septa thin, much thinner than the loculi. The central fossa is comparatively wide and open, the septa being narrow, and there being no columellar tubercle, or, in some calices, only a microscopic rudiment. The top of the columella therefore forms a flat floor to the fossa, only sometimes the synapticular ring rises a little above its margin. It is generally solid, or nearly so.

This clear, deep fossa without columellar tubercle is very characteristic. Gravier's description of his *P. somaliensis* (p. 81) is very like this species : " C'est cette taille relativement trés grande des palis qui constitue l'une des characteristiques les plus frappantes de ce *Porites*. Dans la plupart des calices la saillie columaire est indiscernable." His figures, however, show a tubercle fairly frequently, and in Vaughan's (1918) specimen it is generally present, though small. Gravier's statement, taken alone, would apply equally well to *P. lutea*, as described by Klunzinger (1879, p. 40) and myself (1941, p. 24), but the pali of this latter are remarkably thick, and they hide the columella by being close together instead of leaving a wide fossa. The septa of " the triplet " in *P. stephensoni* are narrower than the others, the laterals often half their width ; they may be mere ridges, and joined, if at all, only deep down, immediately above the columella, where they meet the synapticular ring ; generally they are quite free. Pali on the paired septa are always tall, those on the single septum smaller ; on the " triplet " there may be one large one, three small ones, two small ones or none at all. In No. 377 the arrangement is the same as described above, but a small tubercle is sometimes present, and often the columella is looser, its radiating parts joining the synapticular ring like the spokes of a wheel.

No. 373 is a colony with a flat upper surface : here the pali are particularly well separated from the septa, and on some of the pairs they are " V "-shaped. A considerable area low down one side has shallow calices, thick septa, and inconspicuous pali. Some septa join over walls. Columella is solid, and there are no more traces of the columellar tubercle than in No. 381.

No. 262, an abnormally shaped colony, may have grown on a vertical surface. Septa and walls often thicker than normal; near the base much more so than in any other specimen. Columella solid.

No. 232 is lightly built, so some wheel columellae are present. Laterals of " triplet " very narrow, but joined low down oftener than usual. No trace of a columellar tubercle. This specimen is labelled by Matthai (but not in his hand) "*Porites* (? *P. haddoni*)."

No. 305 has deep calices ; thin, narrow, smooth septa ; very slender pali, spinulae at tops ; triplets mere ridges, and usually only four pali. Yet the walls are rather thick.

Stephenson, p. 130, remarks : " It is not impossible that more than one species provided us with planulae. The identification of *Porites* down to species is probably impossible in the field, and in any case there is no certainty as to what characteristics constitute specific limits in the genus, the matter being still within the realm of personal opinion." I have described this series in detail since, so far as only six samples go, it shows that only one species was dealt with, and that a particularly well-defined one.

It is of interest to compare the parents with the very young colonies bred by Stephenson, and illustrated on his pl. v. There is hardly any resemblance, except in the case of fig. 12 (a " colony of *Porites* from a larva, or larvae, which settled on clean materials fixed in a box in *Porites* pond "), which shows the conspicuous pali, single septal granule, and spinulation of this species. The chances are, therefore, that it belongs to this species, and that the differences from the other figures are due to age.

It is interesting to note that the ease with which young colonies of *Pocillopora* and *Porites*, and of these genera only, are obtained artificially is paralleled by the fact that corals found on artificial objects, *e.g.*, buoys and their chains, are nearly always species of *Pocillopora* (*bulbosa* or *damicornis*), or more rarely *Porites*. In particular I may mention tiles and clean pearl-oysters put down for the purpose of obtaining young colonies in a bed of a great variety of corals at Dongonab ; in the course of a year or more only these two genera appeared. Pearl-shells with attached corals are common in museums and curio-shops, but I found in Dongonab that, of the hundreds of thousands of pearl-shells cultivated a proportion of which spent four or five years among growing coral, very few indeed had young coral colonies on them. It is a mystery, as it is difficult to believe that the substrata were unsuitable, for the other conditions were those in which many species of corals flourished.

Besides the breeding series we have the following :

No. B.M. 233 is a minute scrap from Batt Reef, Patch No. 1, labelled *P. somaliensis* by Matthai. It is a little coarser than those of the series, but has no better development of the columella, and the fossa is quite open. The " triplet " is, perhaps, better formed, and fusion more frequent. These conditions can be matched on many areas of the series. The absence of a columellar tubercle, and the usually free ends of the " triplet," divide it distinctly from *P. somaliensis*.

In sample 122, a small scrap, the " triplet " is usually free, sometimes fused to a (synapticular) membrane. In places small columellar tubercles are frequent.

Sample No. 4 is similar to No. 122 in calicular characters, but the "triplet" is more often fused to a part of the synapticular ring. The corallum is a wholly detached nodule, covered everywhere with living calices, somewhat flattened, 45 mm. long, 37 mm. broad, about 27 mm. thick, with a somewhat undulating surface. It would be expected that movement of the corallum would bring every part into the same relationship to its surroundings, but the differences characteristic of the tops and bases of fixed colonies are found here, *viz.*, at one end and on one side are found deeper, thinner-walled calices and long, slender pali and thin septa; at the other end and other side distinctly shallower calices, stouter septa and shorter pali.

No. 62, B.M. 368, along with small colonies of *Stylaraea punctata* is encrusting an *Arca* shell from a mangrove passage. It has the usual thin perforated walls (they thicken below) besides the thick synapticular ring. This, and the large flat-topped columella-complex, close up the theca so that the loculi below its level appear as a ring of nearly round holes. The septa are fairly thick and coarsely granular on their sides, and the pali less conspicuous than usual; these are features of the shallower calices. Over the umbo of the shell the crust is thicker, the calices are deeper, etc., but the great, flat columella is found over the whole colony, though it is not always quite solid.

Sample 248 is one of the larger specimens, a nearly smooth column, attached by a narrow base, and narrowing again at the top; 8 cm. high, about 6·5 cm. at the thickest. The calices, etc., are typical. One side of the colony has delicate calices with very narrow triplet-septa; on the other side both are stouter. There are some few columellar tubercles near the base, but they are rudimentary.

Eleven specimens with such constant characters justify my creation of a new species, though I do so with reluctance. Examination of a larger series, including older colonies from varied habitats, might prove the deep, open fossa to be a phenomenon of youth.

It is conceivable that there was a columellar style or plate which has been reabsorbed during the breeding stage* to make room for the planula when the polyp is retracted, and the "triplet" may have been affected also, but it is all very unlikely.

Porites haddoni Vaughan.

1918. Vaughan, p. 197, pl. 87, figs. 1, 1*a* and 1*b* (with synonymy).
1925. *Porites lutea* Hoffmeister, p. 73, pl. 21, fig. 3.
1905. *Porites Solomon Islands*, 6. Bernard, p. 86, pl. viii, figs. 5–6; pl. xi, fig. 6.†
1938. *Porites lutea haddoni* Eguchi, p. 385.

Two larger specimens and a small nodule, Nos. B.M. 399, 406 and 231, belong to this species. The latter was named by Matthai, but it is less typical than the other larger ones, which are from Low Isles, 231 being from Batt Reef. The growth-form is markedly different in the two larger specimens. No. 399 is a piece broken from the edge of the top of a large solid mass, two fused and flat-topped columns being included, having a total width of 11 cm. The surface of both is undulating. No. 406 is a low summit from the top of a larger mass, the surface consisting of a number of mammillae; it is perfectly shown by Bernard's pl. xi, fig. 6 of his "Solomon Islands 6," which differs little, if at all, from this species.

* Bernard (1905), p. 21.

† The reference to pl. xi, fig. 6, is not given in Bernard's text, but in the explanation of the plates.

The walls are particularly delicate, and, in places, tall, their granules usually flattened in the same plane, projecting but little, and so delicately frosted as to be almost smooth. To the naked eye they form a delicate network over the surface of the corallum as in *P. stephensoni.*

The great difference between upper and lower calices of the sides of the corallum illustrated by Bernard, pl. viii, figs. 5 and 6, is even more striking than usual, and the shallow calices are not confined to the actual base ; this may be a specific character.

The correspondence with Vaughan's description is good, except that, like Hoffmeister, I should describe the columella as a " compressed granulated plate, but it is often styliform." Also " as a rule the pali are distributed according to Bernard's illustration 3 B " (*i.e.*, in the diagram on p. 19), " although they may be arranged as in 3 C."

I cannot agree that *P. haddoni* is a synonym of *P. lutea* until the stabilization of this species, demanded in my account of Forskaal's Collection, is carried out. Hoffmeister's fig. 3 corresponds to *part* of the Red Sea specimen attributed to Forskaal, but, for the present, the majority of calices must show the big, thick pali, etc., of my own and Klunzinger's figures before the name *P. lutea* can be applied.

Distribution : Great Barrier, including Murray Island ; Samoa, Palao and Solomon Islands. Probably also Fiji and Ellice Islands.

Porites lobata Dana.

1907. Vaughan, p. 196.

A small chip from the surface of a larger colony (Batt Reef, Patch 1, B.M. 236) is thus labelled by Matthai.

It would seem to be nearest to Vaughan's form *parvicalyx*, the portion he described in the middle paragraph of p. 201. The larger calices are 1 mm. across. This specimen is peculiar in that the tall, but imperfect synapticular ring above the edge of the columella is generally joined by the septa before they meet each other, so that the characteristic Poritid fusions cannot be made out, and, as the pali are very slightly developed, the bilateral pairs cannot be distinguished by their presence. In fact, in most calices, the septa resemble the spokes of a wheel joined to a thick hub. There is the further complication that, instead of a columellar style or plate, the synapticular ring is crossed irregularly by several delicate beams in any direction, nearly level with the tops of the small pali. Only rarely is a style or plate distinguished among them.

It is particularly unfortunate that this scrap is all we have of this interesting corallum.

Distribution : Hawaii, Fanning, Fiji and Samoa Islands. Now Great Barrier Reef.

Porites solida (Forsk.).

1918. Vaughan, p. 191, pl. 84, figs. 3, 3*a*.
1941. Crossland, p. 21, pls. i to iv.

There are only four samples of this species, usually so abundant, *viz.*, a small flat nodule, and a small piece of a crust tied together as sample 404, while Nos. 46 and 50 are pieces of the top edge of larger colonies.

Distribution : Red Sea (the Arabian towns of both sides of the sea are built of it) ; Cocos Keeling, where Wood Jones says it is very abundant. It will probably be found abundant throughout the Indo-Pacific when the synonymy, and confusion with *P. lutea*, are cleared up.

Porites australiensis Vaughan.

1918. Vaughan, p. 194, pl. 85, figs. 4, 4*a*, 5, 6 and 6*a*. (This gives also Bernard's reference numbers.)

A small nodule (Batt Reef, Patch 1, No. B.M. 234) is thus labelled by Matthai. It corresponds well with Vaughan's description and figures.

Distribution : Great Barrier Reef and Murray Island ; Philippines.

Porites sp. indet.

Sample 47 is a lamina, 7 cm. across the base, proximally 7 mm. thick. The calices recall those of *P. haddoni*, but I do not attempt identification of such a fragment, since I noted in Tahaiti (though not elsewhere) that both *Synaraea* species and solid species of *Porites* often form basally lamellar outgrowths, the calices of which vary greatly from those of the main masses.

Porites lanuginosa Studer.

(Plate LI, fig. 1.)

1901. Studer, p. 423, pl. xxix, fig. 9.
1907. Vaughan, p. 209 ; pl. lxxxvii ; pl. lxxxviii, figs. 1–1*a*.

The specimen dredged at Stn. XXV is rather larger than Studer's, being 17 cm. × 11 cm. above, and 19 cm. high ; 7 cm. was living, the rest being a narrower dead stalk, as in Studer's specimen, but larger. The broken attachment is only 3 cm. wide and 11 cm. long ; the dead part is rotted by the usual organisms, and its original surface removed : it is partly covered by lithothamnia, *Gypsina*, and a thin crust of *Montipora*.

Studer does not give the sizes of the calices, and from Vaughan's figures they seem to be 1·6 mm. across ; but this refers to a specimen supplied by Verrill. I therefore hesitated to identify this Barrier Reef specimen, in which the calices are only 1 mm. across, and many, even on the humps, rather less. But Studer's figure, being a colotype, is clearer than Vaughan's half-tone, and agrees with this example quite clearly, showing too that many of the walls are not so thin as in Vaughan's fig. 1*a*. Studer gives no illustration of calices, which I therefore supply, attempting to show the characteristic high, spinulate wall and septal granules which give the coral its " woolly," or better, velvety surface. The triplets are usually fused, and the laterals bend to the median, which bears one palus ; but they are often free and bear three pali, which may sometimes fuse side by side to a plate. Pali tall, palial synapticular ring not visible.

Distribution : Hawaii (Laysan) ; and now Great Barrier Reef.

Porites evermanni Vaughan.

1907. Vaughan, p. 194 ; pl. 80 ; pl. 81, fig. 2.

Sample No. 1 is, apparently, the half of a solid, conical mass, the vertical section being 13 cm. wide and 10 cm. high, with undulating surface—the whole very like the figure of *P. solida* on Plate I of my description of Forskaal's collection : the low projections are the tops of fused columns. It is quite different from the specimen figured by Vaughan on pl. 80 (but see the last paragraph of his description, in which he describes a series of growth forms parallel to Forskaal's of *P. solida*).

This specimen is remarkable for the lightness of its walls and septa over most of the surface, in spite of the weight and solidity of the colony as a whole. The synapticular ring inside the wall is conspicuous, but often incomplete. The differences from Vaughan's description are : (1) that the palus on the dorsal directive, always small, is often suppressed altogether so that there are generally 5 pali, not 6. (2) I cannot make out the forking of the septa against the wall, nor is it visible in Vaughan's figure. (3) In the very delicate calices of the upper parts the pali are often radially flattened.

The two ends of the specimen differ markedly in the strength of the walls and septa—another case where some ecological details are called for.

Distribution : Hawaii and now Great Barrier Reef.

Porites densa Vaughan.

1918. Vaughan, p. 201, pl. 89, figs. 2, 2*a* and 2*b*.

Sample Nos. 414 and 408 correspond exactly with the above description, except that, in some calices, there are definite pali.

No. 408 is a small, low mass 5 cm. in longer diameter and about 3 cm. in greatest height. No. 414 is broken from a solid mass, the broken surface 7 cm. thick and 9 cm. wide, not made of fused columns. Only an oval area, measuring 4 cm. × 7 or 8 cm., was living, the rest being covered with lithothamnia. In both cases the top is smooth, as in the type.

Distribution : Great Barrier Reef and Murray Island only.

Branched Species

Sidnie Manton (1935) refers to them on p. 289 and in pls. vii and xi. Specimens are small and rare.

Porites andrewsi Vaughan.

1918. Vaughan, p. 203, pl. 91, figs. 1, 1*a*, 2 and 2*a*.

1925. *Porites andrewsi* Hoffmeister, p. 77, pl. 22, figs. 2*a*–2*c*.

Bernard's " Queensland 12 ", " Fiji 1," " Tonga 8 and 9," and " Solomon Isles 9." Vaughan gives Bernard's " Fiji 1 " and " Tonga 8 and 9 " as " almost certainly " this species ; I omit the " almost " and add " Solomon Islands 9," which was overlooked by Vaughan, probably owing to an error in Bernard's reference to the plates. In the text (p. 89) he refers to pl. xii, fig. 1, in the Explanation of the Plates to pl. xi, fig. 7. The former corresponds to the description of " Caroline Islands 3 " (p. 94), the latter to the description given of " Solomon Islands 9," and is typical of this species.

There are three small fragments : samples 412–416 ; and a single branch dredged from Station XXVII that was tied to the lamina I have named *Porites* (*Synaraea*) *vaughani*, but not related to it : I take their being tied together to mean only that they are from the same station.

Sample 412 is a small piece consisting of a fork, each branch with three small branchlets ; it corresponds with both Bernard's and Vaughan's descriptions, but the growth form is more like Bernard's figure.

As Vaughan found, the peculiar arrangement of the " triplet," shown in Bernard's diagram " H " on p. 19, is only occasional.

Sample 416 is a broad fusion of two flattened branches, of equal size at the base, one of which aborts while the other grows on and branches. This branch bears low mounds on one side (possibly the beginnings of branches) and two short branches on its other side, which demonstrate their readiness for fusion (characteristic of the species) by attaching themselves to a piece of dead, lithothamnia-covered coral.

The dredged specimen is interesting in comparison with the one Mayer placed in "deep water" (about 5 fms.) where there was no appreciable current (Hoffmeister, 1925 p. 77, pl. 22, fig. 2*c*; Mayor, Memorial Volume, 1924, p. 55, and table 8, p. 71, pl. 19, fig. 24D). This branch is similar, *i.e.*, thin and round, but the calices are normal, almost quite level with the surface. A considerable part of one side is morbid, covered with broad flakes, among which calices are barely distinguishable. Clearly the habitat was unsuitable.

Distribution: Great Barrier Reef; Tonga, Fiji, Solomon and Samoa Islands.

Porites suppressa sp. n.

(Plate LI, figs. 2 and 3.)

No. B.M. 371 ("Nigger Head, Undine Reef. Branched massive *Porites*") is illustrated on Plate LI. The flat, much divided branch to the right is in marked contrast to the simpler, rounded, and more upright ones to the left; and, in view of the importance attached to growth-form by some authors, a further selection of branches would have been interesting. I take it that the word "massive" on the label, usually meaning "solid," here means that the colony was large.

The specific name refers to the fact that of the very short, thick septa several may be partly or wholly suppressed.

The walls have thin edges, covering the surface with a reticulation, as in several other species; the calices are filled up by pali and columella; but, except near the base, they cannot be called superficial. The walls are thickened below by broad synapticular rings, which bear thick, spinulose septal granules close to the wall much larger than those of the wall, which are upright, thin, and often circumferentially flattened.

Below these large granules the thick septa lie rather deep in the calyx, and are very short, joining a thick columellar ring, so that it is often impossible to make out the usual fusions. That several septa are suppressed is obvious. With care one can determine that these may be one of a lateral pair, one or both of the laterals of the "triplet," or the dorsal directive, the suppression may be partial or complete. It appears as though some lateral pairs were fused throughout their lengths. The sides of the septa are rough.

There are usually five tall pali, with rather swollen, roughened (not spinulate) ends, symmetrically surrounding a lower, but thick, prominent, and round columellar tubercle—thicker than in most species. A sixth small palus may be present on the dorsal directive, set back from the ring of the larger. Loculi appear rather as holes than slits, an outer circle between the synapticular rings, and about four minute holes between the inner ring and the columella. This describes the more open calices of the upper parts of the branches. Basally the walls and all granules thicken, the calyx becomes much shallower, and the loculi are obliterated, often so completely that the septa are invisible, except perhaps a low ridge or two. This thickening and shallowing extends over much larger areas on one side of the specimen than on the other. This species resembles Bernard's "*Tonga* 10" (p. 41, pl. ii, fig. 8; pl. xi, fig. 1) and, as Bernard himself remarks, "*Singapore* 7" (p. 187, pl. xxviii, fig. 7; pl. xxix, fig. 1). Bernard separates these species on account of the difference in growth forms, which seems to me quite insufficient. They differ from *P. suppressa* in having (1) smaller septal granules near walls ; (2) often 3 pali on the triplet, as shown in the figure ; (3) small columellar tubercle ; (4) more distinct septa ; (5) " the transverse section shows immense development of the horizontal elements." Sections of the new species show nothing of this.

Porites annae nom. nov.

(Plate LII, figs. 1 to 3.)

1905. *Porites " Great Barrier Reef* 26." Bernard, p. 129, pl. xvi, figs. 8 and 9 ; pl. xx, fig. 1.

I am placing four specimens in this species, though only one corresponds closely with Bernard's " Great Barrier Reef 26. " They are " Batt Reef, Patch 1, Square 11 " (the specimen just referred to) and Samples 213, 4, and 15.

Bernard's illustration, pl. xx, fig. 1, is of a far better grown example than any of these, which are, in comparison, stunted. They show the same fundamental structure, though it results, in two cases, in striking variations of form.

I therefore amplify Bernard's description. The base of the colony is an incrustation, not free at the edges, or only rarely and to a trifling extent free, which sends up small, columnar branches usually with rather thicker ends. (Measurements may be taken from Plate LII.) These may fuse basally or higher up, in the latter case enclosing cavities. In the Batt Reef specimen and in No. 213 these branches are hardly more than knobs, whilst in No. 4 some attain a length of up to 35 mm., though the longest *free* branch is only 15 mm. In No. 15 some are regular columns 40 mm. high, but of these four, with some smaller, are completely fused by their sides to form a nearly straight-topped plate. In the Batt Reef specimen there is a fusion at one end into a solid mass, the columns composing which are visible on the surface only to the same extent as in normally solid growths. The difference between the calices of the tops and those of the sides of the branches is not always so marked as in Bernard's description ; fairly deep and thin-walled calices may extend down the sides, though those on the basal crusts are always superficial. I do not find eight pali constantly : this number is only made up when there are three on the " triplet " and one on the dorsal directive, besides the usual four on the lateral pairs ; and, in all the cases I have seen, the " triplet " bears three pali only occasionally (it may bear only one in the very next calyx) and the dorsal palus may be rudimentary or absent. The walls " here and there surge up into a loose filamentous reticulum ; it is this which causes the colony to rise into branches." In my view the appearance of this reticulum is the first stage in budding—which may be the same thing. " The septa are thin and irregular in shape and position " (this is not apparent in Bernard's fig. 8) ; the pali, on the other hand, form a conspicuous ring of eight small, frosted points or plates." In these specimens these exceptionally lightly made calices are not found on the tips of all the branches ; they are present, but rather exceptional, and are clearly a stage of growth ; in many cases the septa are regular, fairly thick, and with well-formed *rounded* pali even on the tops of branches. On their sides they are always like this, with pali conspicuous throughout, and, on the shallow calices of the basal crusts, remarkably thick and spinulose.

Distribution : Great Barrier Reef of Australia only.

Subgenus *Synaraea.*

Porites (*Synaraea*) *vaughani* sp. n.

(Plate LIII, figs. 4–5.)

From Stn. XXVII (dredge) a free, squarish lamina, 5 cm. across, about 5 mm. thick at one side, which is dead, very thin on the others, covered underneath with epitheca concentrically ridged, partly overgrown with sponge, polyzoa, etc. The main peculiarity of the species is that the broad coenenchymal ridges also bear calices, though more widely separated than those in the valleys. For details I refer to the plate. This shows that the calices in the valleys do not fall into rows, and are generally a little under 1 mm. across, while those on the mounds are a little wider. Those in the valleys are the more distinct because their loculi are more open and deep as well as nearer together. The coenenchyme forms rounded ridges, about 1 mm. high, finely spongy, bearing numerous, small, upright, spinulate processes. Septa very thick in all cases, spinulose on sides as well as edges, thus closing up the loculi still further. There are two granules on each septum between wall and palus, but they are often confused in the general spinulation. In spite of this the typical arrangement of the septa is easily seen : the " triplet " is free, and bears one to three small pali, or none ; the triplet septa are shorter than the others. All pali low, but thick ; spinulose, generally distinct, but often no more than an emphasis of the general spinulation. The central fossa is open, and there is no columellar tubercle.

I am taking this to be the expanded base of a branched corallum. It is close to Bernard's " Great Barrier 9," " North West Australia 4 " and " China Sea 10 " which, when more material is available, may turn out to be all the same, in spite of wide difference in growth form of one of them. The distance between Macclesfield Bank in the China Sea and Low Isles is now known to be not at all too great for them to be the homes of the same species, as was thought possible in Bernard's time.

I am naming this species after Dr. T. Wayland Vaughan, as a slight recognition of the immense and fruitful work he has accomplished, especially in this genus, of which he is, in fact, the pioneer investigator.

Porites (*Synaraea*) *hawaiiensis* Vaughan.

1905. *Porites* " China Sea (19) 3," Bernard, p. 167, pl. xxv, fig. 9.
1907. *Porites hawaiiensis* Vaughan, p. 216, pl. xci, figs. 2, 2*a*.
1925. *Porites* (*Synaraea*) *horizontalata* Hoffmeister, p. 80, pl. 23, figs. 3*a*–3*b*.

Two very small, but complete, colonies were dredged from Station XXIV. They form thin crusts completely attached to substrata not now recognizable owing to decay. Their outlines are irregular, 40 mm. and 14 mm. across. The surface of the larger specimen is smoothly undulated ; whether this is due to irregularity of the substratum cannot be said. The scattered calices would be inconspicuous but that the thick walls and coenenchyme rise a very little between them : it does not rise up into ridges.

The calices are about 1 mm. in diameter, with about the same between their walls ; they are almost completely filled up by the thick septa, even the central fossa being only a minute hole—too small to allow any columella to be seen. The septa fuse in the usual ways, the lateral pairs and the central of the " triplet " bearing the five conspicuous pali. The triplet is fused, but occasionally one of the laterals may not reach the fusion of the other two. The pali are often not more conspicuous than the septal and mural " granules," which are upstanding pillars of much the same shape, and, like them, well spinulate.

Details of wall structure cannot be made out ; the space between loculi of adjacent calices is a spongy mass, in which thick, horizontal elements bear upright processes, spinulate like those on the walls and septa. This seems to be a distinctive character, dividing the species from some described by Bernard. In some places these processes are smoothed away, not by abrasion, but by some morbid process by which the reticulum is thickened almost to solidity—far beyond what is shown in a normal section, where the horizontal elements are seen to be very thick and solid.

The minute second specimen is much smoother, in fact as perfectly smooth as any *Porites*. The calices are nearer together, and would be quite invisible to the naked eye if the walls did not rise very slightly. The pali are less conspicuous, tending to merge with the other spinulose granules. Otherwise it is like the preceding.

These specimens are the encrusting, first growth-stage of the species described by Hoffmeister, which is the reason for giving an independent description. It is also possible that the Samoan specimens are the young of larger, possibly branching, species (c.f. the note on *Porites sp.* above.) It is to be noted, however, that Hoffmeister had three specimens all, like these, dredged.

They are also the young of the species described by Vaughan and Bernard, differing in that the ridges characteristic of *Synaraea* are present only as traces in the larger Barrier Reef specimen, and are absent in the smaller—a difference due only to youth. In his text Vaughan gives the diameter of the calices and their distance apart as only 0·5 mm., but both his figures show 1 mm. The columellar tubercle also is rarely seen in these specimens, more often in the smaller. It is in all cases minute.

Distribution : Macclesfield Bank ; Hawaii ; Samoa ; and now Great Barrier Reef. Always dredged.

HYDROCORALLINAE.

[Order MILLEPORINA.]

Genus *Millepora.*

Stephenson and others describe the wide distribution of *Millepora* from the mangrove swamp to the reefs. S. Manton also finds it widely distributed on the reef flats to the crest of Yonge Reef, but of large size only below low water (p. 298). On the third 100 feet of the slope of Traverse III (to windward) " *Millepora* forms very large branching colonies " and, further out," other corals identifiable from a boat are luxuriant, such as large Montiporas, branching *Millepora*, etc." Otherwise, judging from her scale drawings, the specimens seen are very small, except those on the coral head (pillar) of Plate XII, where a finely branched colony, 72 cm. across, and dome-shaped, occupies the summit. Apparently the big, upright plates of *M. dichotoma* or the solid honeycombs of *M. platyphyllia* do not exist on the Great Barrier Reef, nor any of the Tahaitian or Marquesan forms. Hickson (1898, p. 256) gave it as his opinion that all the species of this genus are really one, though, in conversation, he said that he could generally say where any given specimen had come from. Vaughan (1918, p. 206), after quoting Hickson says, "but it is at least convenient, if not systematically sound, to recognize by distinctive names the different aspects presented by colonies." In 1941 I gave reasons for thinking that there are three species, genetically distinct, in the Red Sea, though I am still unable to decide whether the Tahaitian forms I described (1928, p. 727) are one or several species. *M. alcicornis*, of the West Indies, I believe to be distinct. So far as the small samples from the Barrier Reef are evidence I believe we have two or three species here, one of which is the first species in which a distinction has been based upon the actual structure of the corallum.

Millepora tortuosa Dana.

(Plate LIII, figs. 1 and 2.)

1848. Dana, p. 545, pl. 52, figs. 3, 3*a–b*.

The four small pieces present might possibly be taken for early stages of colonies of *M. dichotoma* F., but, as far as my recollection goes, growths of this size would show the beginnings of regular reticulate plates, whereas these show no regularity at all. For the growth-form of a full-sized colony we have the diagrammatic figure given by S. Manton on Plate XII, which shows a low dome, 81 cm. across, covered with comparatively short branches (*i.e.*, the form is truly cespitose).

According to Dana the small size of the pores is diagnostic. I find here that in some specimens the pores are quite large, but all agree in being remarkably shallow, and therefore inconspicuous. The variation in their numbers is large, but this is often the case in other species. Specimen No. 189 shows an unusual regularity of form, but is in no way different from the others. No. 409 is a solid plate with few irregular branches, much infested by cirripedes. No. B.M. 427 may or may not be a distinct species. It is broken to pieces, but the illustration shows its peculiarly loose and round branches. It was dredged from Stn. XXVII, so the habitat may account for these peculiarities. It agrees with the reef-specimens in the scarcity and shallowness of the pores. The species differs physiologically from *M. dichotoma* F. in becoming white on drying, as does the species, described by Vaughan from Cocos Keeling, to which he gives this latter name ; but *M. dichotoma* of the Red Sea keeps its rusty brown colour after drying, and even after maceration.

Distribution : It is impossible to give the distribution of any form of this genus. It can be said, however, that this one does not occur in the Red Sea, nor in Tahaiti, and, apparently, not east of Fiji.

Millepora foveolata sp. n.

(Plate LIII, fig. 3.)

Four specimens, P. 20, 31, 411 and 252, encrusting dead coral ; with a note that it often covers unattached pieces.

They are now [12.iii.1942] of a light greenish colour, and all have a nodular surface, which, unlike "*M. verrucosa*," is not due to parasites. The most nodular, P. 20, is infested with cirripedes, but they choose the flat sites between nodules, or, if they occupy a projection they actually flatten it and the area round them. No. 31 is much smoother ; over most of its surface it is undulating rather than nodular. Certain parts of it are infested with numbers of small polychaeta, probably Spionids, as well as a few cirripedes ; but these have no effect upon the structure of the surface now to be described. The projections are not wart-shaped, but rather irregularly columnar, as shown on Plate LIII.

Similar encrusting growths of the same colour and smooth or not are common everywhere, abounding in the northern Red Sea for instance ; but the present ones differ even to the naked eye, to which they seem to be crowded with large pores. Under a lens this is seen to be due to each pore, or a short row of dactylopores, being at the bottom of a funnel-shaped depression formed by a sharp ridge. Dactylopores surround gastropores in the usual way ; the former are more numerous than usual, and often two circles round one gastropore can be made out. The ridges do not surround a set of gastro- and dactylopores, but each separately.

No. P.20 is practically the same on all sides, but with smooth areas between the projections on one side ; No. 31 is completely foveolate on one side, most of the underside smooth ; No. 252, an irregular growth which does not extend onto the underside of its foundation, has considerable smooth areas between the projections ; No. 411, a very small piece broken from a fixed mass, is typical.

Millepora sp.

Possibly *M. platyphyllia* Dana, which is not Ehrenberg's species of the same name from the Red Sea, as Hoffmeister has already remarked ; specimens resembling these of the Great Barrier Reef have not been seen in the Red Sea.

They consist of three small pieces broken from the tops of small plates, ending in irregular, flattened, finger-shaped lobes, two or three of which may fuse to make a broader expansion.

An interesting point is their heavy infection with a cirripede, the same as that found rarely in *M. foveolata*, which, unlike the case of "*verrucosa*" examined by Hickson and verified by me in the Red Sea, do not produce wart-like projections of the surface. Many make no alteration at all ; others are on low flat raised areas ; but it is doubtful how far these are caused or modified by the cirripede, as there is generally a mere film of *Millepora* over the cirripede, which has a quite flat, not conical, upper surface. It is impossible to give a name to these few pieces of such a general type of *Millepora* without an intimate personal knowledge of the Great Barrier Reef fauna. Hoffmeister may or may not be right in placing Dana's *platyphyllia* and *squarrosa* var. *incrassata* under *M. truncata* Dana. This species is perfectly smooth, with numerous and conspicuous pores. It is white when dry.

[Sub-class] ALCYONARIA.*

[Order COENOTHECALIA.]

Heliopora coerulea.

The single specimen brought home, No. 58, is of the form in which solid plates end in slender vertical branches. Some of them are fused together, others free, as illustrated by Milne Edwards and Haime (1857*a*), pl. F. 1, fig. 3*a*. Another form, in which large radiating plates end in rounded lobes, is shown in Yonge's Year on the Great Barrier Reef, pl. xvii A ; and in Gardiner's (1931) Coral Reefs and Atolls, pl. xii. Hickson (1924, p. 118) says : "The form of the colony is very variable. It may be branched like a stag's horn Madrepore, laminate, or almost massive, but the ends of the branches are usually blunt and lobed. It sometimes reaches a size of three or four feet in diameter by two or more in height." It

* Crossland wrote "*Alcyonariidae.*"

is a great reef builder, though usually best developed in lagoons; witness the frequent references to it in Gardiner's descriptions of Indian Ocean and Pacific reefs.

Distribution: Indian Ocean, from the Laccadives to the Seychelles, but not in the Red Sea. Present in Malaysia and the Pacific to Funafuti; not recorded from Samoa, and not present in Tahaiti.

Tubipora musica.

Stephenson and others describe this species as present almost everywhere, from Low Isles to the crest of Yonge Reef, on which S. Manton shows (pl. xiv) two large colonies, the larger 63 × 36 cm. As she did not meet it on the traverses it is presumably rare at Low Isles;† it is generally more abundant and larger on outer reefs, always so in the Red Sea.

For the specific identity of all varieties see Hickson‡ (1924 p. 115). He examined many hundreds of specimens from the beach of Celebes, and many scores alive, and found that every variety known could be found on that one shore.

It was sold in Arab drug shops in Jerusalem at least as late as 1918.

Distribution: Northern Red Sea; throughout the Indian Ocean and Pacific; but not recorded from Samoa; and not present in Tahaiti.

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† Yonge (1930, p. 49) says "absent." Stephenson and others (1931, p. 71) say "rare."

‡ Crossland, in his typescript, referred also to Hickson's paper in Quart. J. micr. Sci. London, XXIII, 1883. But in it there appears to be no reference to the specific identity of all varieties of *Tubipora*.—[A.K.T.]

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INDEX

DESCRIPTION OF PLATE I.

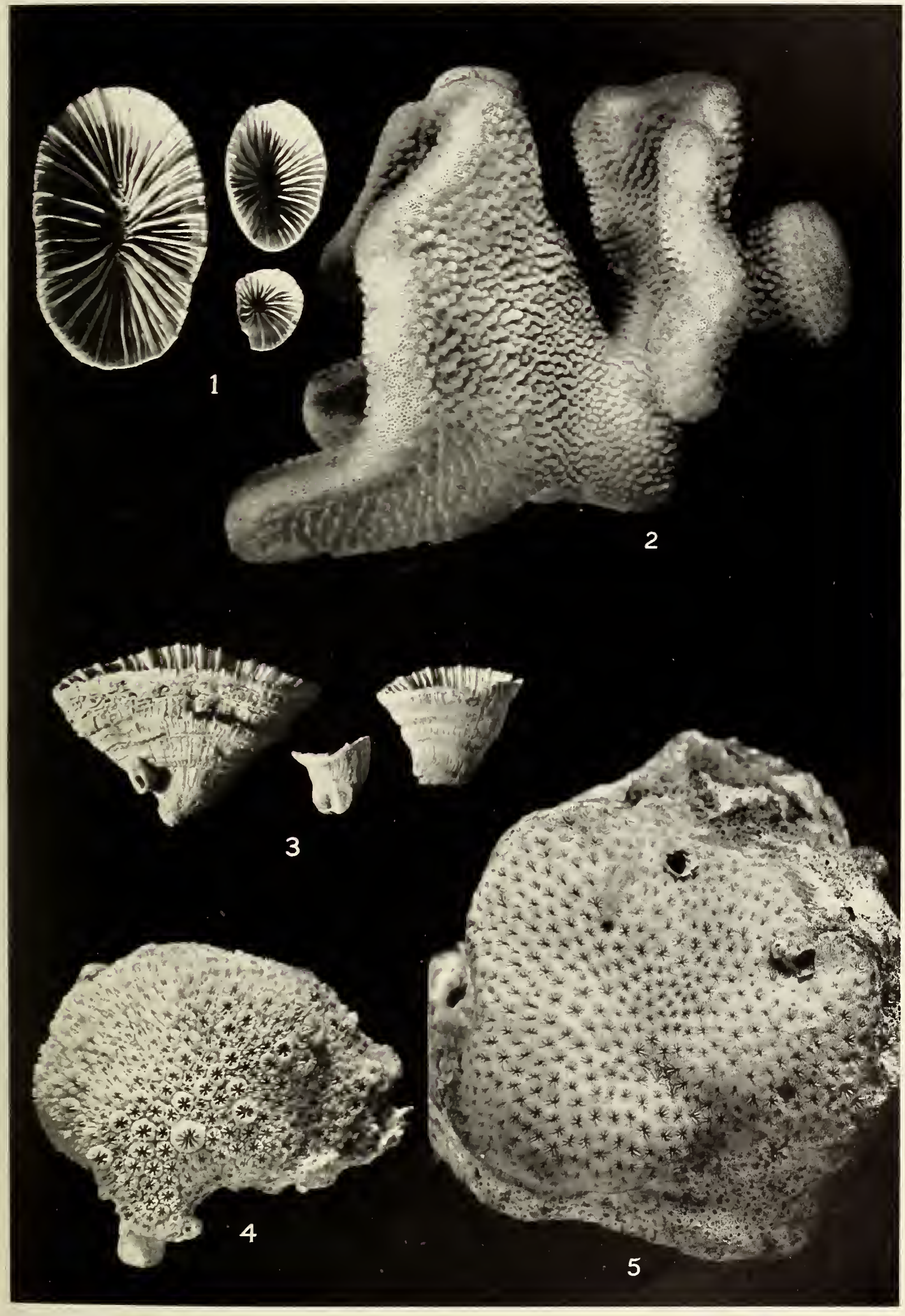
FIG. 1.—*Flabellum vacuum*, sp. n. × 1·1.
B.M. Reg. No. 1934.5.14.620.

FIG. 2.—*Pocillopora eydouxi* M. E. and H. × ·5.
G.B.R.E. No. 629.

FIG. 3.—*Flabellum vacuum*, sp. n. × 1.
B.M. Reg. No. 1934.5.14.620.

FIG. 4.—*Leptastrea bottae* M. E. and H. × 1.
G.B.R.E. No. 407.

FIG. 5.—*Leptastrea purpurea* Dana. × 1.
B.M. Reg. No. 1934.5.14.420.



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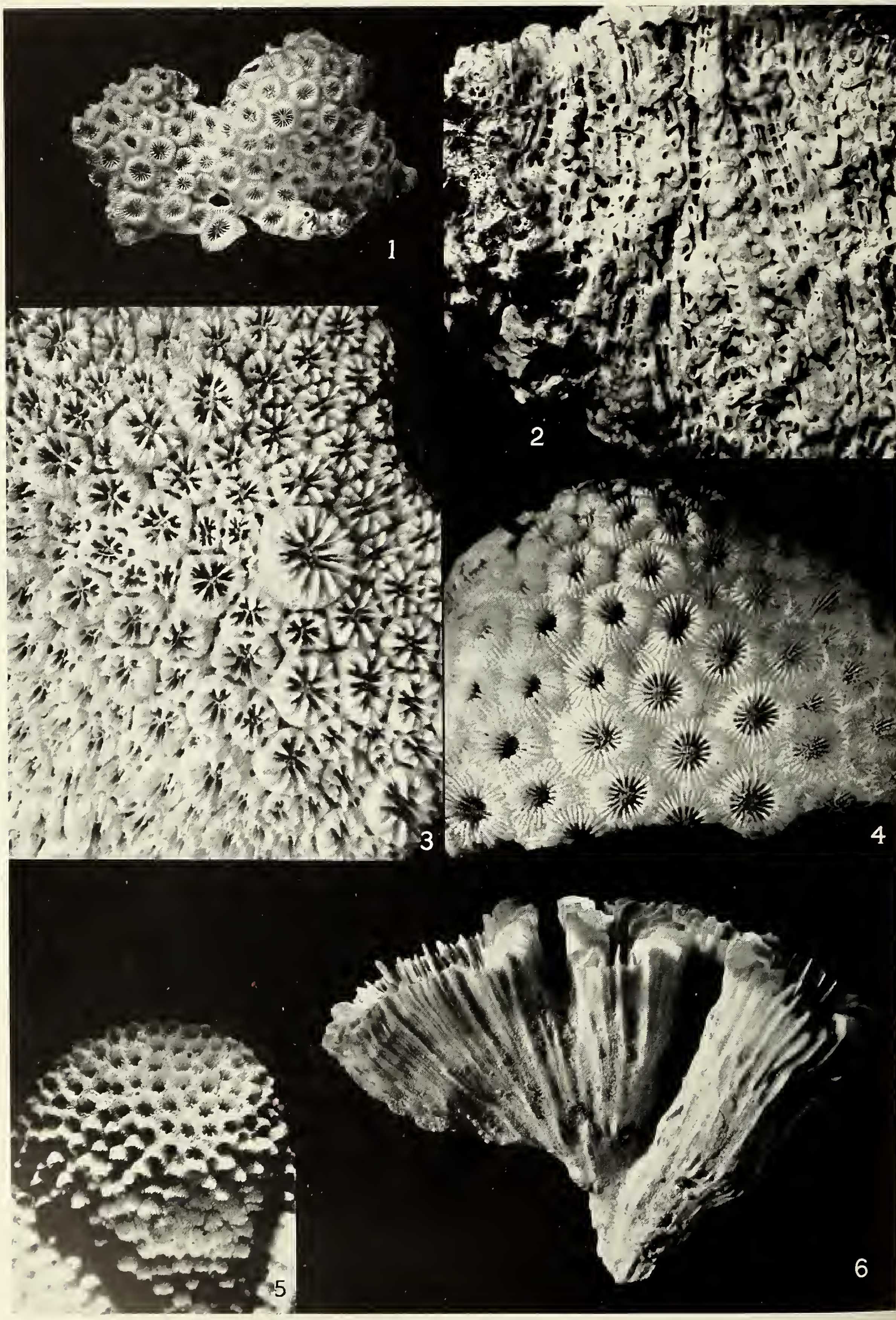

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DESCRIPTION OF PLATE II.

FIG. 1.—*Orbicella vacua*, sp. n. × ·8.
G.B.R.E. No. 400.

FIG. 2.—*Leptastrea bottae* M. E. and H. × 3·5.
B.M. Reg. No. 1934.5.14.444.

FIG. 3.—*Leptastrea bottae* M. E. and H. × 3·8.
B.M. Reg. No. 1934.5.14.444.

FIG. 4.—*Orbicella vacua*, sp. n. × 2.
G.B.R.E. No. 433.

FIG. 5.—*Stylophora septata* Gardiner. × 3.
G.B.R.E. No. 369.

FIG. 6.—*Euphyllia glabrescens* (Chamisso). × 1·6.
G.B.R.E. No. 431.

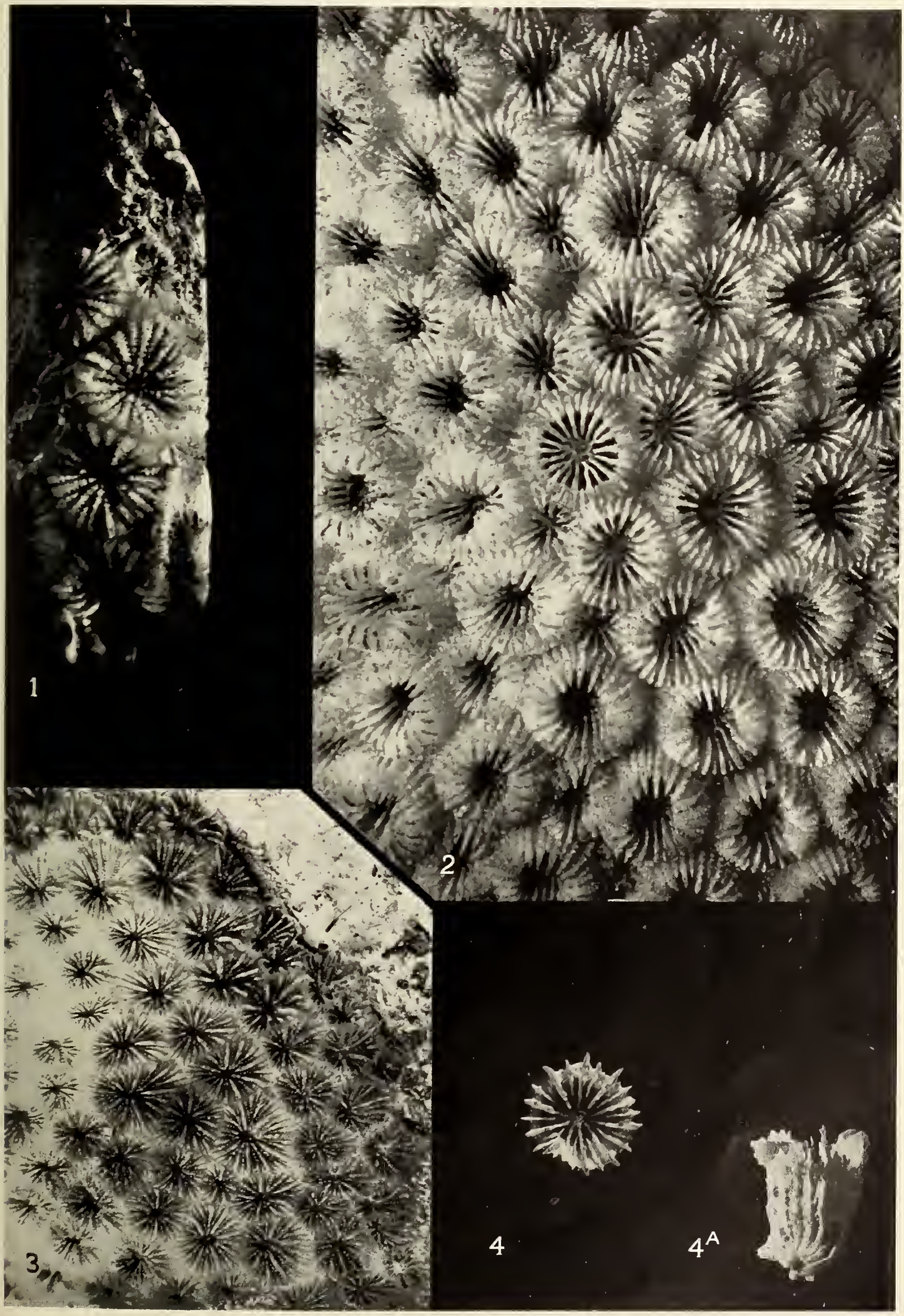
DESCRIPTION OF PLATE III.

FIG. 1.—*Leptastrea pruinosa*, sp. n., Holotype. × 4·9.
B.M. Reg. No. 1934.5.14.630.

FIG. 2.—*Orbicella vacua*, sp. n. × 3.
G.B.R.E. No. 433.

FIG. 3.—*Leptastrea purpurea* Dana. × 3.
B.M. Reg. No. 1934.5.14.420.

FIGS. 4–4*a*.—*Caulastrea simplex*, sp. n., Holotype. × 2.
B.M. Reg. No. 1934.5.14.615.



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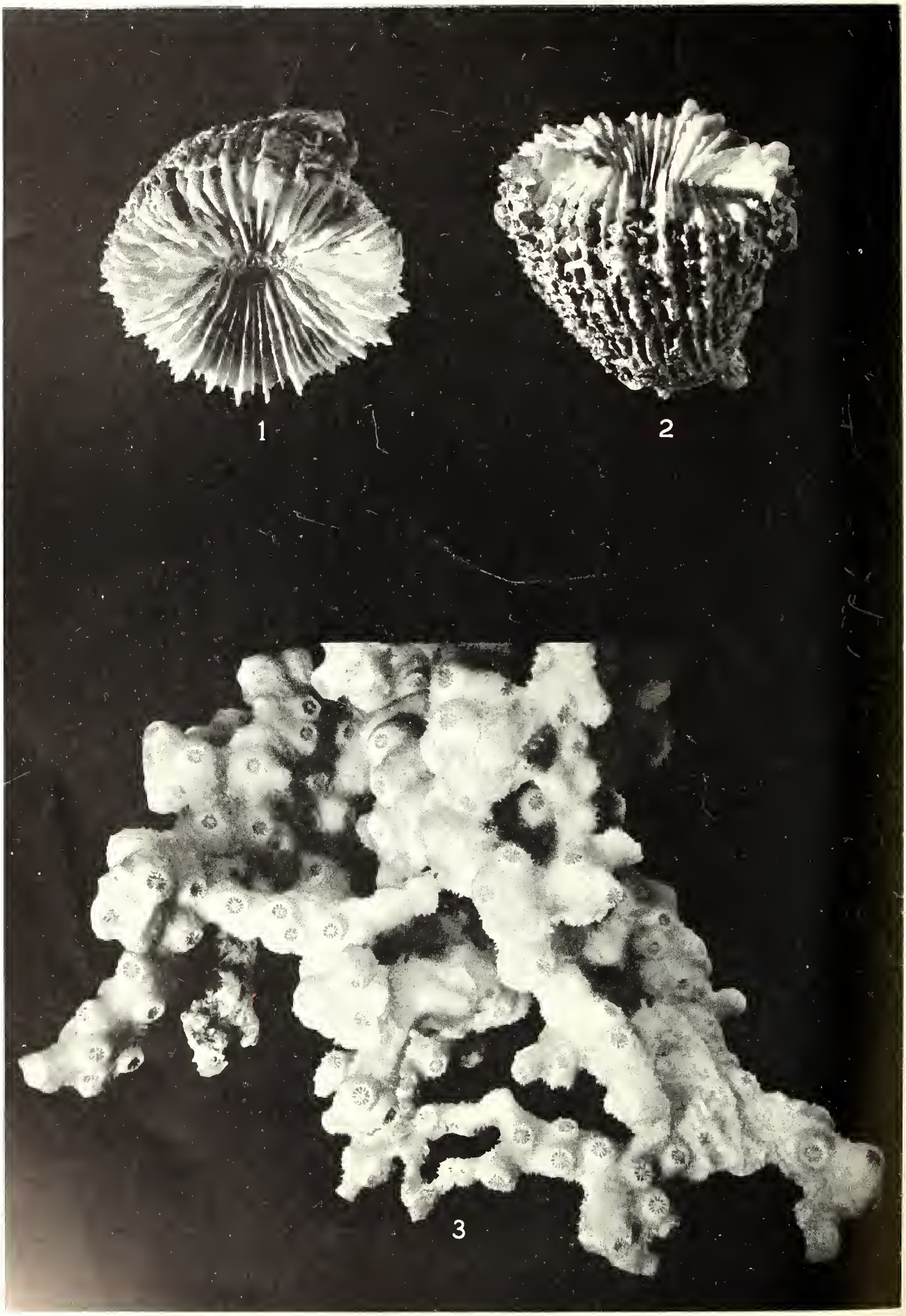

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DESCRIPTION OF PLATE IV.

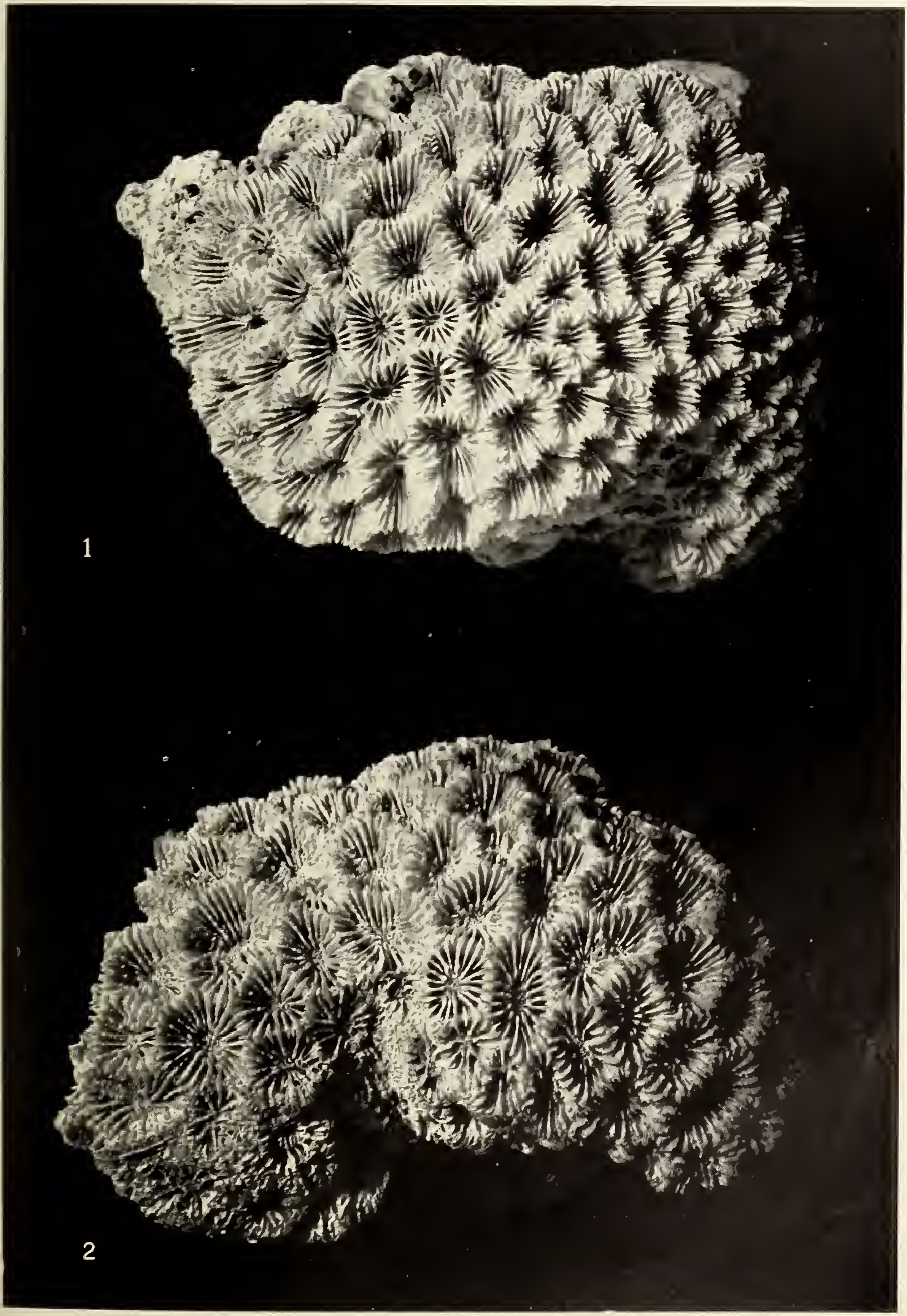
FIGS. 1 and 2.—*Cynarina savignyi* Brügg. × 1.
B.M. Reg. No. 1934.5.14.492.

FIG. 3.—*Echinopora horrida* Dana. × 1.
G.B.R.E. No. 26.

DESCRIPTION OF PLATE V.

Fig. 1.—*Favites aspera* Verrill. × 1·3.
G.B.R.E. No. 166.

Fig. 2.—*Favites aspera* Verrill. × 1·5.
G.B.R.E. No. 155.



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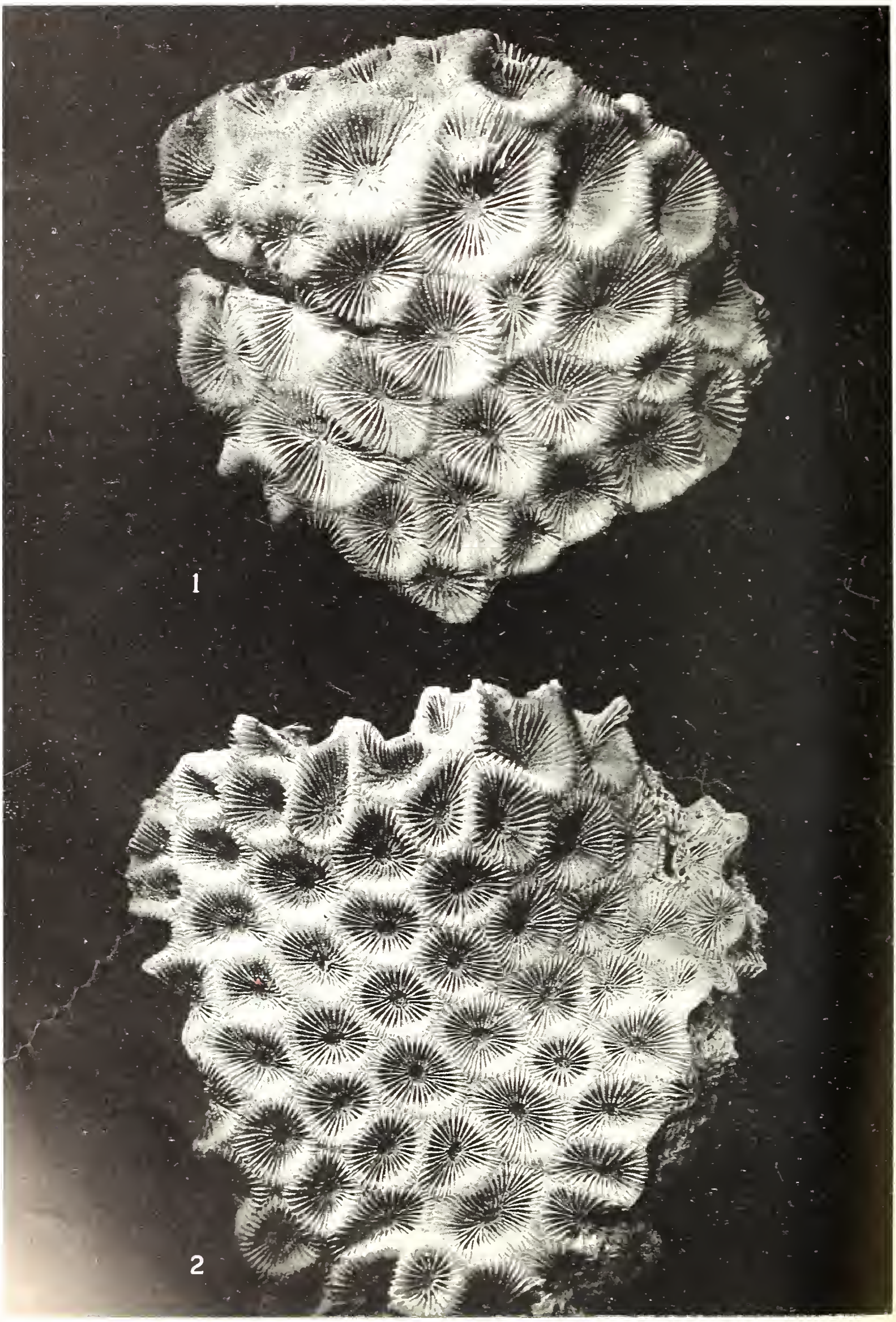


[Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE VI.

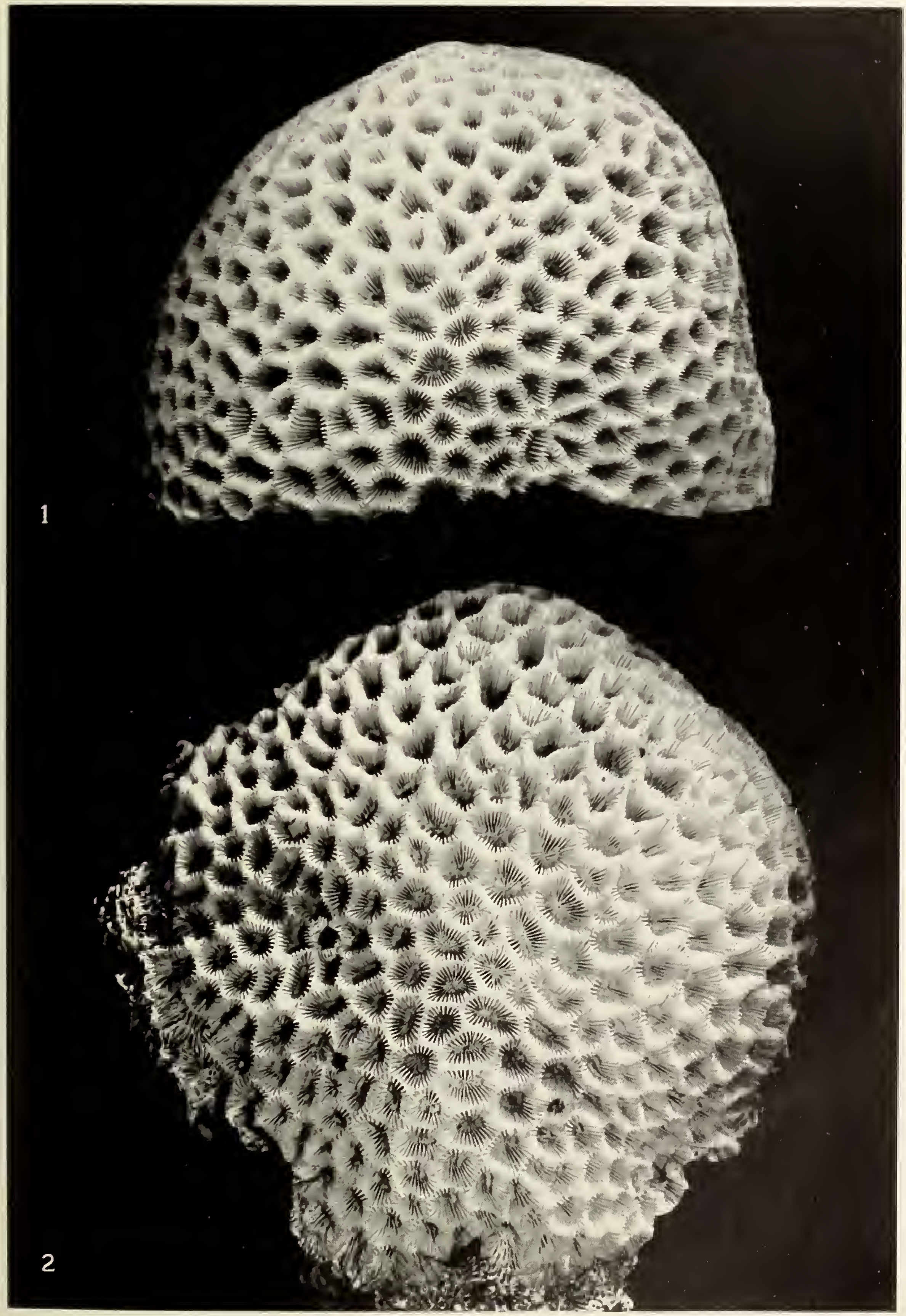
FIG. 1.—*Favites virens* Dana. × 1.
G.B.R.E. No. 114.

FIG. 2.—*Favites virens* Dana. × 1.
G.B.R.E. No. 115.

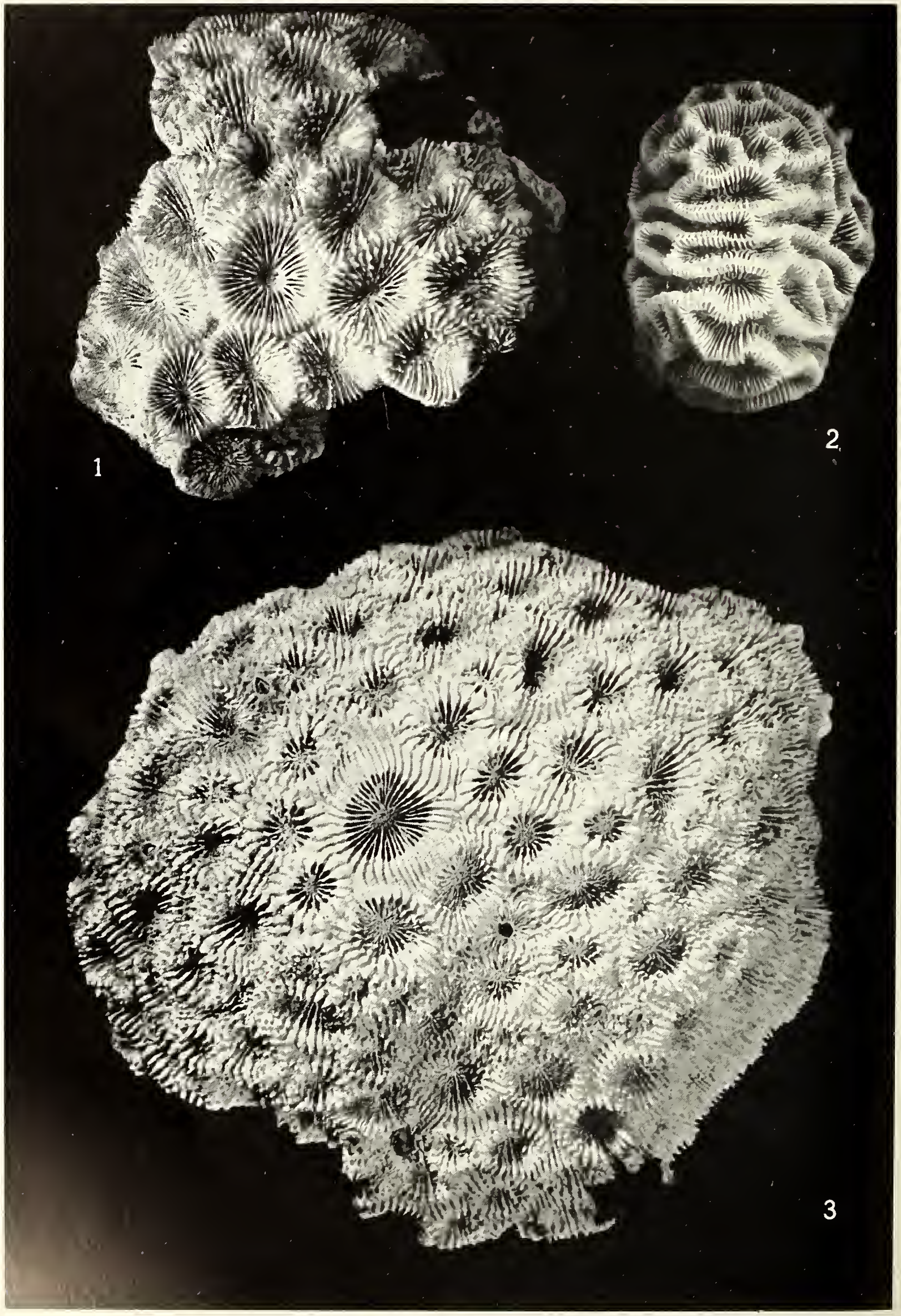
DESCRIPTION OF PLATE VII.

Fig. 1.—*Goniastrea mantonae*, sp. n. $\times$ 1.
G.B.R.E. No. 120. K5.

Fig. 2.—*Goniastrea mantonae*, sp. n. $\times$ 1.
G.B.R.E. No. 128.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE VIII.

Fig. 1.—*Acanthastrea echinata* Dana. × 2.
G.B.R.E. No. 151.

Fig. 2.—*Goniastrea benhami* Vaughan. × 1.
G.B.R.E. No. 51.

Fig. 3.—*Acanthastrea echinata* Dana. × 1·2
G.B.R.E. No. 144.

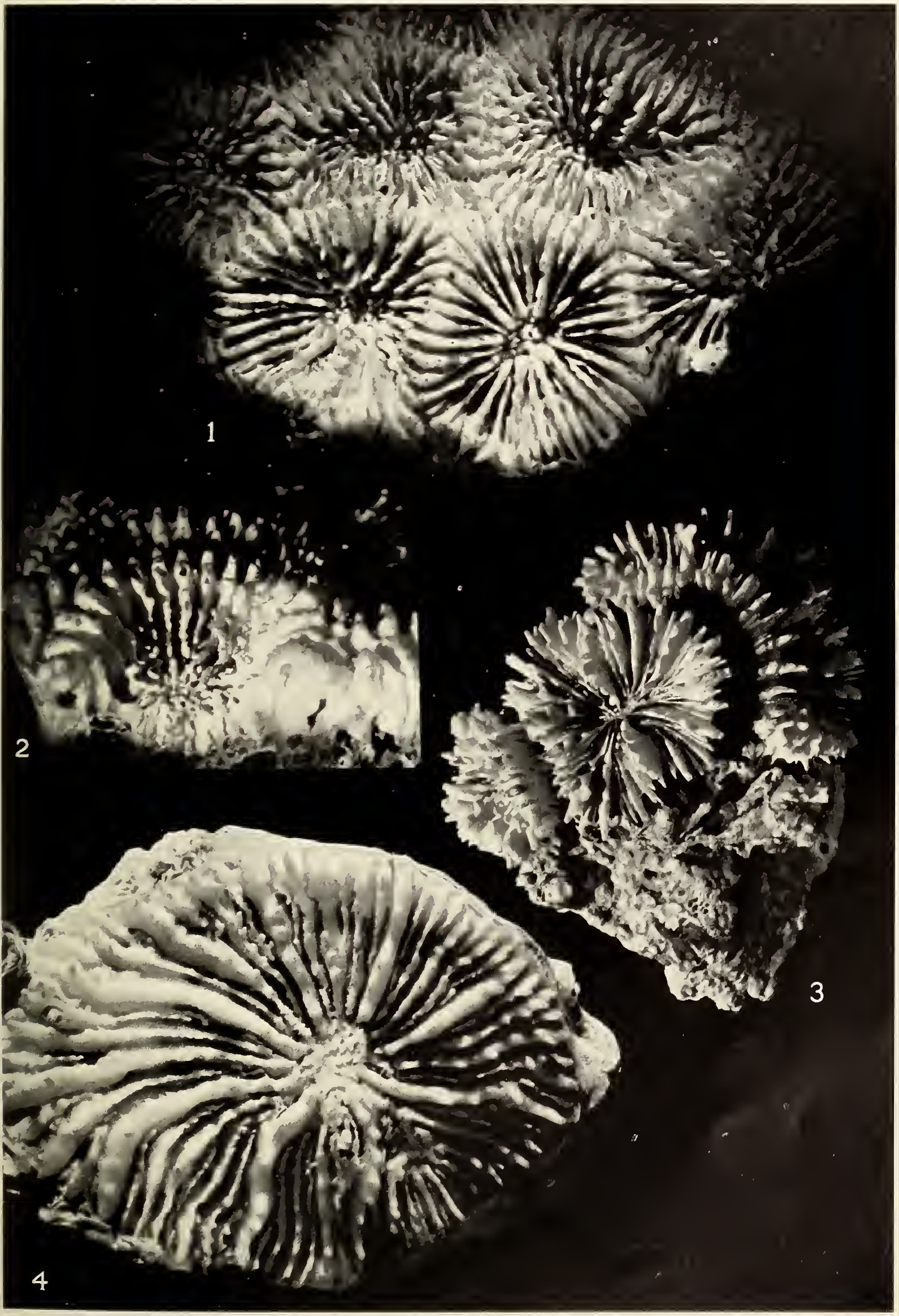
DESCRIPTION OF PLATE IX.

Fig. 1.—*Acanthastrea echinata* Dana. × 3.
G.B.R.E. No. 151.

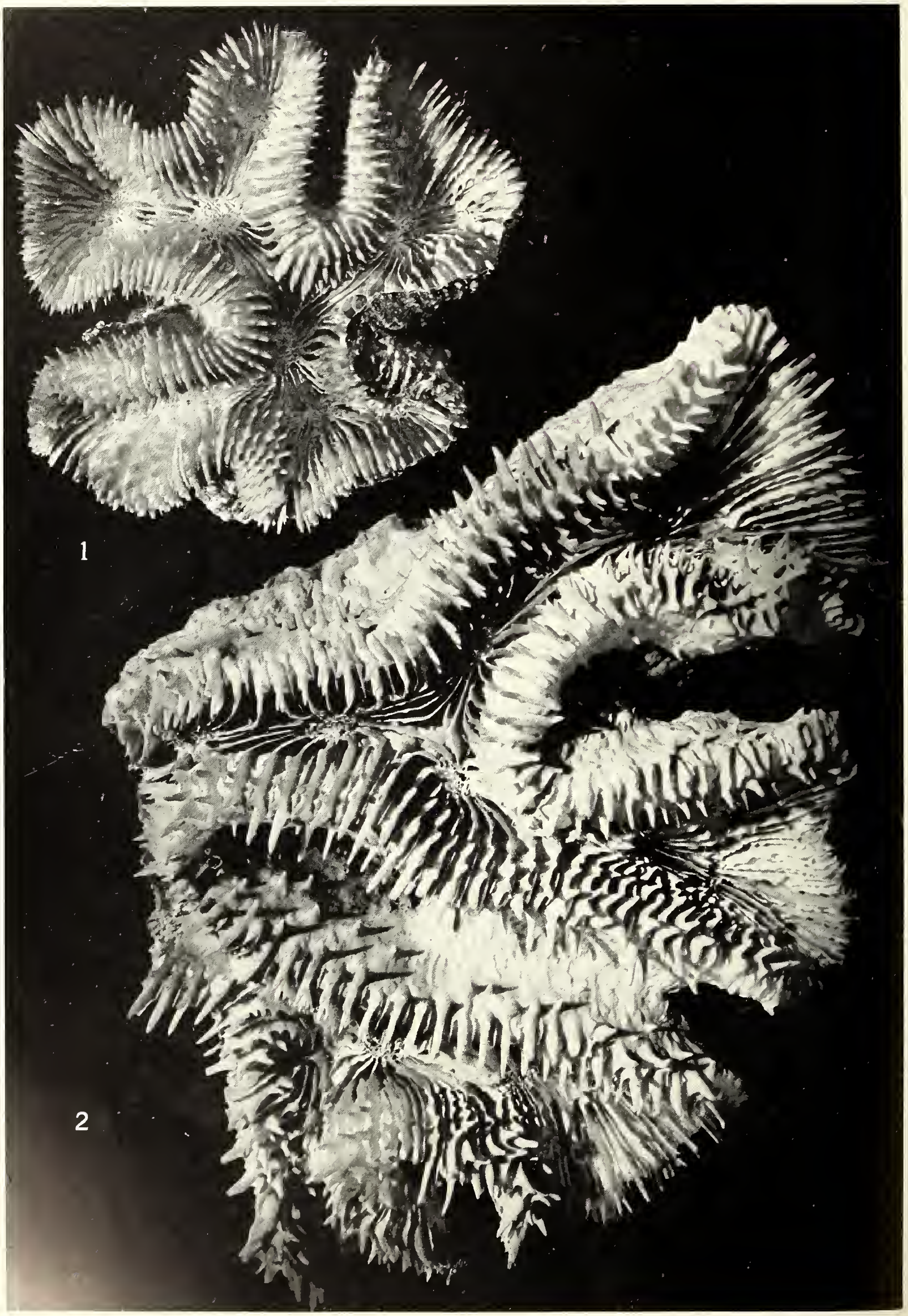
Fig. 2.—*Acanthastrea echinata* Dana. × 3.
G.B.R.E. No. 144.

Fig. 3.—*Lobophyllia corymbosa* (Forskål). × 1.
G.B.R.E. No. 447.

Fig. 4.—*Lithophyllia vitiensis* (Brügg). × 3.
Stn. XXIV.
B.M. Reg. No. 1934.5.14.410c.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE X.

Fig. 1.—*Lobophyllia hemprichii* (Ehr.). $\times$ 1.
G.B.R.E. No. 450.

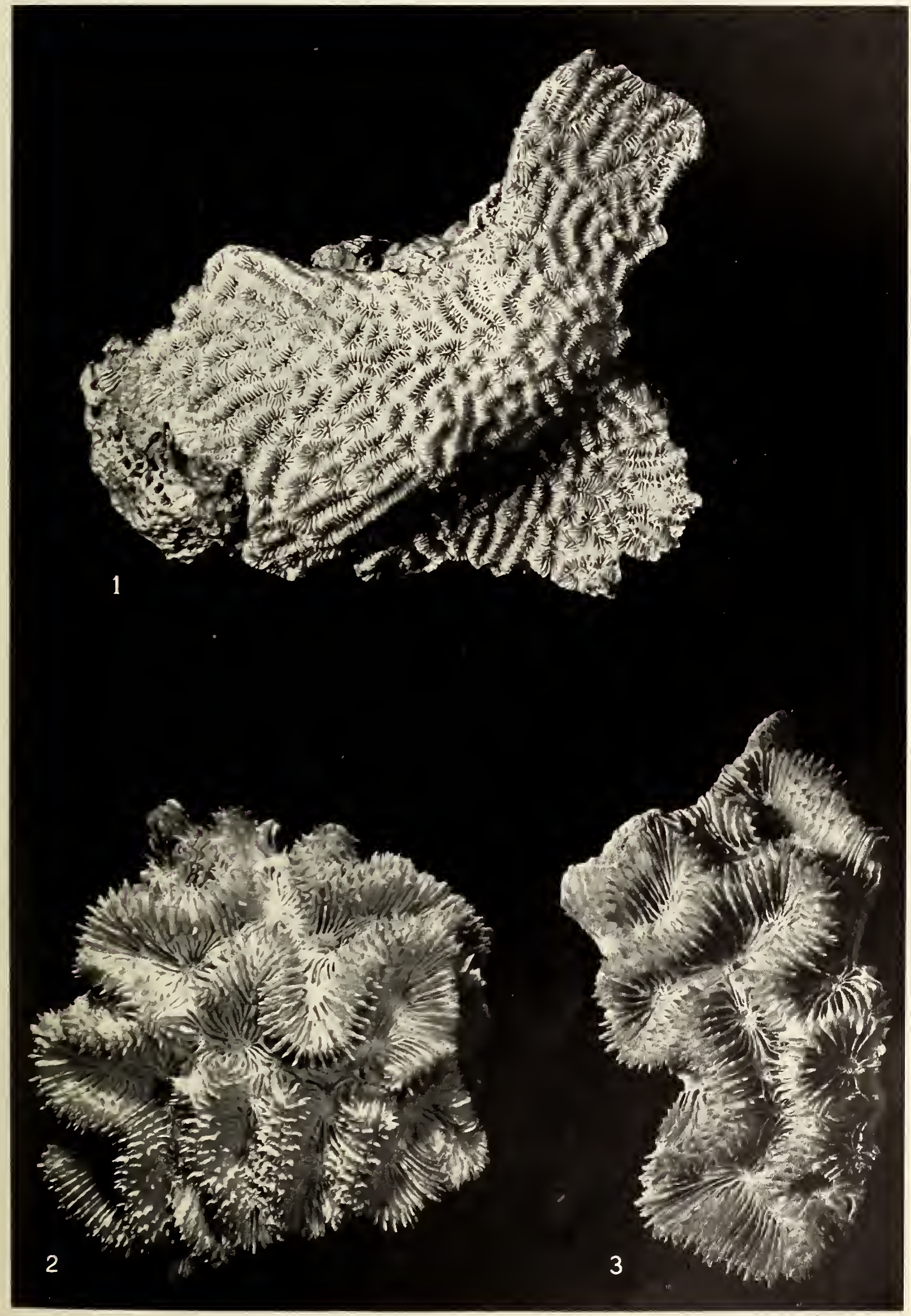
Fig. 2.—*Lobophyllia hemprichii* (Ehr.). $\times$ 1.
B.M. Reg. No. 1934.5.14.380. Stn. No. 2, Low Island.

DESCRIPTION OF PLATE XI.

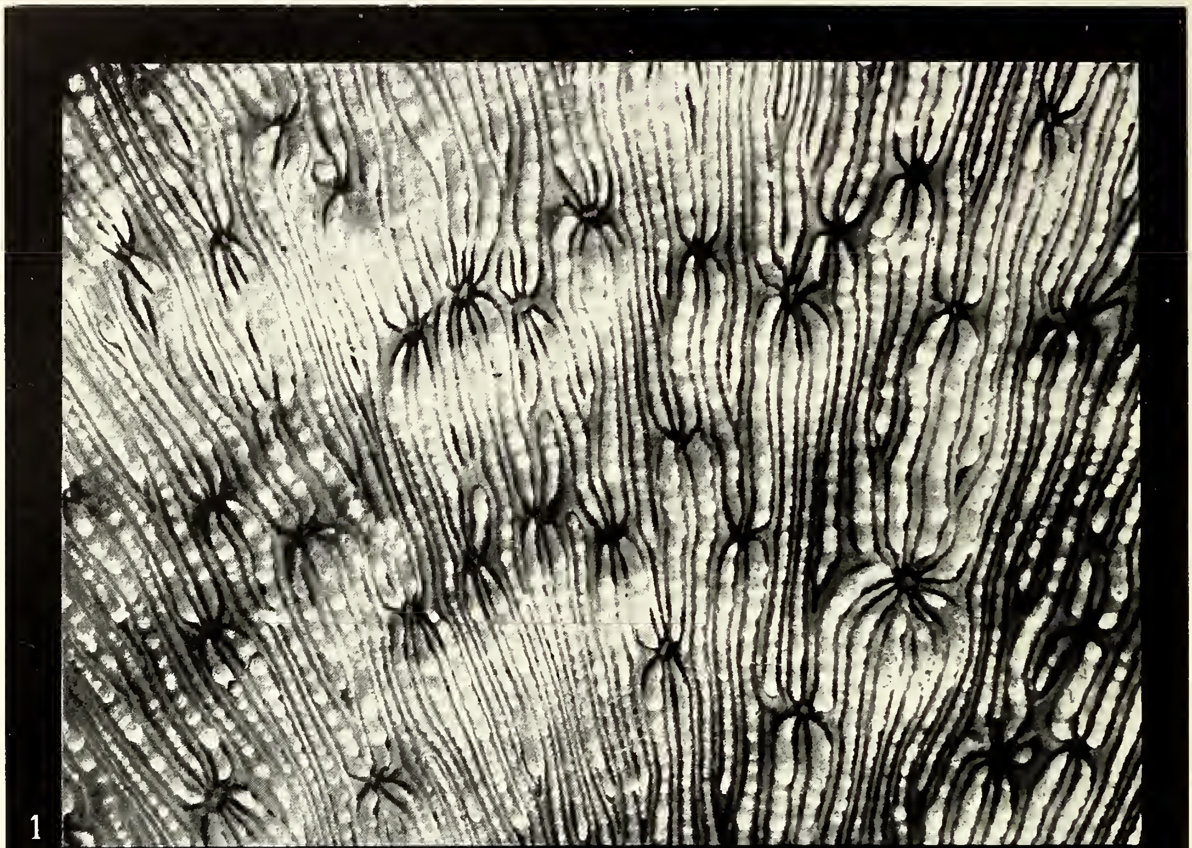
FIG. 1.—*Coeloria daedalea* (Ell. and Sol.). × 1.
G.B.R.E. No. 138.

FIG. 2.—*Symphyllia recta* M. E. and H. × 1.
B.M. Reg. No. 1934.5.14.405.

FIG. 3.—*Symphyllia recta* M. E. and H. × 1.
B.M. Reg. No. 1934.5.14.365.



[*Adlard & Son, Ltd., Impr.*



1

2

[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XII.

FIG. 1.—*Podobacia crustacea* (Pallas). × 3.
G.B.R.E. No. 36.

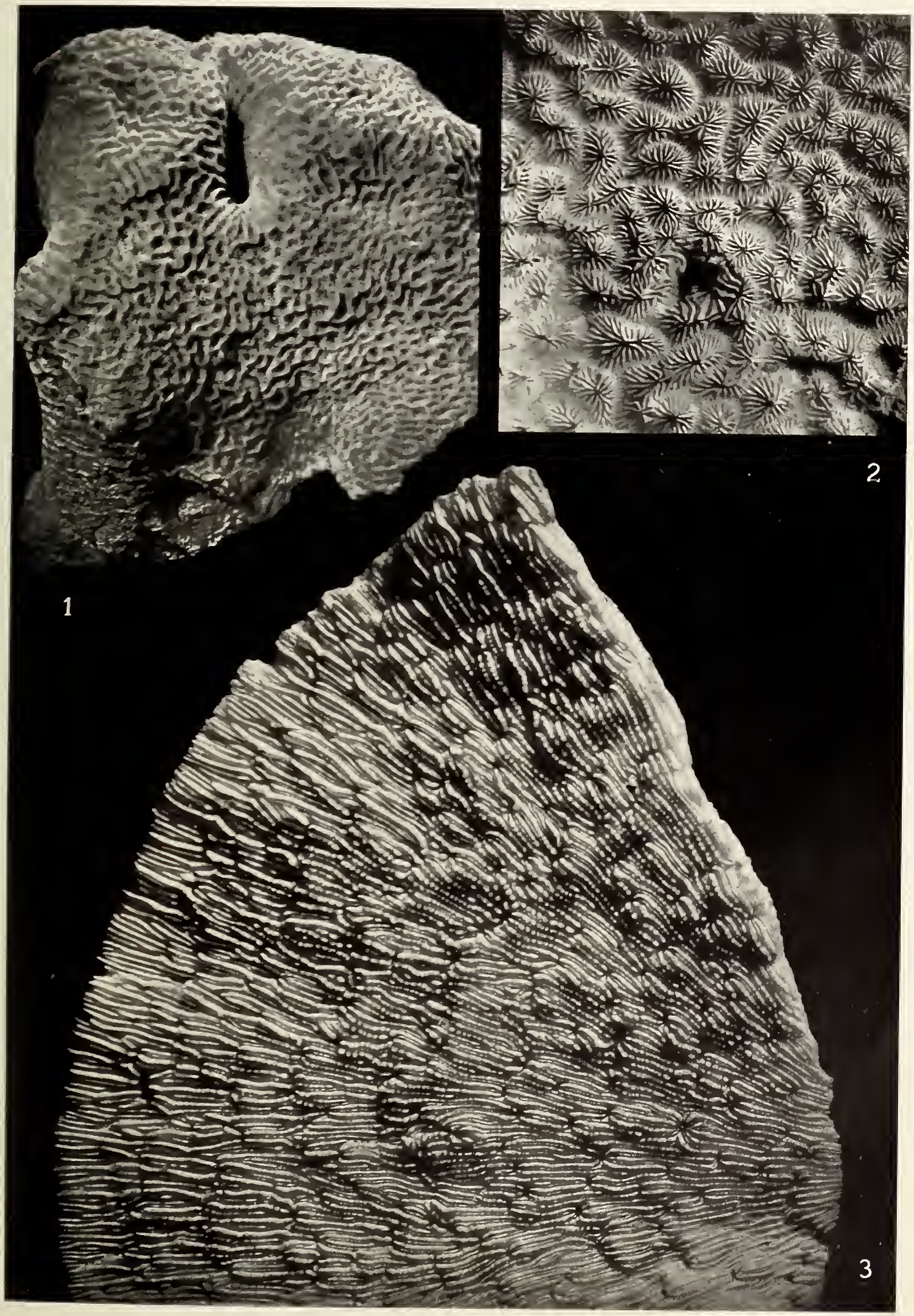
FIG. 2.—*Coeloria daedalea* (Ell. & Sol.). × 3.
G.B.R.E. No. 138.

DESCRIPTION OF PLATE XIII.

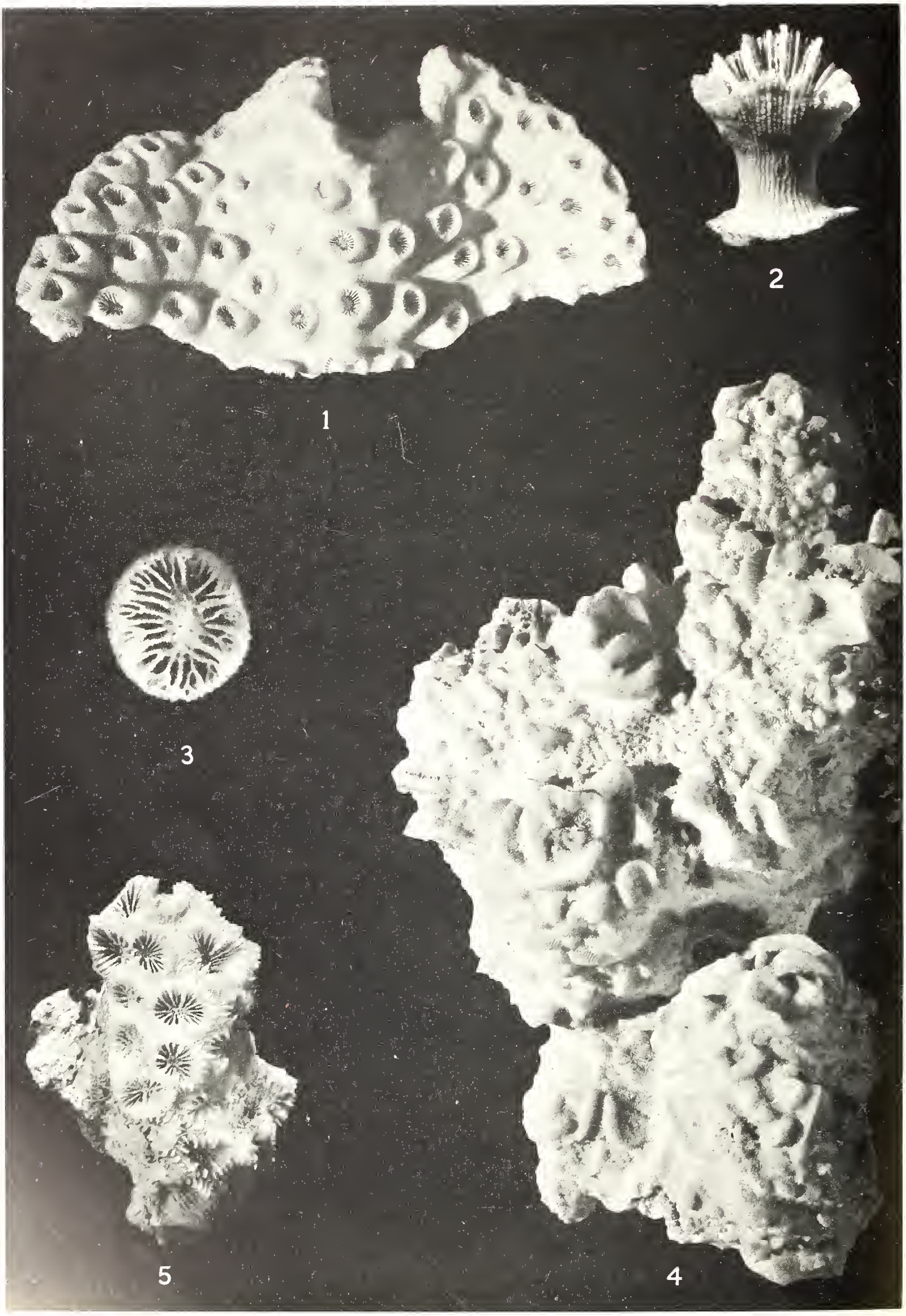
FIG. 1.—*Pavona varians* Verrill. × 1.
G.B.R.E. No. 117.

FIG. 2.—*Pavona varians* Verrill. × 3.
G.B.R.E. No. 117.

FIG. 3.—*Podobacia crustacea* (Pallas). × 1.
G.B.R.E. No. 36.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XIV.

FIG. 1.—*Turbinaria peltata*, var. *gibiari*, var. n. × 1.
G.B.R.E. No. 193.

FIG. 2.—*Balanophyllia yongei*, sp. n. × 2.
Specimen No. 6. Holotype.
B.M. Reg. No. 1934.5.14.491.

FIG. 3.—*Dendrophyllia arbuscula* Horst. × 4·3.
Fragments of corallite 5.
B.M. Reg. No. 1934.5.14.490.

FIG. 4.—*Pavona varians* Verrill. × 1.
G.B.R.E. No. 55.

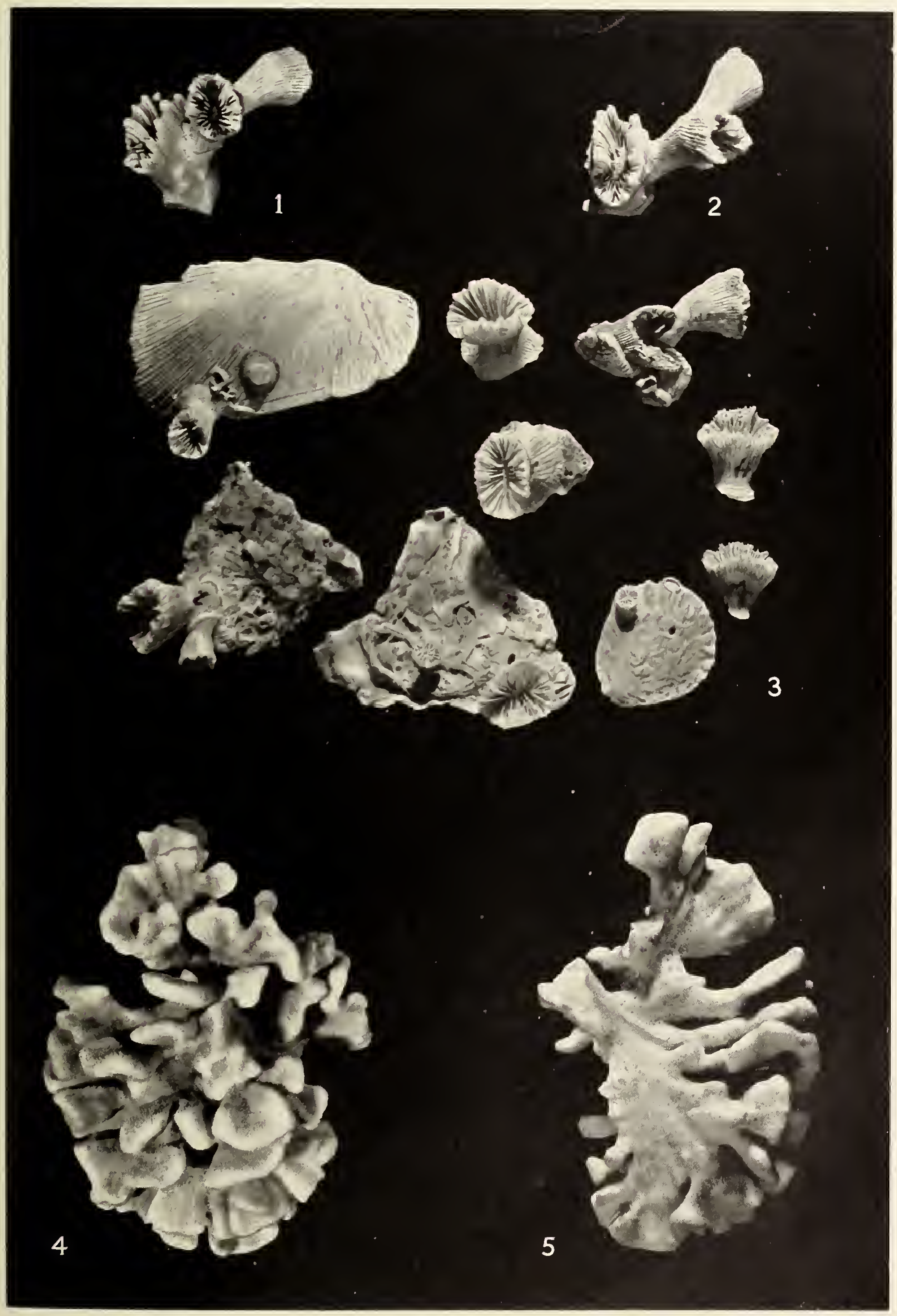
FIG. 5.—*Favia favus* (Forskål) var. *crassidens*, var. n. × 1.
G.B.R.E. No. 410.

DESCRIPTION OF PLATE XV.

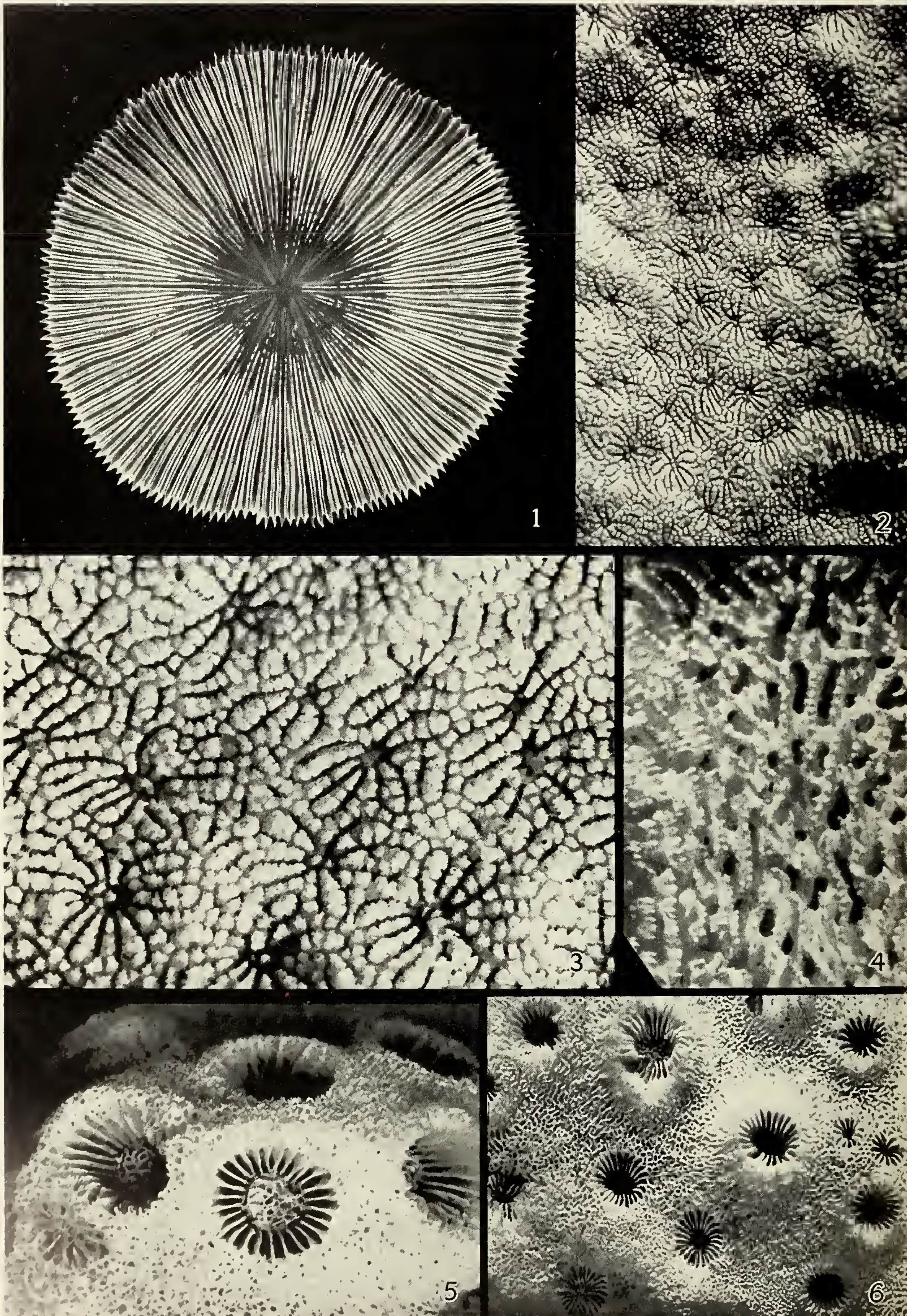
Figs. 1 and 2.—*Balanophyllia incisa*, sp. n. Holotype. × 1.
B.M. Reg. No. 1934.5.14.369.

Fig. 3.—*Balanophyllia yongei*, sp. n. × 1.
B.M. Reg. No. 1934.5.14.491.

Figs. 4 and 5.—*Psammocora contigua* (Esper). × 1.
G.B.R.E. No. 11.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XVI.

FIG. 1.—*Fungia patelliformis* Boschma. × 1·5.
Photographed by transmitted light.
B.M. Reg. No. 1934.5.14.610.

FIG. 2.—*Psammocora exesa* Dana. × 4·2.
G.B.R.E. No. 17.

FIG. 3.—*Psammocora exesa* Dana. × 12·3.
G.B.R.E. No. 17.

FIG. 4.—*Turbinaria peltata* var. *gibiari*, var. n. × 16.
G.B.R.E. No. 193.

FIG. 5.—*Turbinaria peltata*. × 4.
G.B.R.E. No. 435.

FIG. 6.—*Turbinaria mantonae*, sp. n. × 4.
G.B.R.E. No. 323.

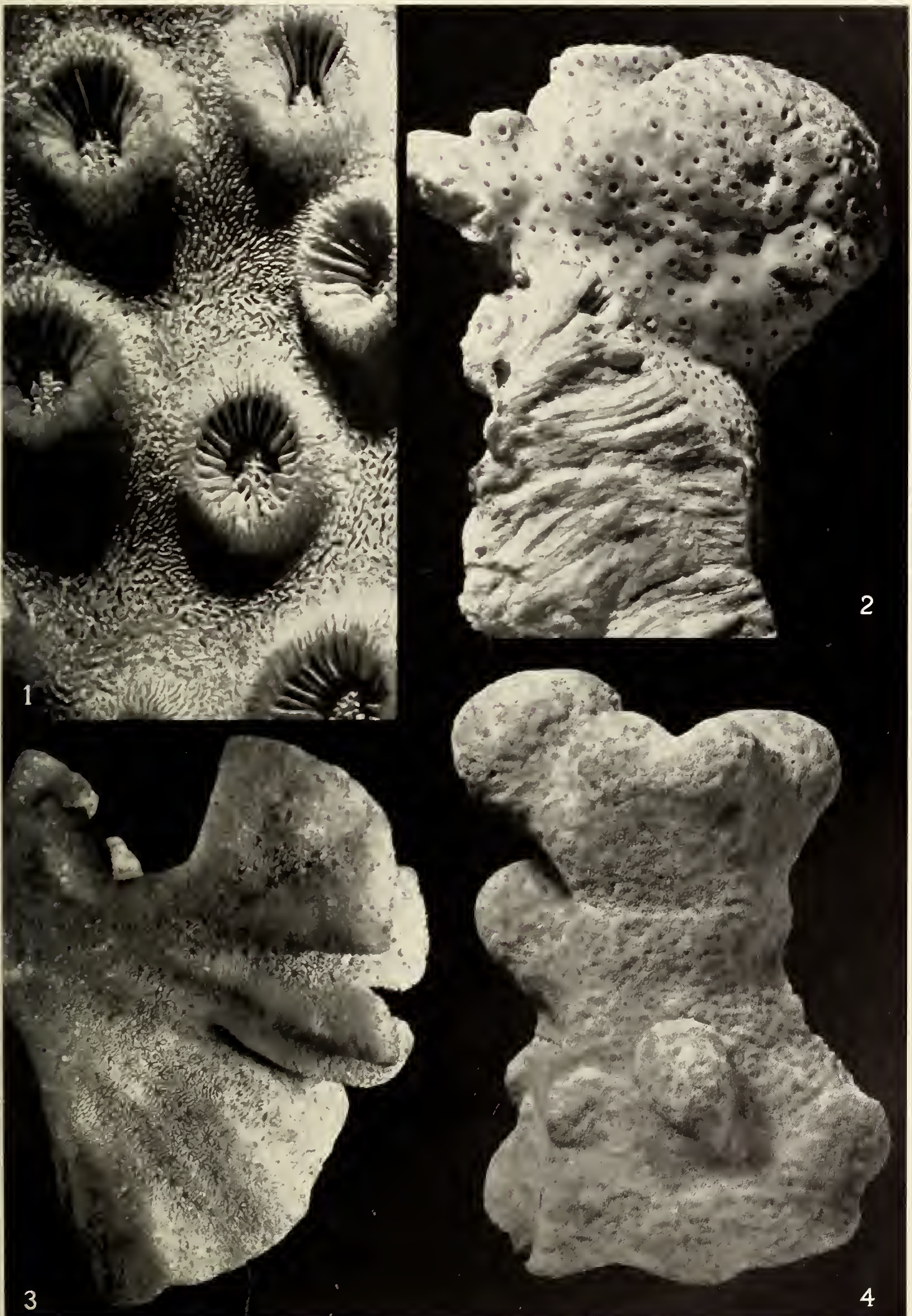
DESCRIPTION OF PLATE XVII.

FIG. 1.—*Turbinaria peltata* var. *gibiari*, var. n. × 4.
G.B.R.E. No. 193.

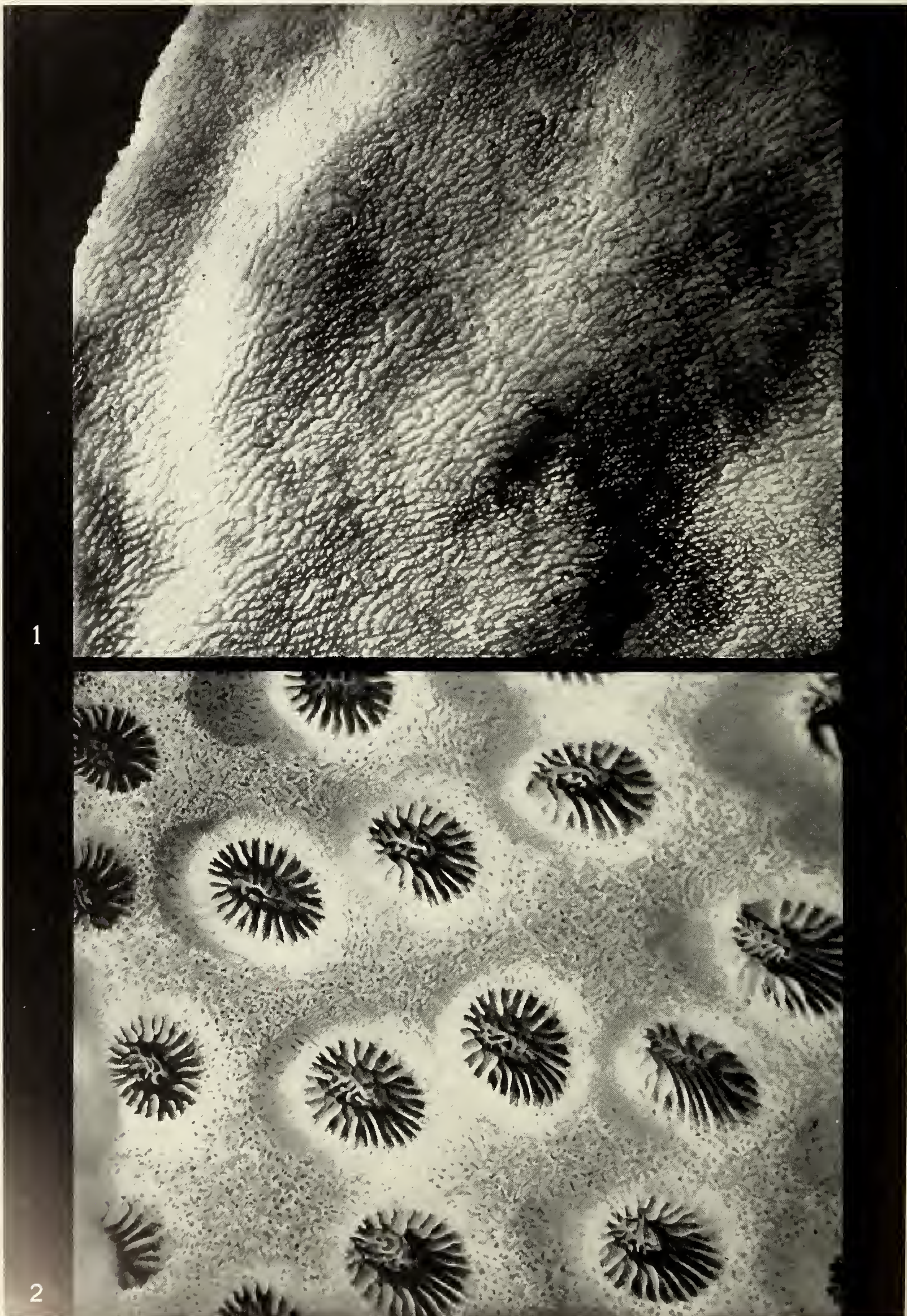
FIG. 2.—*Turbinaria mantonae*, sp. n. × 1.
G.B.R.E. No. 323.

FIG. 3.—*Psammocora contigua* (Esper). × 3.
G.B.R.E. No. 11.

FIG. 4.—*Psammocora exesa* Dana. × ·8.
G.B.R.E. No. 17.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XVIII.

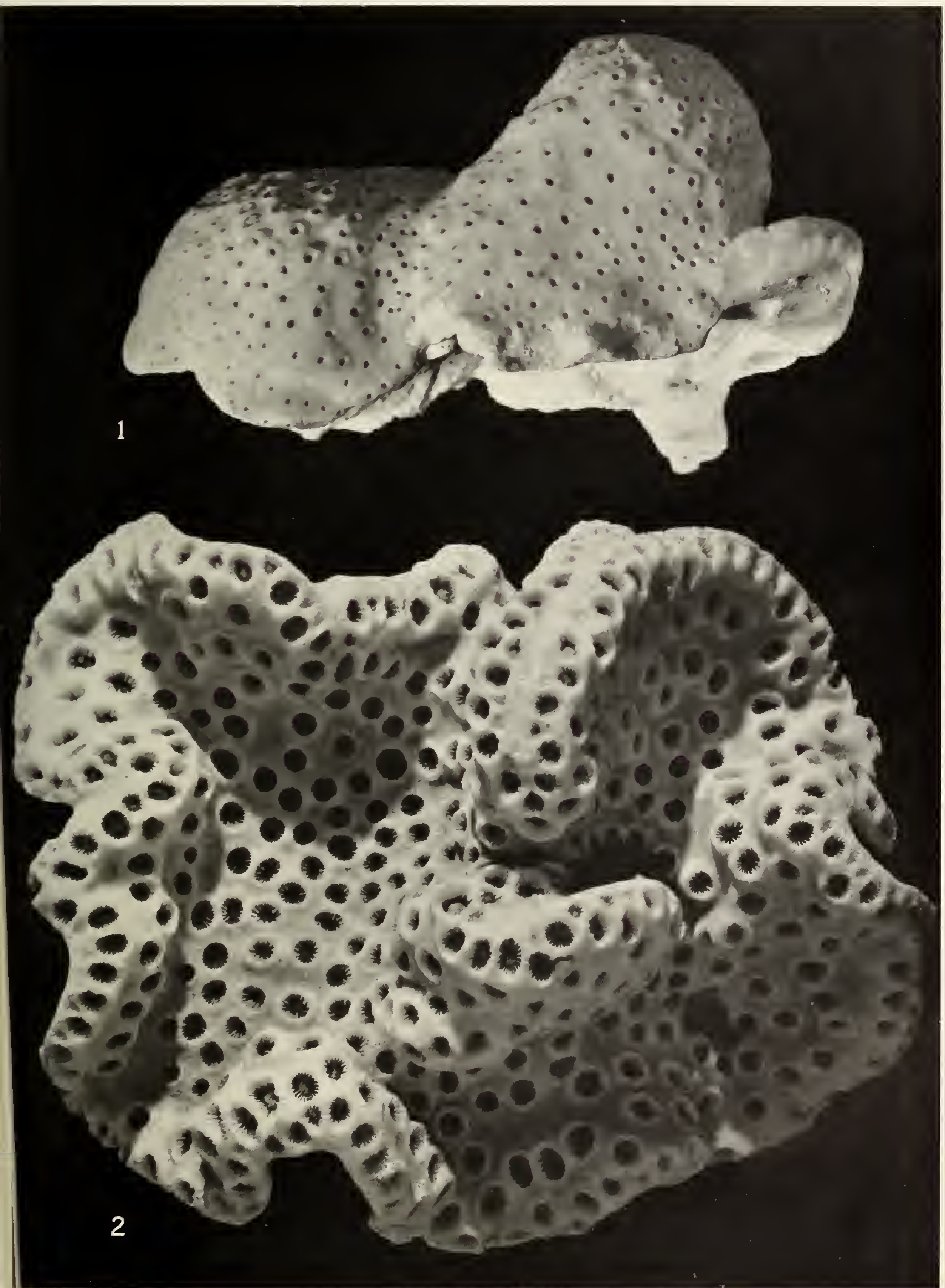
FIG. 1.—*Turbinaria peltata* var. *gibiari* var. n. × 4.
G B.R.E. No. 193.

FIG. 2.—*Turbinaria peltata*. × 4·7.
G.B.R.E. No. 435.

DESCRIPTION OF PLATE XIX.

Fig. 1.—*Turbinaria mantonae*, sp. n. × 1.
G.B.R.E. No. 323.

Fig. 2.—*Turbinaria peltata*. × 1.
G.B.R.E. No. 435.



[*Adlard & Son, Ltd., Impr.*

[*Adlard & Son, Ltd., Impr.*

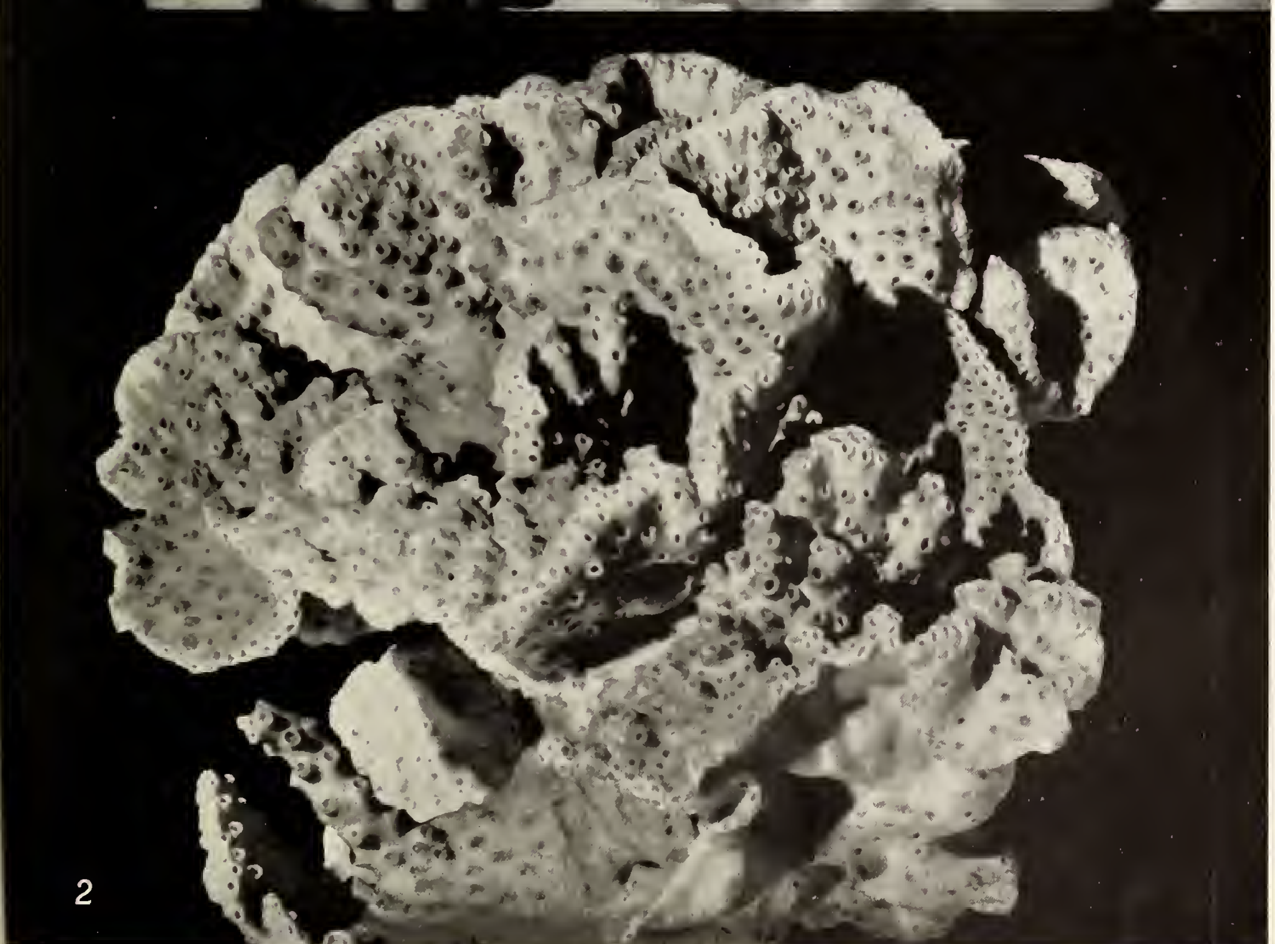
DESCRIPTION OF PLATE XX.

Figs. 1 and 2.—*Montipora millepora*, sp. n. × 4.
B.M. Reg. No. 1934.5.14.410.

DESCRIPTION OF PLATE XXI.

Figs. 1 and 2.—*Turbinaria bifrons* Brügg. × 1.
B.M. Reg. No. 1934.5.14.272.


1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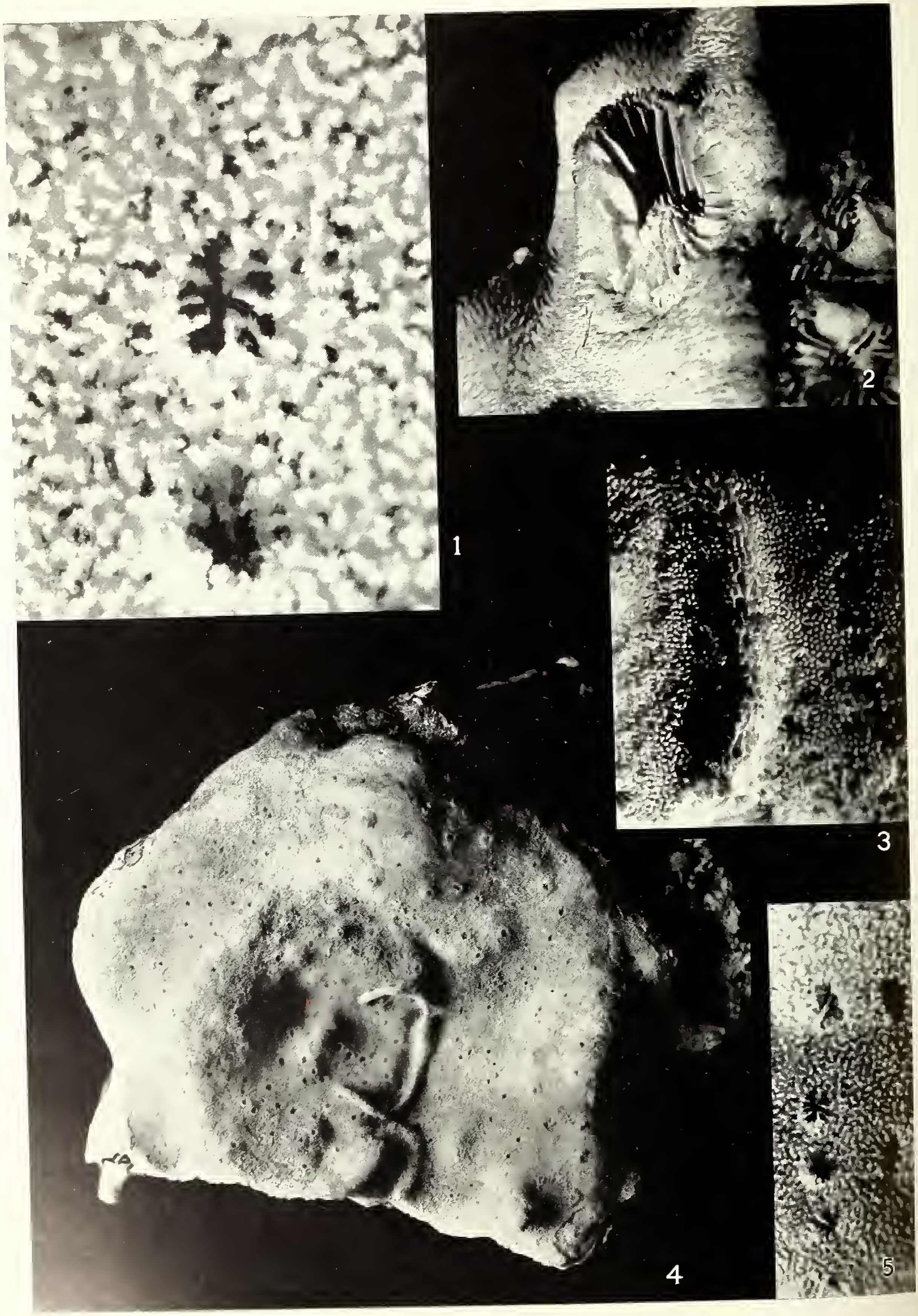
[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XXII.

FIG. 1.—*Montipora millepora*, sp. n. × 30.
B.M. Reg. No. 1934.5.14.410.

FIG. 2.—*Turbinaria peltata* var. *gibiari*, var. n. × 4·5.
G.B.R.E. No. 193.

FIG. 3.—*Montipora millepora*, sp. n. × 10.
B.M. Reg. No. 1934.5.14.410.

FIG. 4.—*Montipora millepora*, sp. n. × 2.
B.M. Reg. No. 1934.5.14.410.

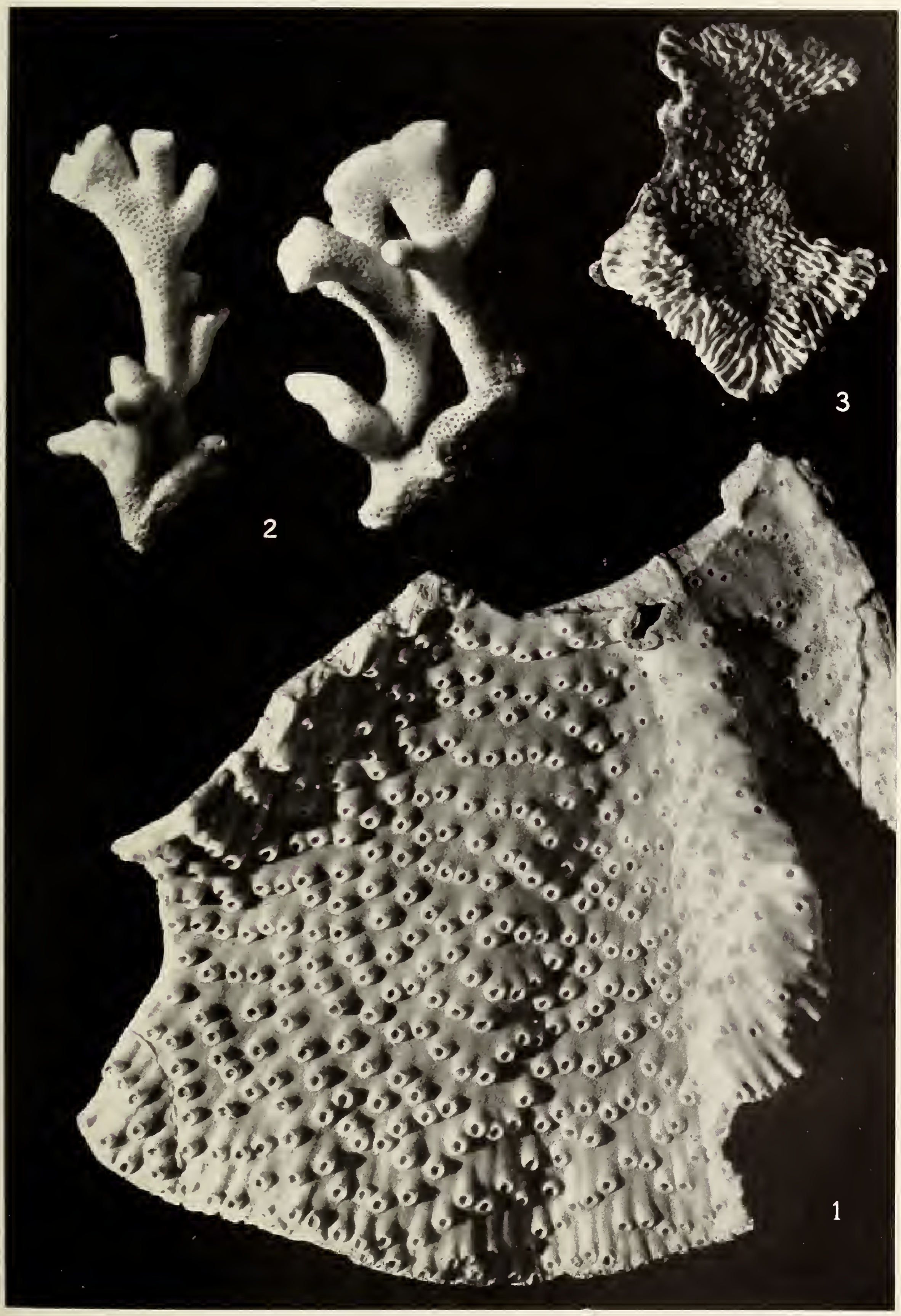
FIG. 5.—*Montipora millepora*, sp. n. × 10.
B.M. Reg. No. 1934.5.14.410.

DESCRIPTION OF PLATE XXIII.

Fig. 1.—*Turbinaria frondens* (Dana). × 1.
G.B.R.E. No. 326.

Fig. 2.—*Montipora fruticosa* Bernard. × 1.
B.M. Reg. No. 1934.5.14.193.

Fig. 3.—*Montipora undans*, sp. n. × 1.
G.B.R.E. No. 13.



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DESCRIPTION OF PLATE XXIV.

Fig. 1.—*Montipora prominula*, sp. n. × ·8.
G.B.R.E. No. 327.

Fig. 2.—*Montipora erythraea* Marenz. × ·8.
G.B.R.E. No. 30.

Fig. 3.—*Montipora erythraea* Marenz. × ·8.
G.B.R.E. No. 136.

Fig. 4.—*Montipora erythraea* Marenz. × ·8.
G.B.R.E. No. 319.

DESCRIPTION OF PLATE XXV.

Fig. 1.—*Montipora granulosa* Bernard. × 1.
G.B.R.E. No. 113.

Fig. 2.—*Montipora tertia* sp. n. × 1.
G.B.R.E. No. 11.

Fig. 3.—*Montipora angularis*, sp. n. × 1.
G.B.R.E. No. 137.

Fig. 4.—*Montipora granulosa* Bernard. × 1.
G.B.R.E. No. 113.

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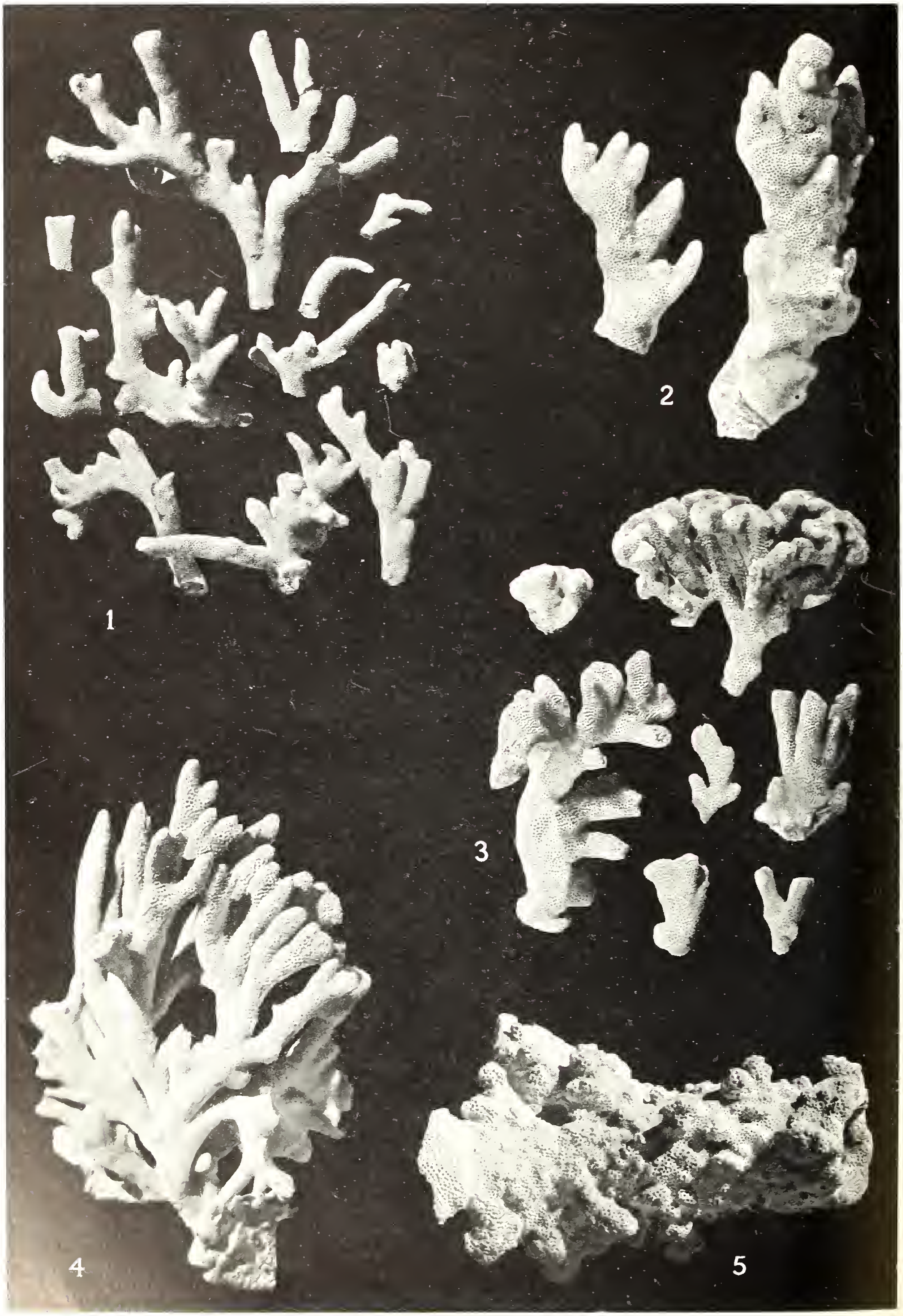


[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XXVI.

Fig. 1.—*Montipora digitata* (Dana). × ·4.
B.M. Reg. No. 1934.5.14.281.

Fig. 2.—*Montipora fossae* sp. n. × ·4.
B.M. Reg. No. 1934.5.14.286.

Fig. 3.—*Montipora ramosa* Bernard. × ·5.
B.M. Reg. No. 1934.5.14.275.

Fig. 4.—*Montipora ramosa* Bernard. × ·5.
B.M. Reg. No. 1934.5.14.273.

Fig. 5.—*Montipora venosa*, var. *angulosa*, Klz. × ·4.
B.M. Reg. No. 1934.5.14.394.

DESCRIPTION OF PLATE XXVII.

FIG. 1.—*Montipora erythraea* Marenz. × 4.
G.B.R.E. No. 136.

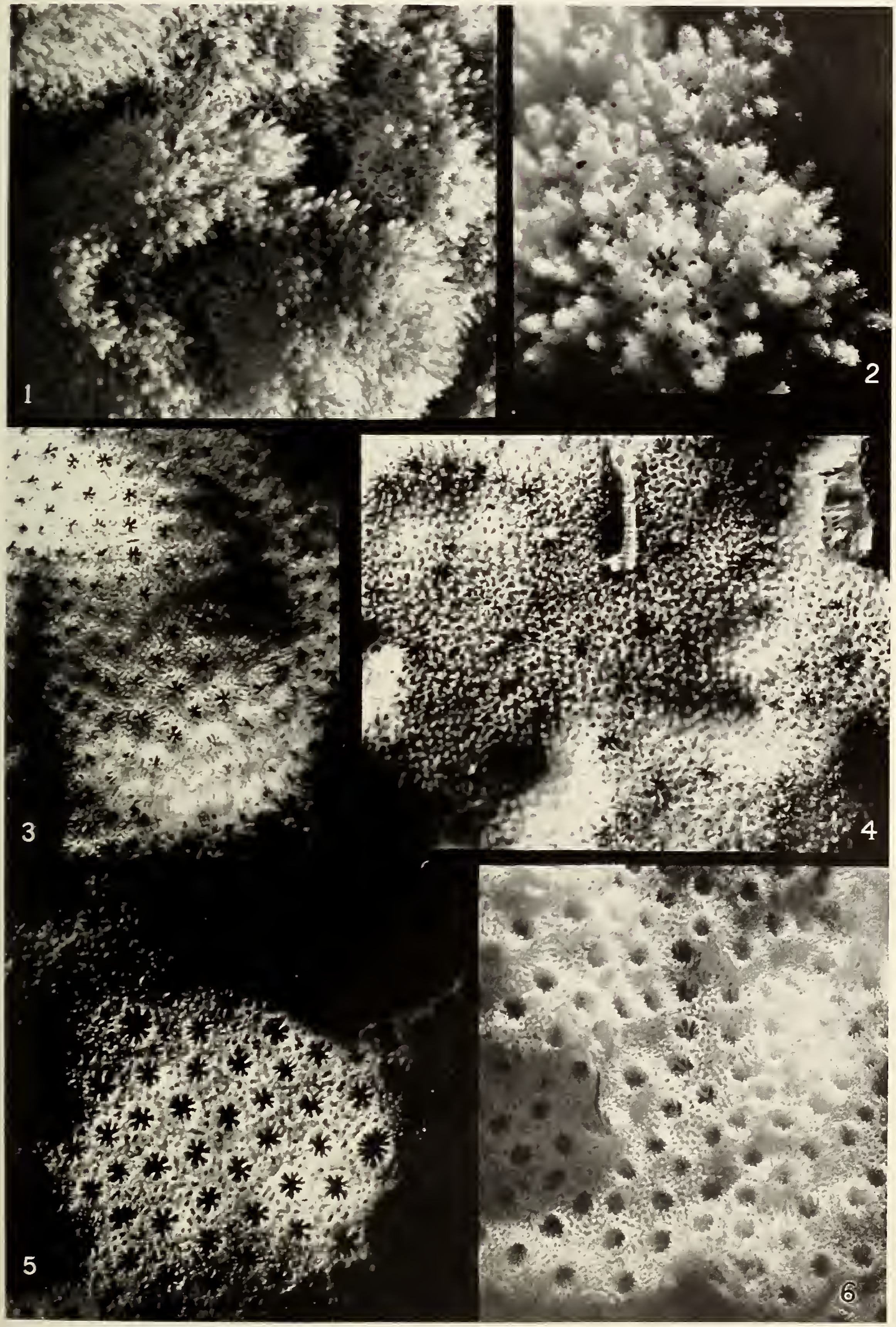
FIG. 2.—*Montipora erythraea* Marenz. × 8.
G.B.R.E. No. 136.

FIG. 3.—*Montipora ramosa* Bernard. × 5.
B.M. Reg. No. 1934.5.14.300.

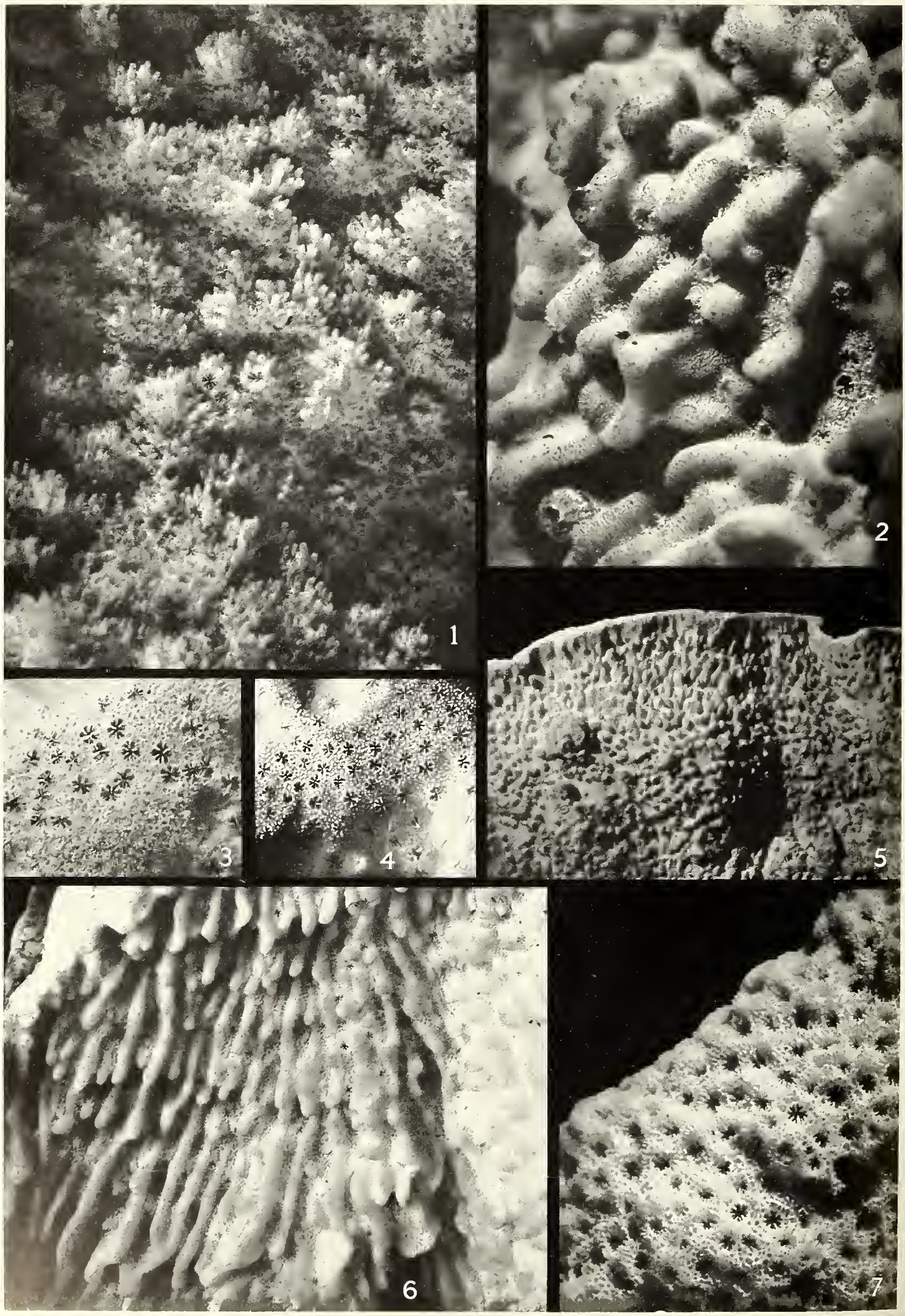
FIG. 4.—*Montipora granulosa* Bernard. × 5·8.
G.B.R.E. No. 113.

FIG. 5.—*Montipora venosa* var. *angulōsa* Klz. × 6.
B.M. Reg. No. 1934.5.14.394.

FIG. 6.—*Montipora prominula*, sp. n. × 5.
G.B.R.E. No. 327.



[*Adlard & Son, Ltd., Impr.*



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DESCRIPTION OF PLATE XXVIII.

FIG. 1.—*Montipora composita*, sp. n. × 4.
G.B.R.E. No. 186.

FIG. 2.—*Montipora undans*, sp. n. × 8.
G.B.R.E. No. 13.

FIG. 3.—*Montipora angularis*, sp. n. × 4.
G.B.R.E. No. 137.

FIG. 4.—*Montipora tertia*, sp. n. × 4.
G.B.R.E. No. 11.

FIG. 5.—*Montipora composita*, sp. n. × ·8
G.B.R.E. No. 186.

FIG. 6.—*Montipora sulcata*, sp. n. × 4.
G.B.R.E. No. 16.

FIG. 7.—*Montipora venosa*, var. *angulosa* Klz. × 5.
B.M. Reg. No. 1934.5.14.394.

DESCRIPTION OF PLATE XXIX.

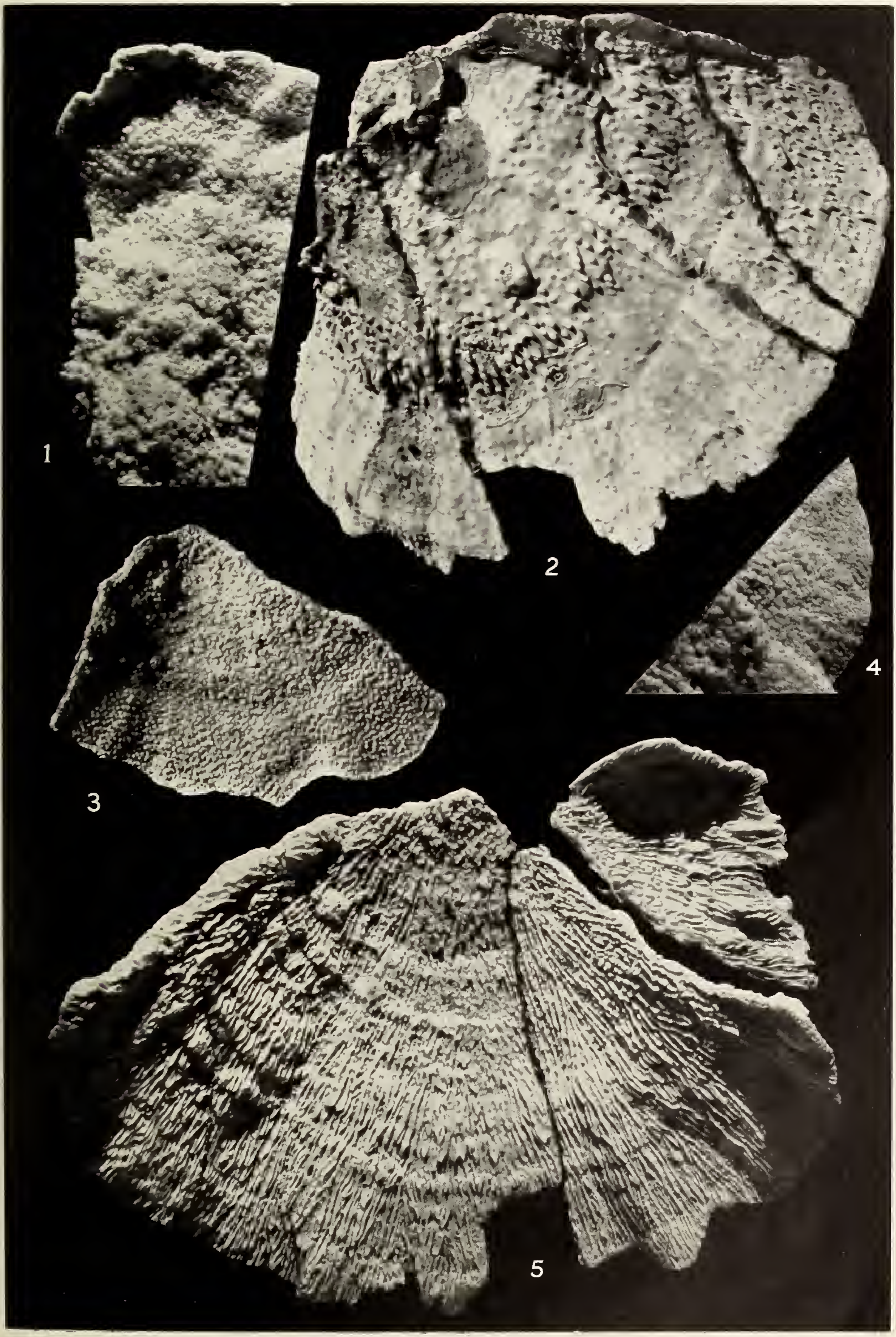
FIG. 1.—*Montipora composita*, sp. n. $\times$ ·4.
G.B.R.E. No. 186.

FIG. 2.—*Montipora sulcata*, sp. n. $\times$ ·6.
G.B.R.E. No. 16.

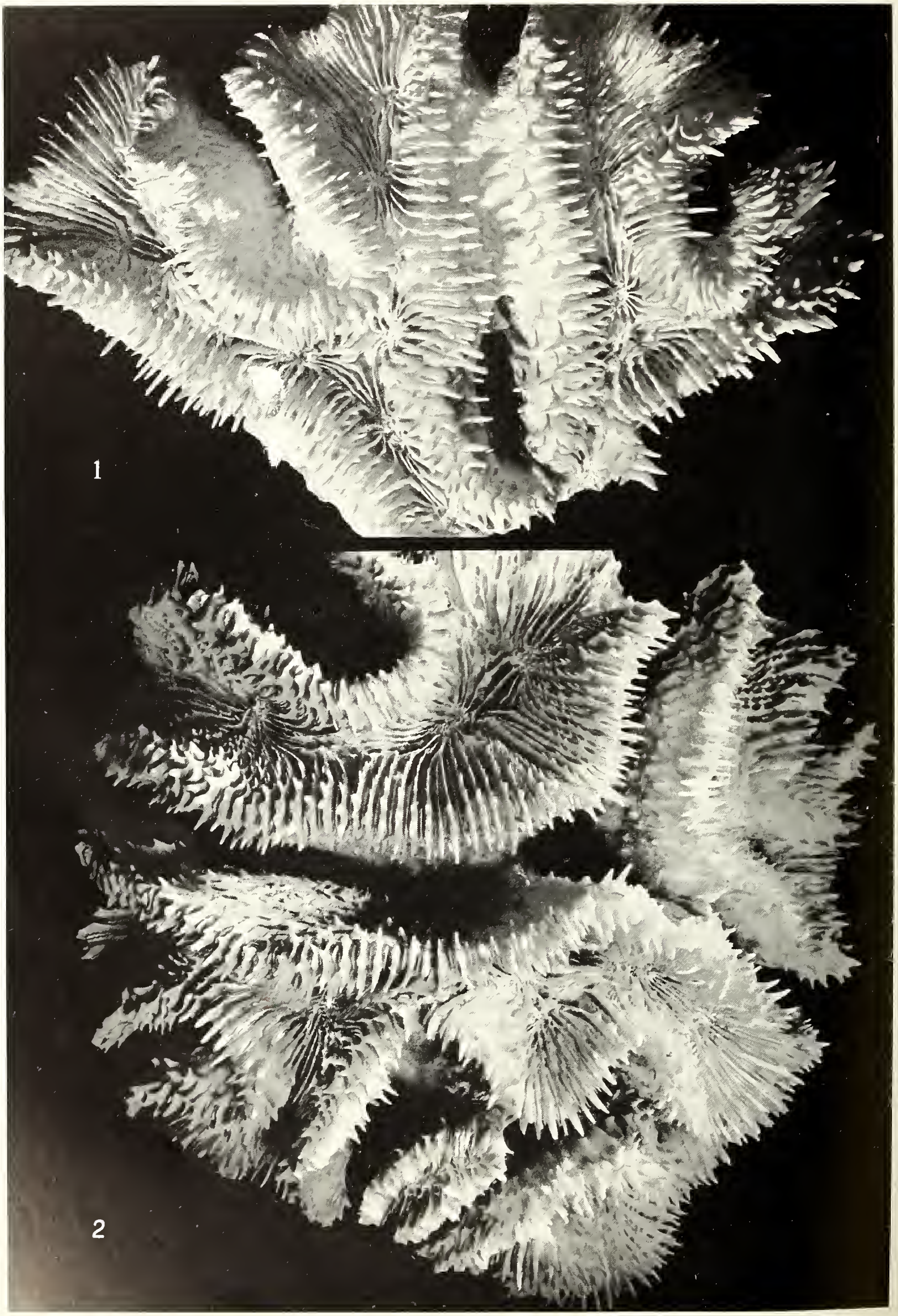
FIG. 3.—*Montipora composita*, sp. n. $\times$ ·4.
G.B.R.E. No. 23.

FIG. 4.—*Montipora composita*, sp. n. $\times$ ·4.
G.B.R.E. No. 186.

FIG. 5.—*Montipora sulcata*, sp. n. $\times$ ·6.
G.B.R.E. No. 16.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr*

DESCRIPTION OF PLATE XXX.

FIG. 1.—*Lobophyllia hemprichii* (Ehr.). × 1.
B.M. Reg. No. 1934.5.14.380.

FIG. 2.—*Lobophyllia hemprichii* (Ehr.). × ·9.
G.B.R.E. No. 94.

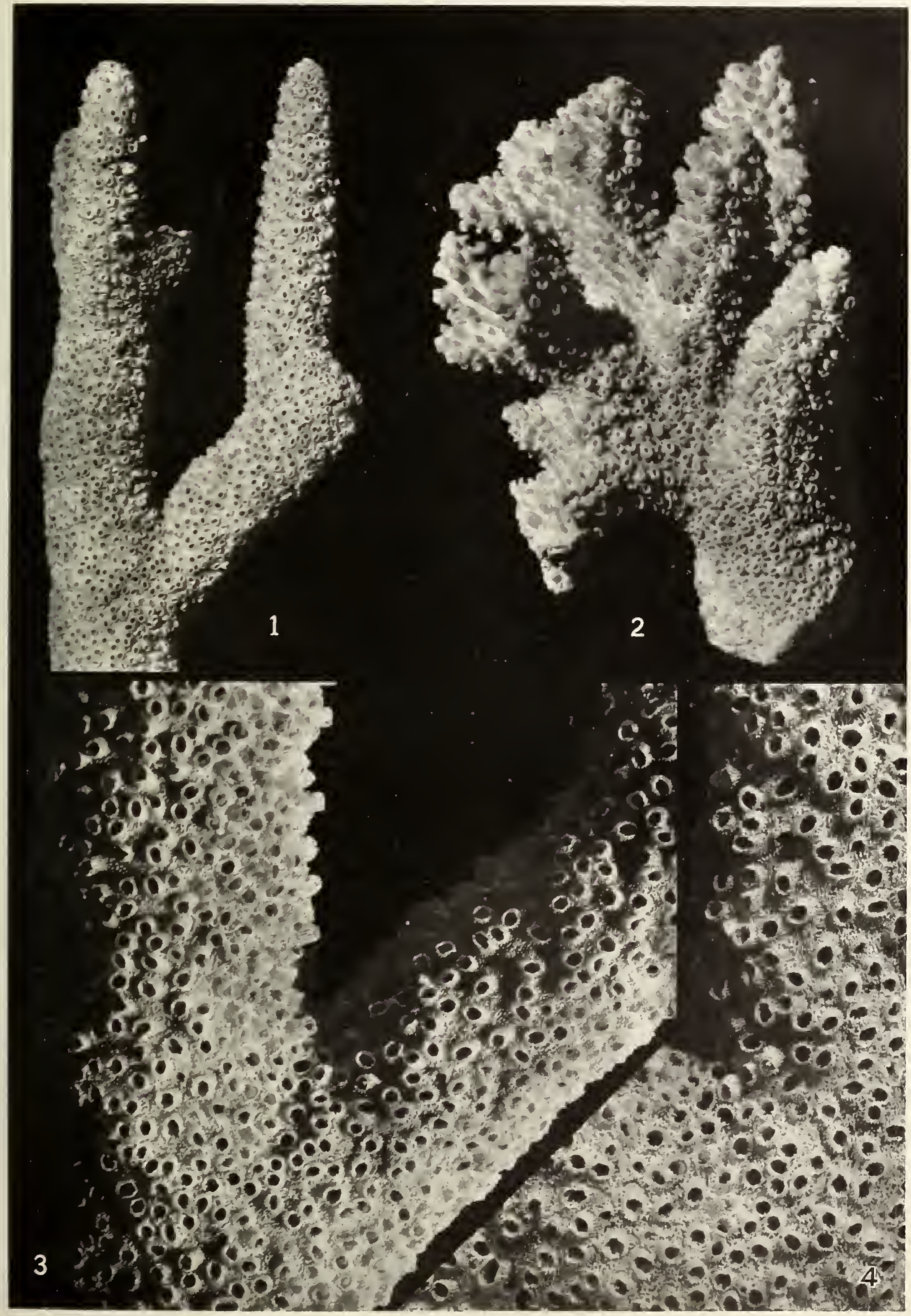
DESCRIPTION OF PLATE XXXI.

FIG. 1.—*Acropora grandis* (Brook). $\times$ 1.
G.B.R.E. No. 266.

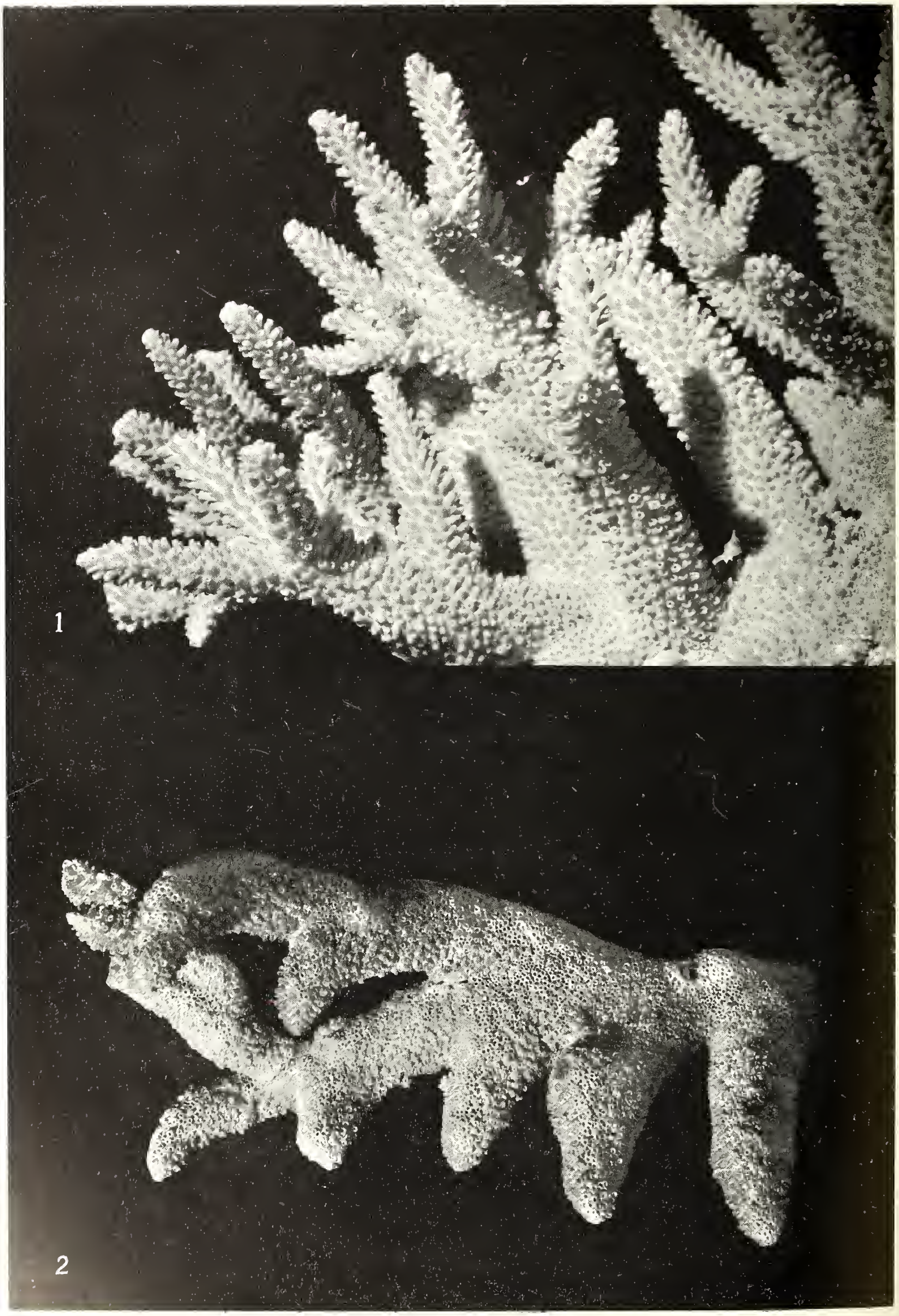
FIG. 2.—*Acropora pacifica* (Brook). $\times$ 1.
G.B.R.E. No. 345.

FIG. 3.—*Acropora grandis* (Brook). $\times$ 3.
G.B.R.E. No. 266.

FIG. 4.—*Acropora grandis* (Brook). $\times$ 3.
G.B.R.E No. 266.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XXXII.

Fig. 1.—*Acropora intermedia* (Brook). × 1.
G.B.R.E. No. 78.

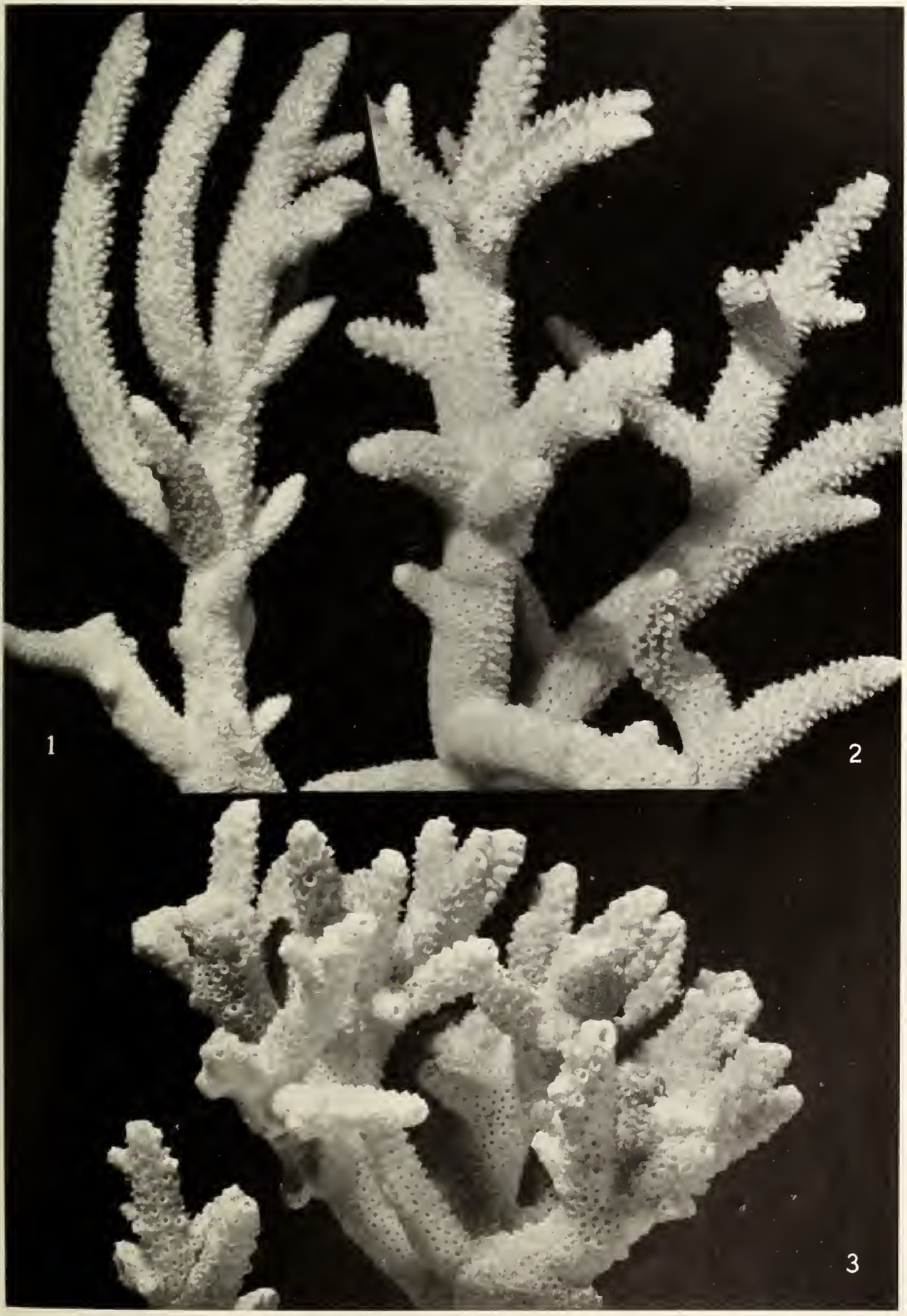
Fig. 2.—*Acropora pacifica* (Brook). × ·5.
G.B.R.E. No. 270.

DESCRIPTION OF PLATE XXXIII.

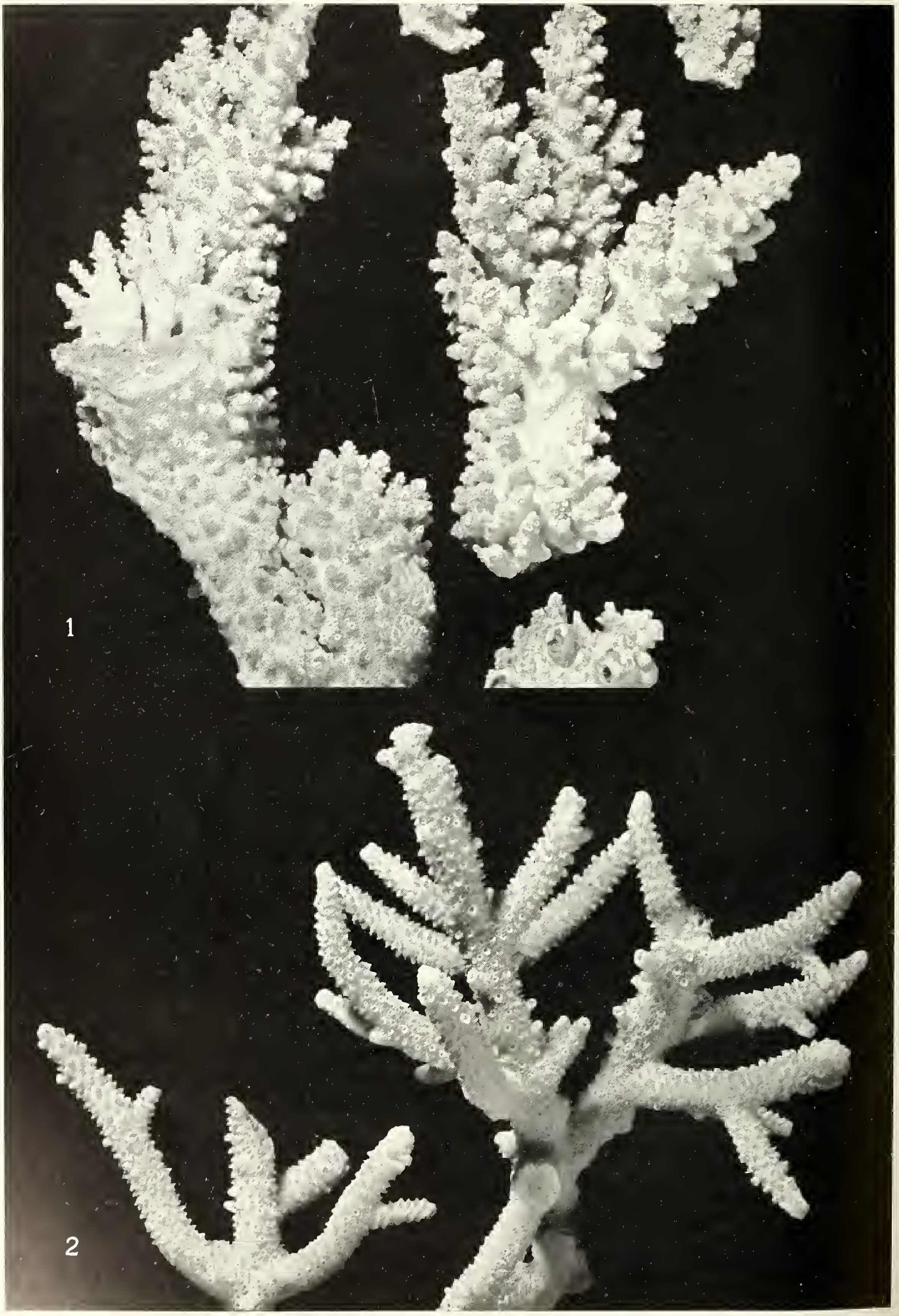
FIG. 1.—*Acropora haimei* M. E. and H. × 1.
G.B.R.E. No. 234.

FIG. 2.—*Acropora aspera* (Dana). × 1.
G.B.R.E. No. 304.

FIG. 3.—*Acropora aspera* (Dana). × 1·1.
G.B.R.E. No. 285.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XXXIV.

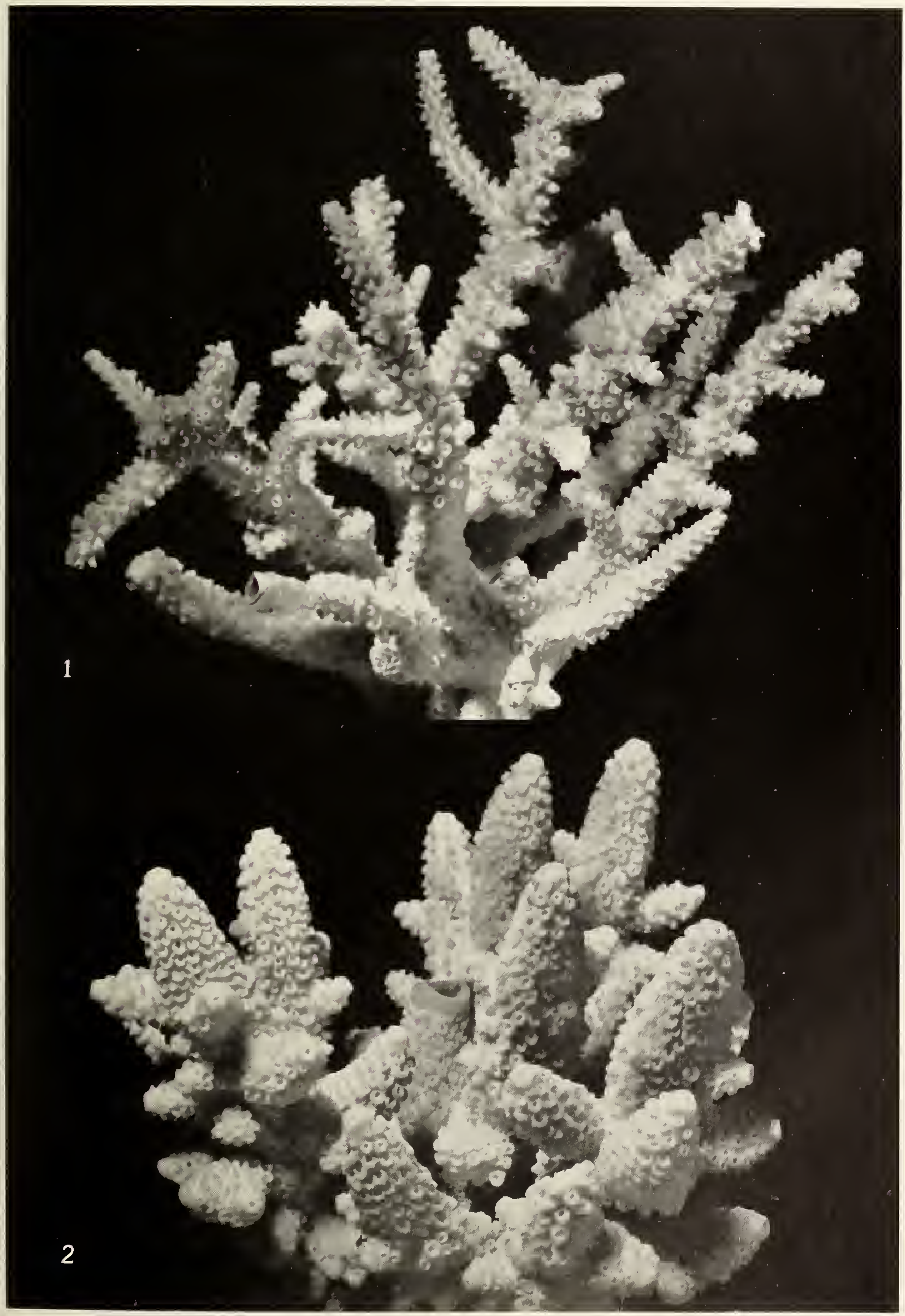
Fig. 1.—*Acropora affinis* (Brook). × ·5.
G.B.R.E. No. 384.

Fig. 2.—*Acropora pulchra* var. *stricta* (Brook). × 1.
G.B.R.E. No. 92.

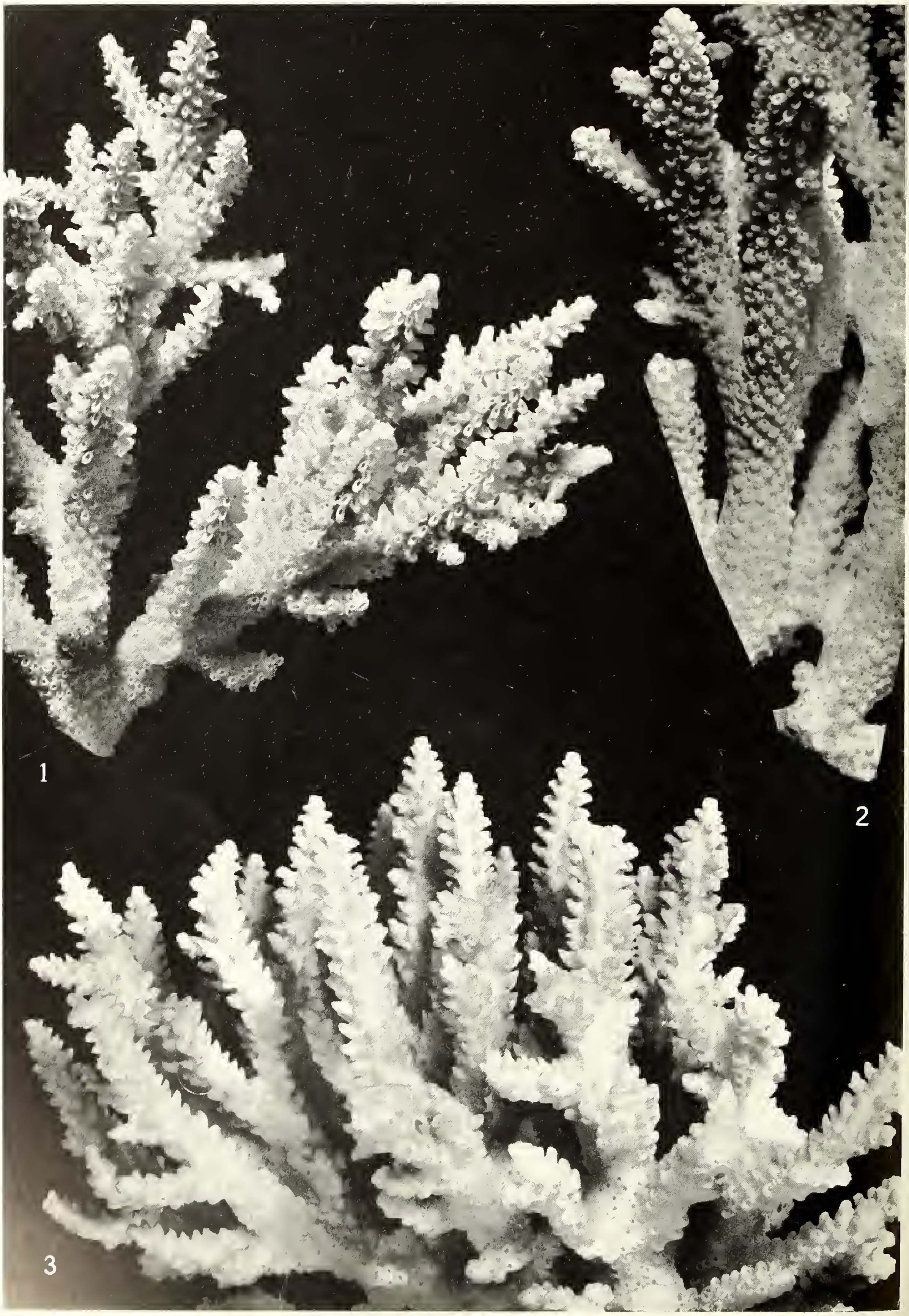
DESCRIPTION OF PLATE XXXV.

Fig. 1.—*Acropora haimei* M. E. and H. × 1.
G.B.R.E. No. 296.

Fig. 2.—*Acropora digitifera* (Dana). × 1·1.
G.B.R.E. No. 308.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XXXVI.

FIG. 1.—*Acropora quelchi* (Brook). × 1.
G.B.R.E. No. 279.

FIG. 2.—*Acropora quelchi* (Brook). × 1.
G.B.R.E. No. 284.

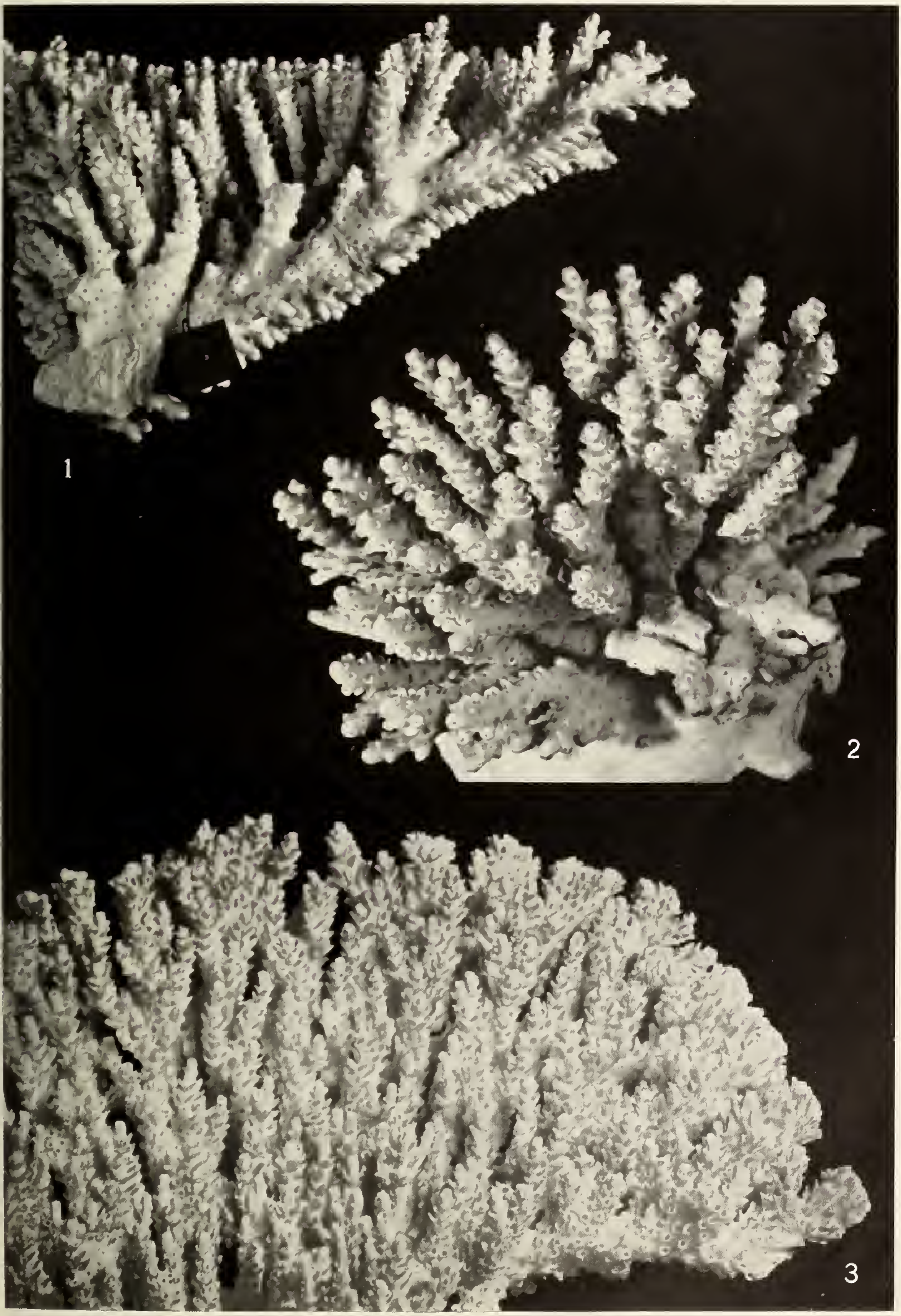
FIG. 3.—*Acropora quelchi* (Brook). × 1.
G.B.R.E. No. 272.

DESCRIPTION OF PLATE XXXVII.

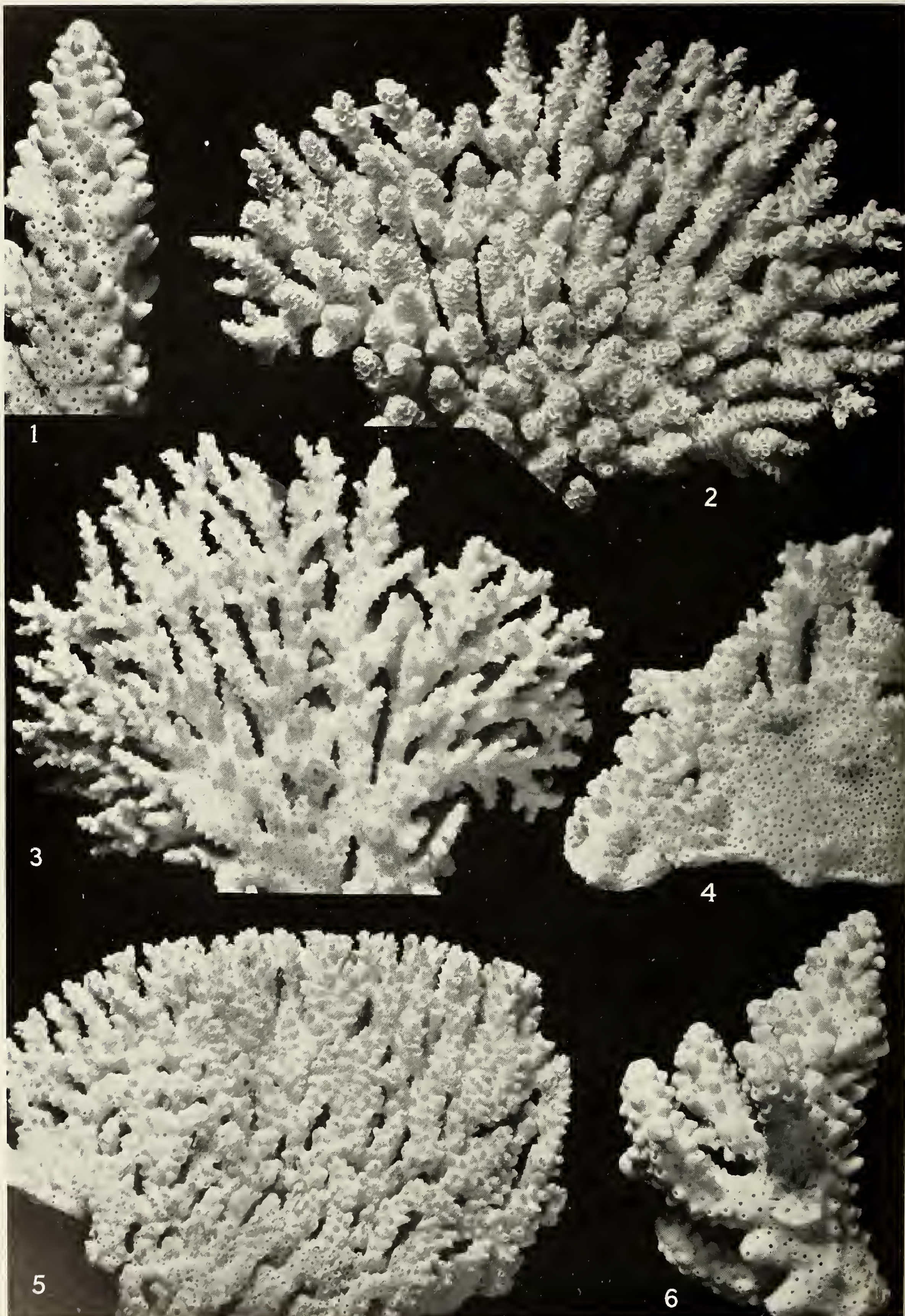
Fig. 1.—*Acropora armata* (Brook). × ·9.
G.B.R.E. No. 76.

Fig. 2.—*Acropora armata* Brook var. × 1·1.
G.B.R.E. No. 326.

Fig. 3.—*Acropora armata* (Brook). × 1.
G.B.R.E. No. 238.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XXXVIII.

Fig. 1.—*Acropora variabilis* var. *pachyclados* Klz. × 1.
G.B.R.E. No. 343.

Fig. 2.—*Acropora surculosa* (Dana). × ·9.
G.B.R.E. No. 287.

Fig. 3.—*Acropora surculosa* (Dana). Underside. × ·8.
G.B.R.E. No. 287.

Fig. 4.—*Acropora surculosa* (Dana). Underside. × ·8.
G.B.R.E. No. 339.

Fig. 5.—*Acropora surculosa* (Dana). Underside. × ·8.
G.B.R.E. No. 288.

Fig. 6.—*Acropora variabilis* var. *pachyclados* Klz. × 1.
G.B.R.E. No. 343.

DESCRIPTION OF PLATE XXXIX.

Fig. 1.—*Acropora glochiclados* (Brook). × 1·1.
G.B.R.E. No. 64.

Fig. 2.—*Acropora glochiclados* (Brook). × 5.
G.B.R.E. No. 64.

Fig. 3.—*Acropora exilis* (Brook). × 1.
G.B.R.E. No. 45.

Fig. 4.—*Acropora exilis* (Brook). × 1.
G.B.R.E. No. 199.

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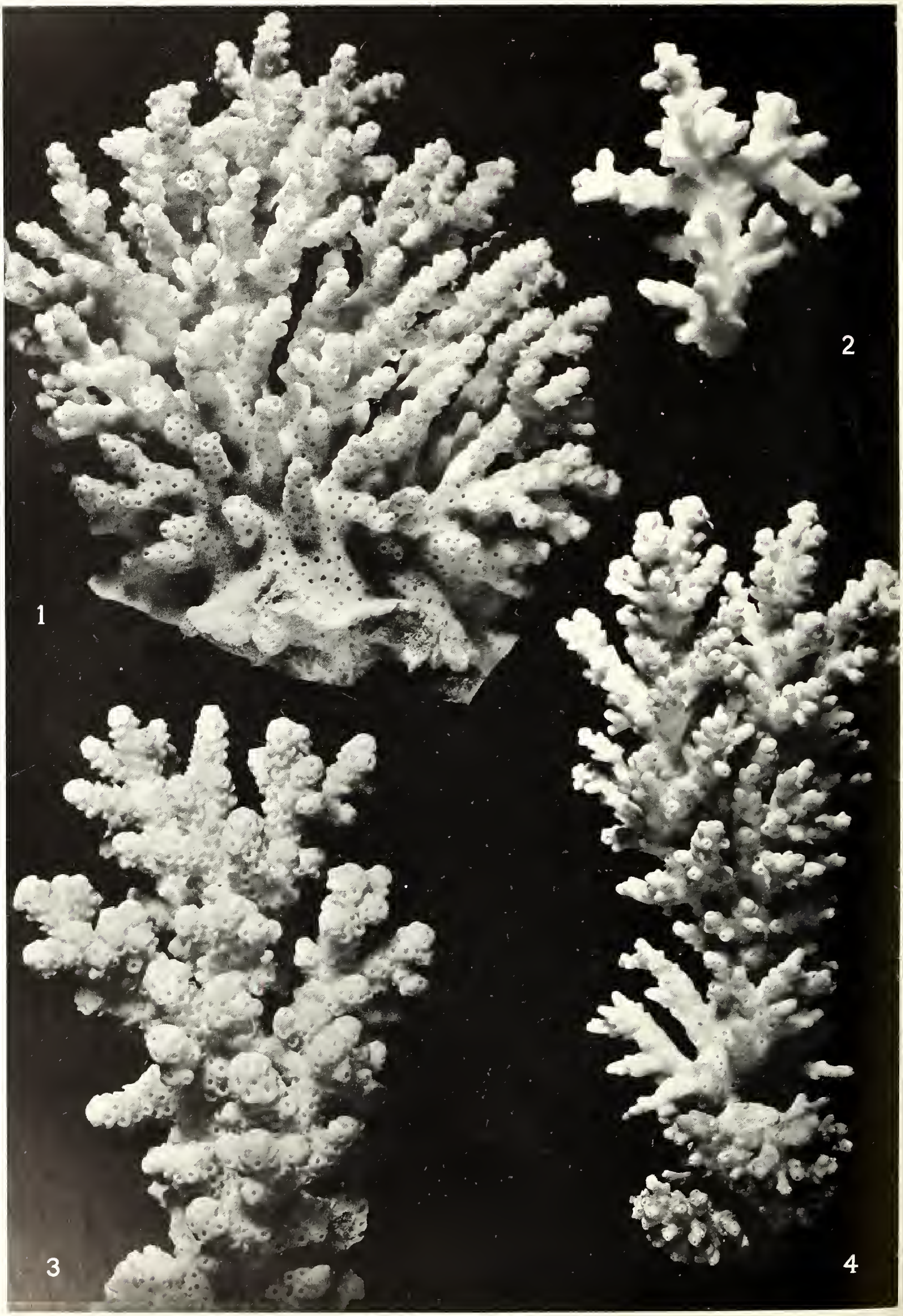


[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XL.

Fig. 1.—*Acropora rosaria* (Dana). Form II. × 1·1.
G.B.R.E. No. 108.

Fig. 2.—*Acropora clavigera* (Brook). × 1.
B.M. Reg. No. 1934.5.14.611.

Fig. 3.—*Acropora rosaria* (Dana). Form I. × 1.
G.B.R.E. No. 310.

Fig. 4.—*Acropora rosaria* (Dana). Form III. × 1.
G.B.R.E. No. 216.

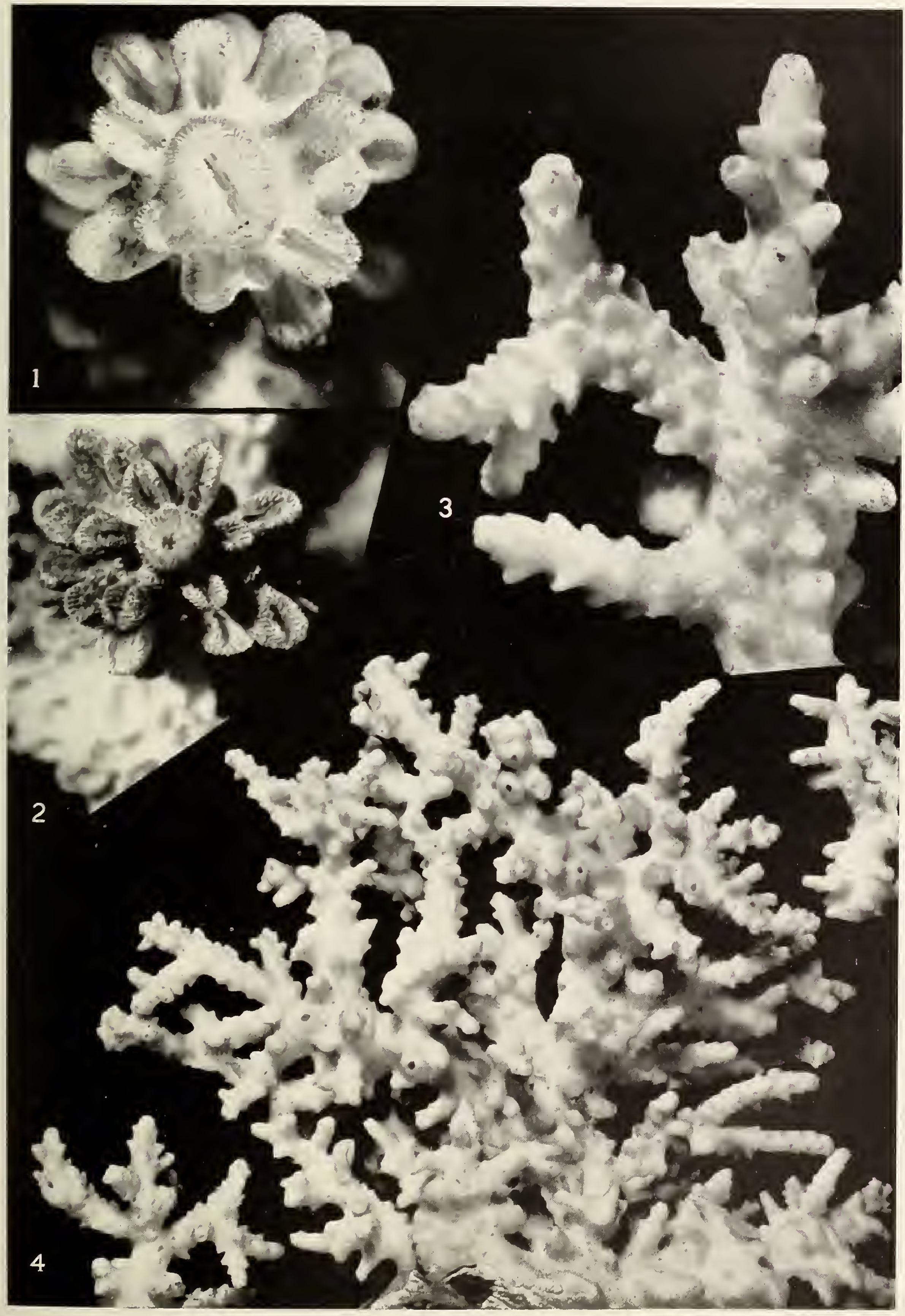
DESCRIPTION OF PLATE XLI.

FIG. 1.—*Acropora lutkeni*, sp. n. × 7.
G.B.R.E. No. 271.

FIG. 2.—*Acropora brooki*, sp. n. × 5·5.
G.B.R.E. No. 290.

FIG. 3.—*Acropora cancellata* (Brook). × 3.
B.M. Reg. No. 1934.5.14.415.

FIG. 4.—*Acropora cancellata* (Brook). × 1.
B.M. Reg. No. 1934.5.14.415.



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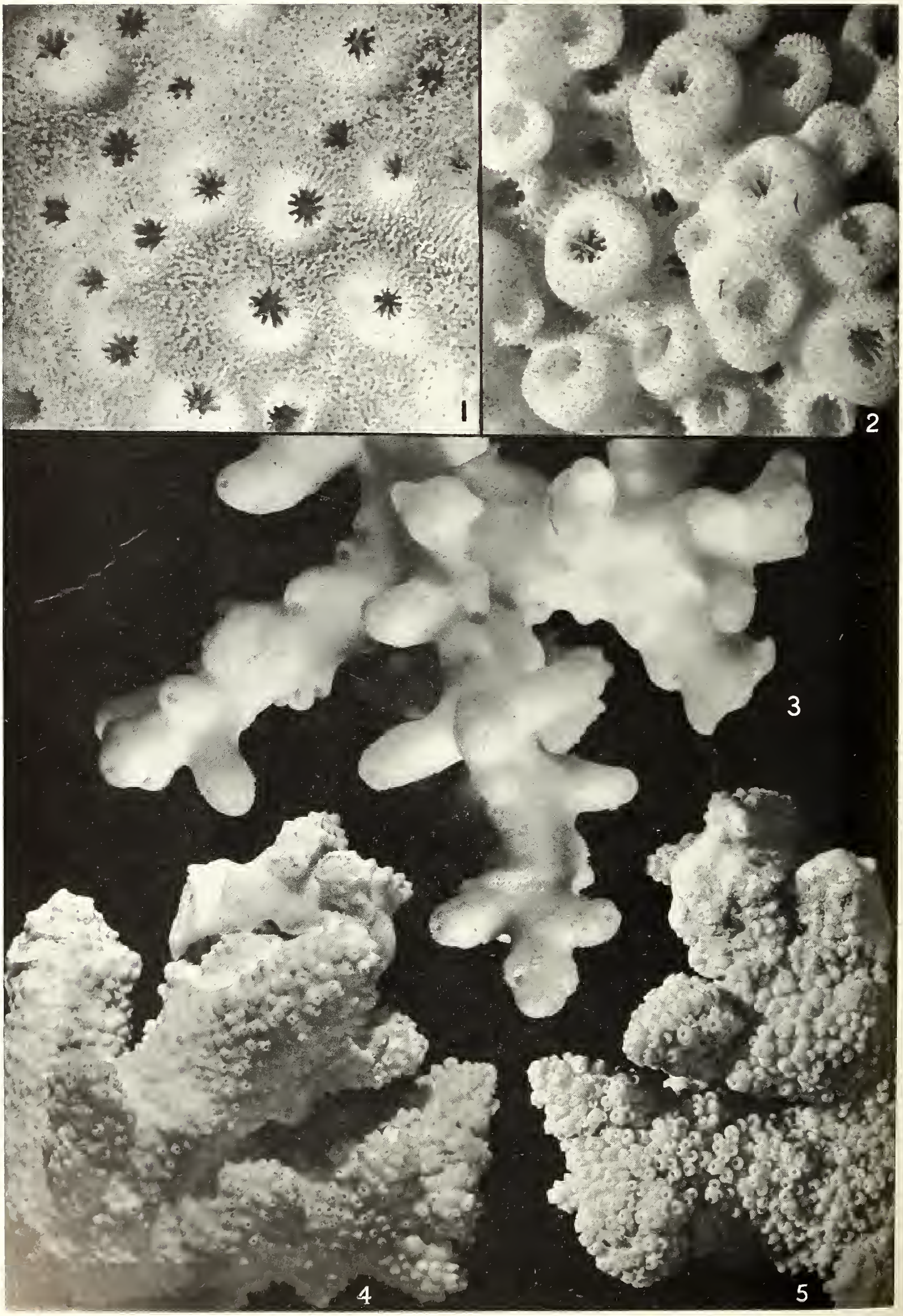


[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XLII.

Fig. 1.—*Acropora jeulini*, sp. n. × 9.
G.B.R.E. No. 330.

Fig. 2.—*Acropora jeulini*, sp. n. × 9.
G.B.R.E. No. 330.

Fig. 3.—*Acropora clavigera* (Brook). × 3.
B.M. Reg. No. 1934.5.14.611.

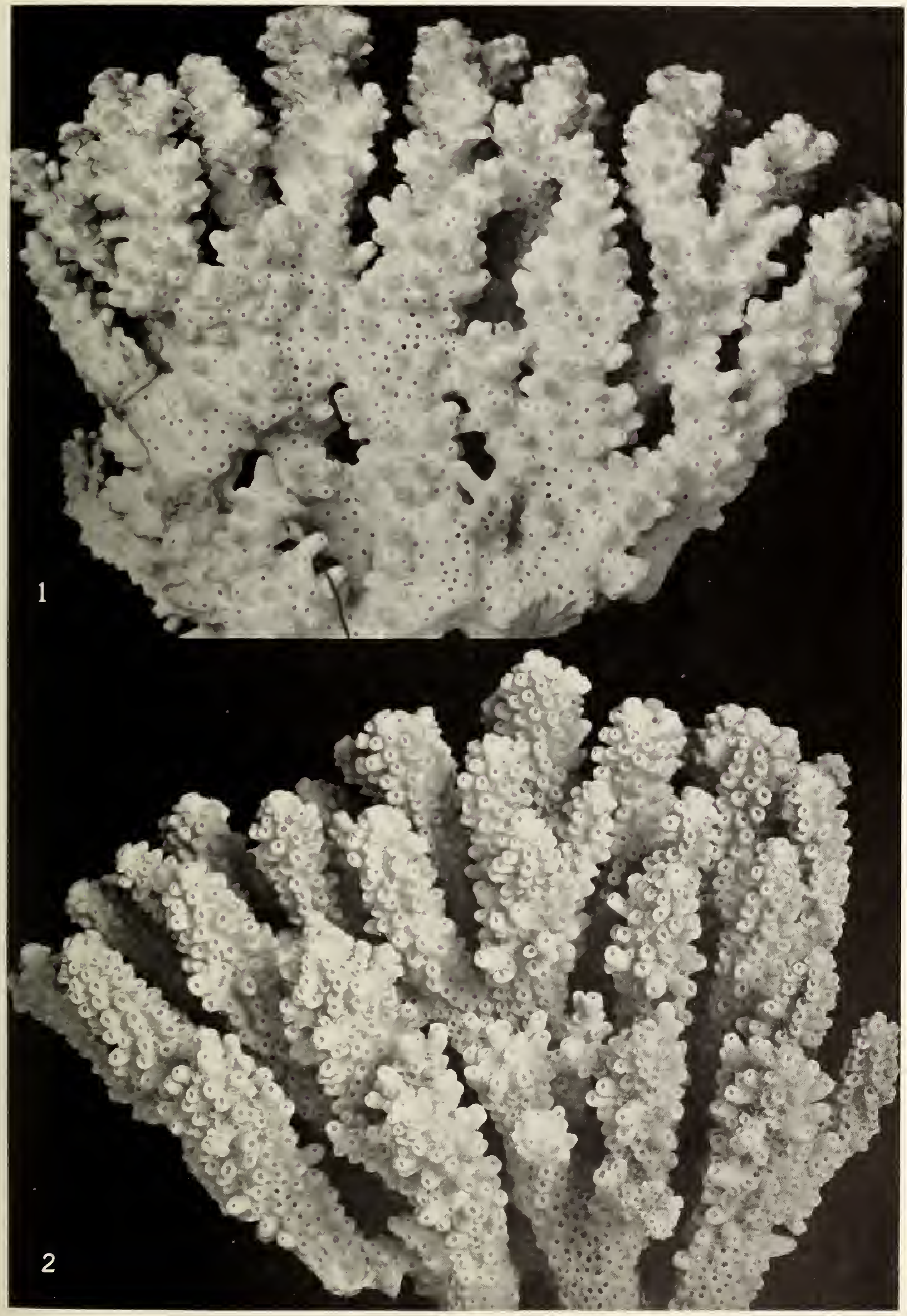
Fig. 4.—*Acropora jeulini*, sp. n. Underside. × 1.
G.B.R.E. No. 330.

Fig. 5.—*Acropora jeulini*, sp. n. Upper surface. × 1.
G.B.R.E. No. 330.

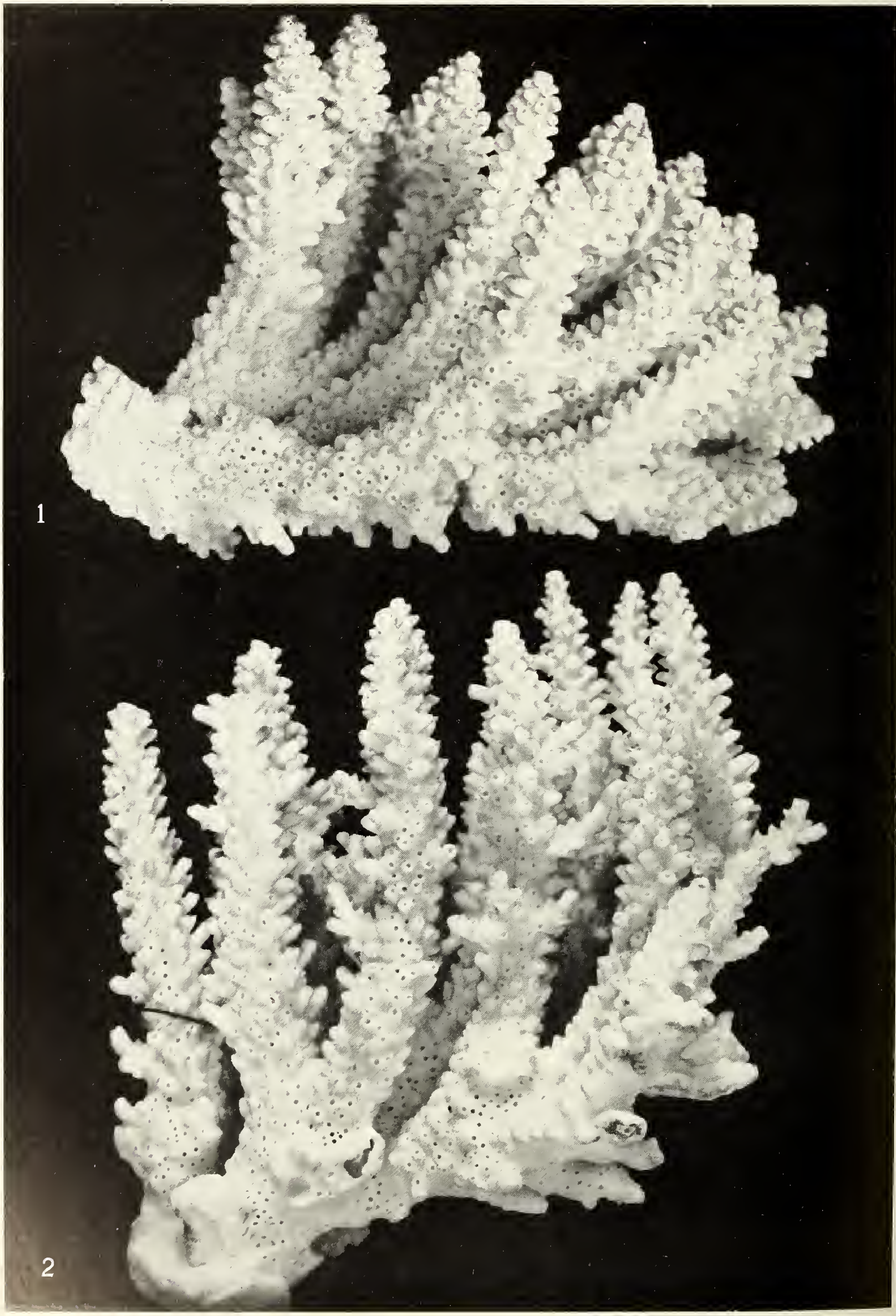
DESCRIPTION OF PLATE XLIII.

FIG. 1.—*Acropora otteri*, sp. n. Holotype. Underside. × 1.
G.B.R.E. No. 338.

FIG. 2.—*Acropora otteri*, sp. n. Holotype. Upper surface. × 1.
G.B.R.E. No. 338.



[*Adlard & Son, Ltd., Impr.*



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE XLIV.

FIG. 1.—*Acropora otteri*, sp. n. Paratype. × 1.
G.B.R.E. No. 306.

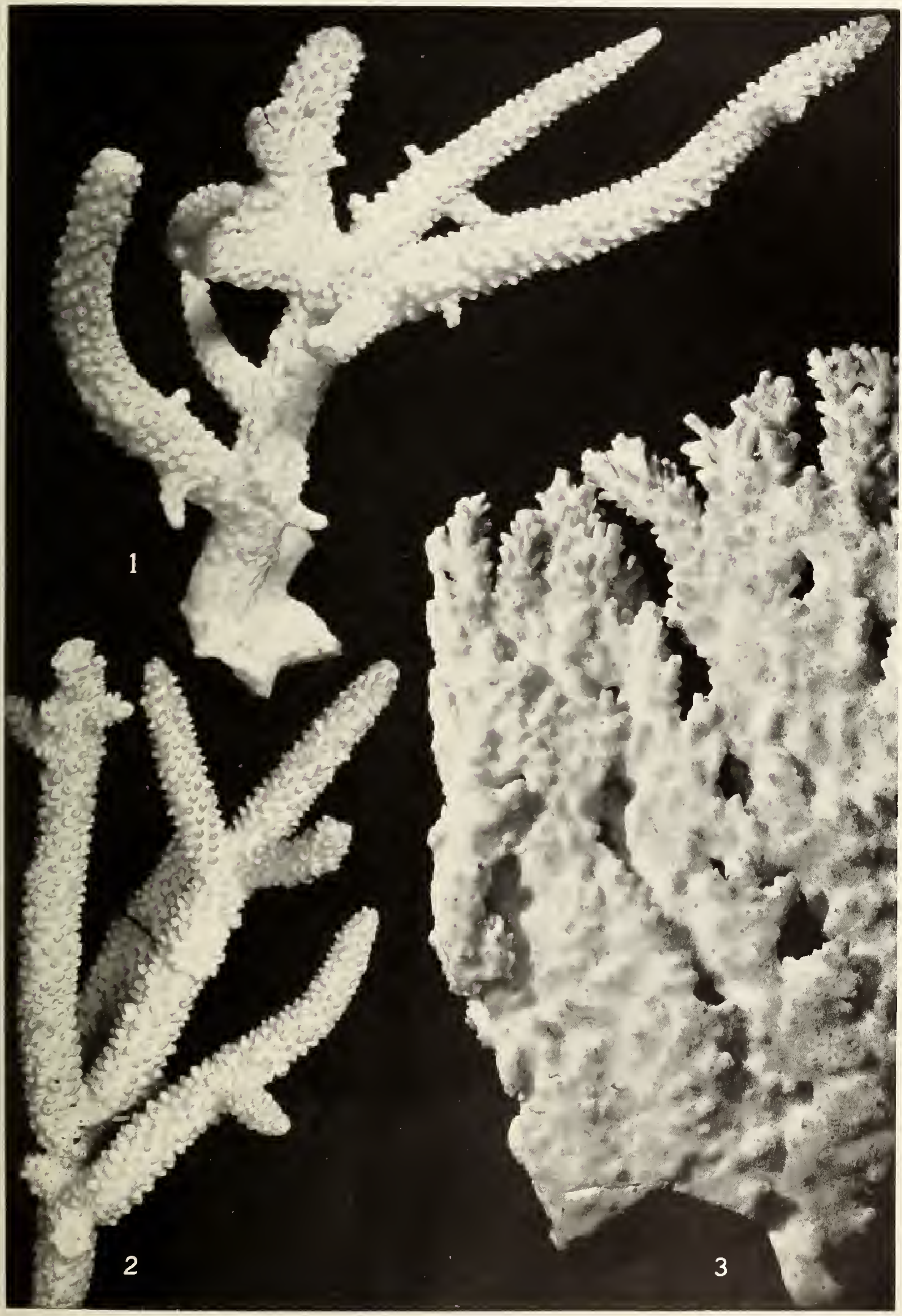
FIG. 2.—*Acropora otteri*, sp. n. Paratype. × 1.
G.B.R.E. No. 60.

DESCRIPTION OF PLATE XLV.

Fig. 1.—*Acropora laevis,* sp. n. × 1.
G.B.R.E. No. 79.

Fig. 2.—*Acropora laevis,* sp. n. × 1.
G.B.R.E. No. 93.

Fig. 3.—*Acropora brooki,* sp. n. Underside. × 1·2.
G.B.R.E. No. 290.



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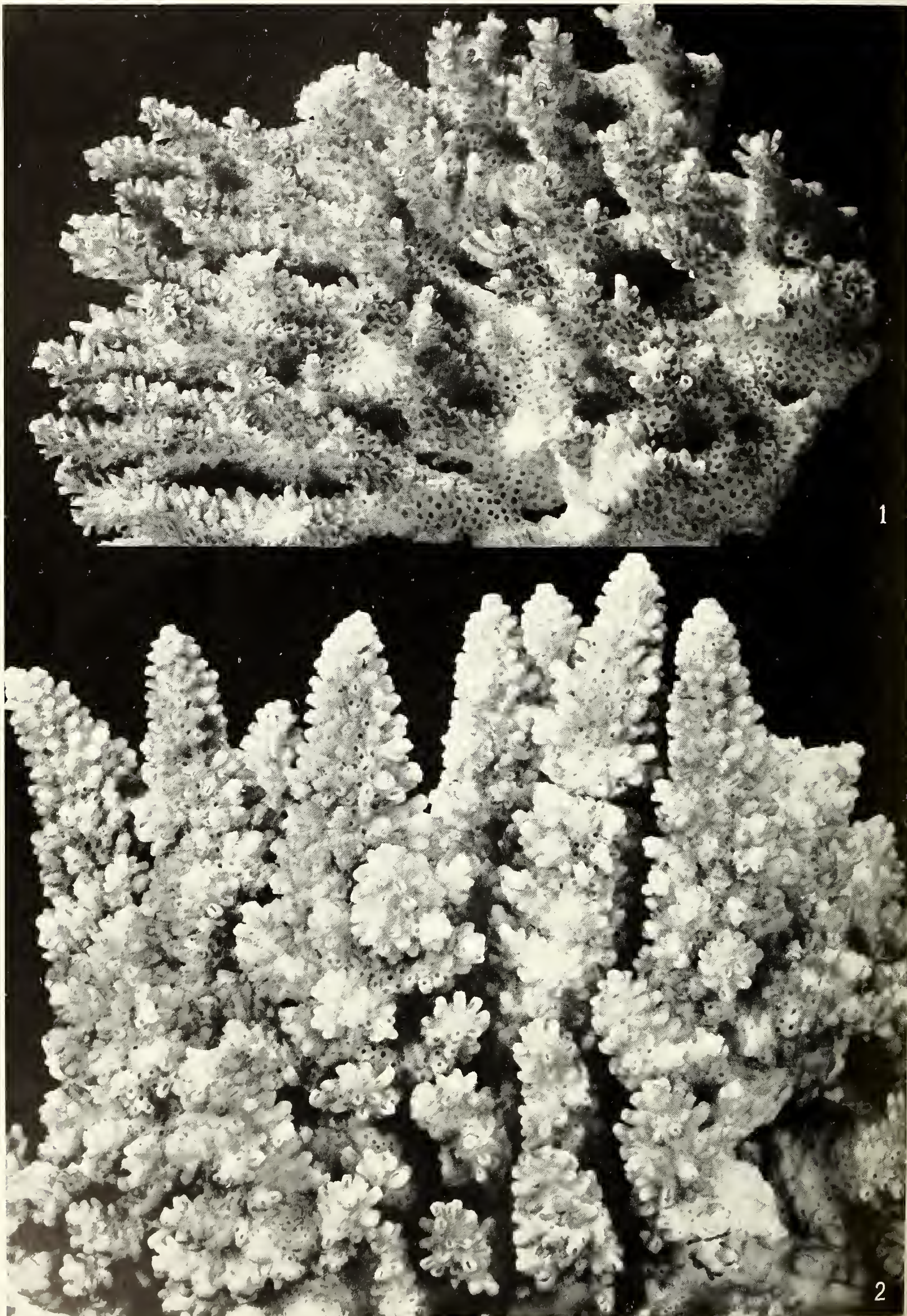

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DESCRIPTION OF PLATE XLVI.

FIG. 1.—*Acropora brooki*, sp. n. Upper surface. × 1·1.
G.B.R.E. No. 290.

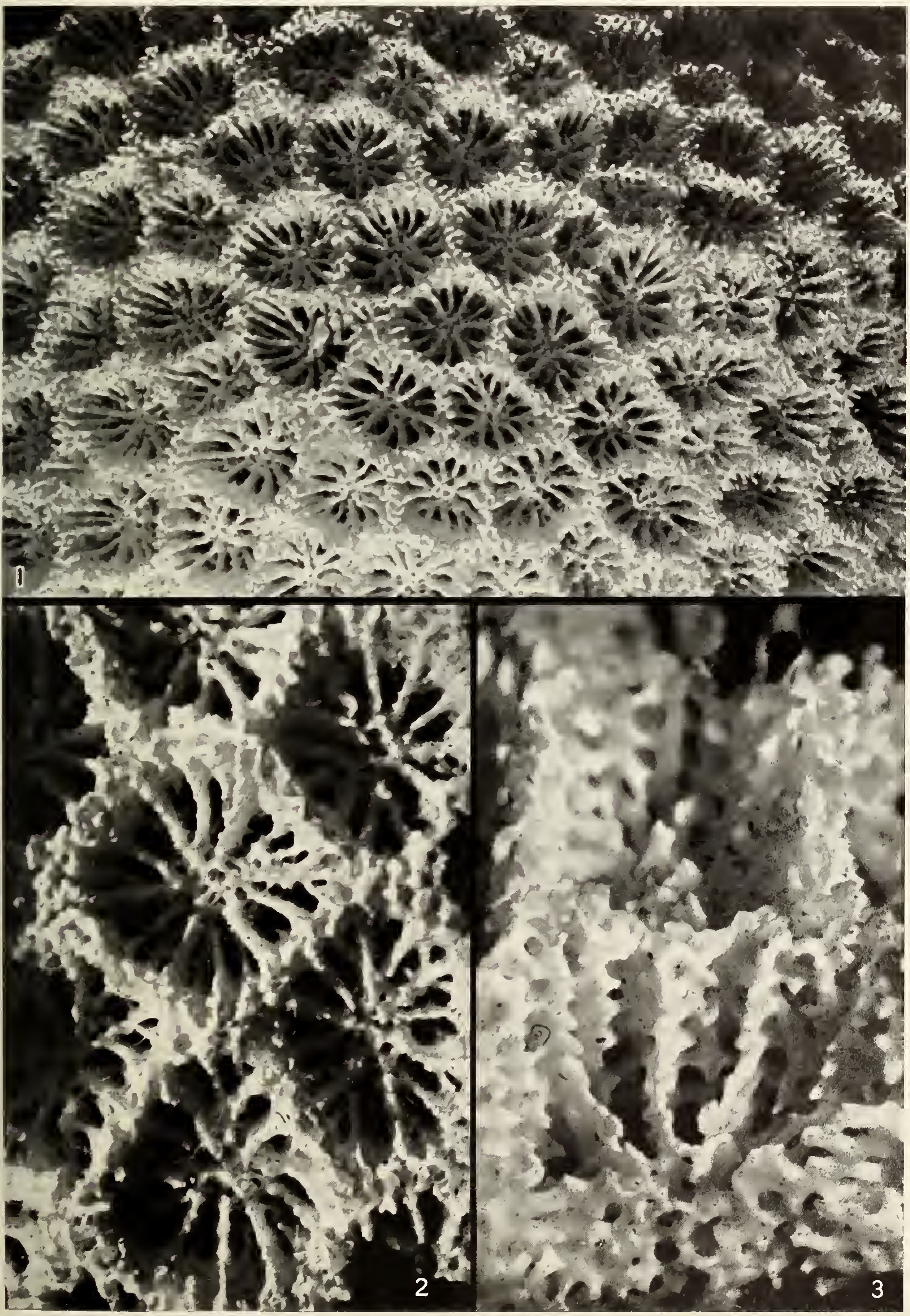
FIG. 2.—*Acropora lutkeni*, sp. n. × 1.
G.B.R.E. No. 271.

DESCRIPTION OF PLATE XLVII.

FIG. 1.—*Goniopora lobata* M. E. and H., Bedot. × 4.
G.B.R.E. No. P37.

FIG. 2.—*Goniopora lobata* M. E. and H., Bedot. × 10.
G.B.R.E. No. P37.

FIG. 3.—*Goniopora lobata* M. E. and H., Bedot. × 18.
G.B.R.E. No. P37.



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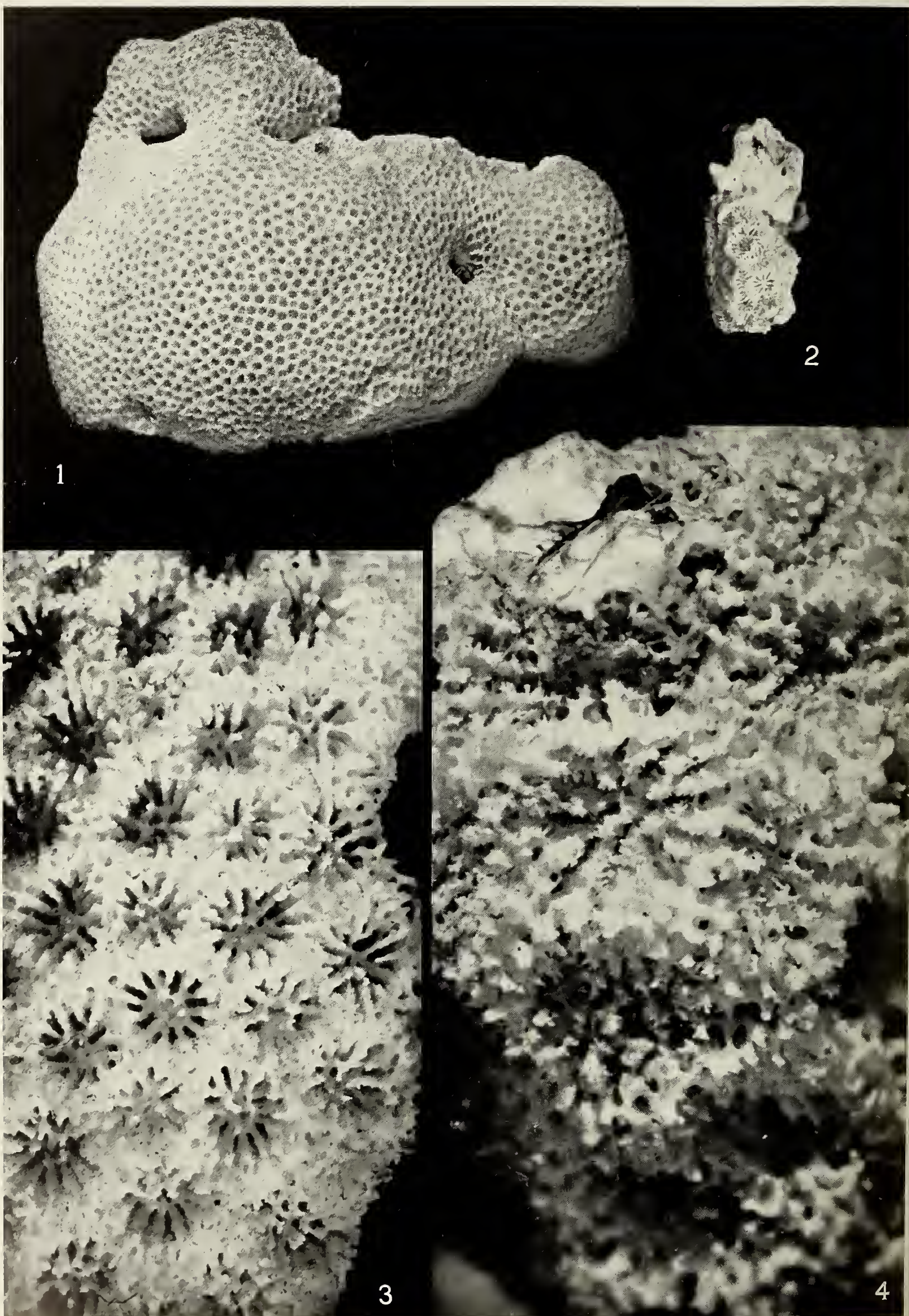

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DESCRIPTION OF PLATE XLVIII.

FIG. 1.—*Goniopora minor*, nom. n. × 1.
G.B.R.E. No. 56.

FIG. 2.—*Goniopora hirsuta*, sp. n. × 2.
B.M. Reg. No. 1934.5.14.424.

FIG. 3.—*Goniopora minor*, nom. n. × 10.
G.B.R.E. No. 56.

FIG. 4.—*Goniopora hirsuta*, sp. n. × 18.
B.M. Reg. No. 1934.5.14.424.

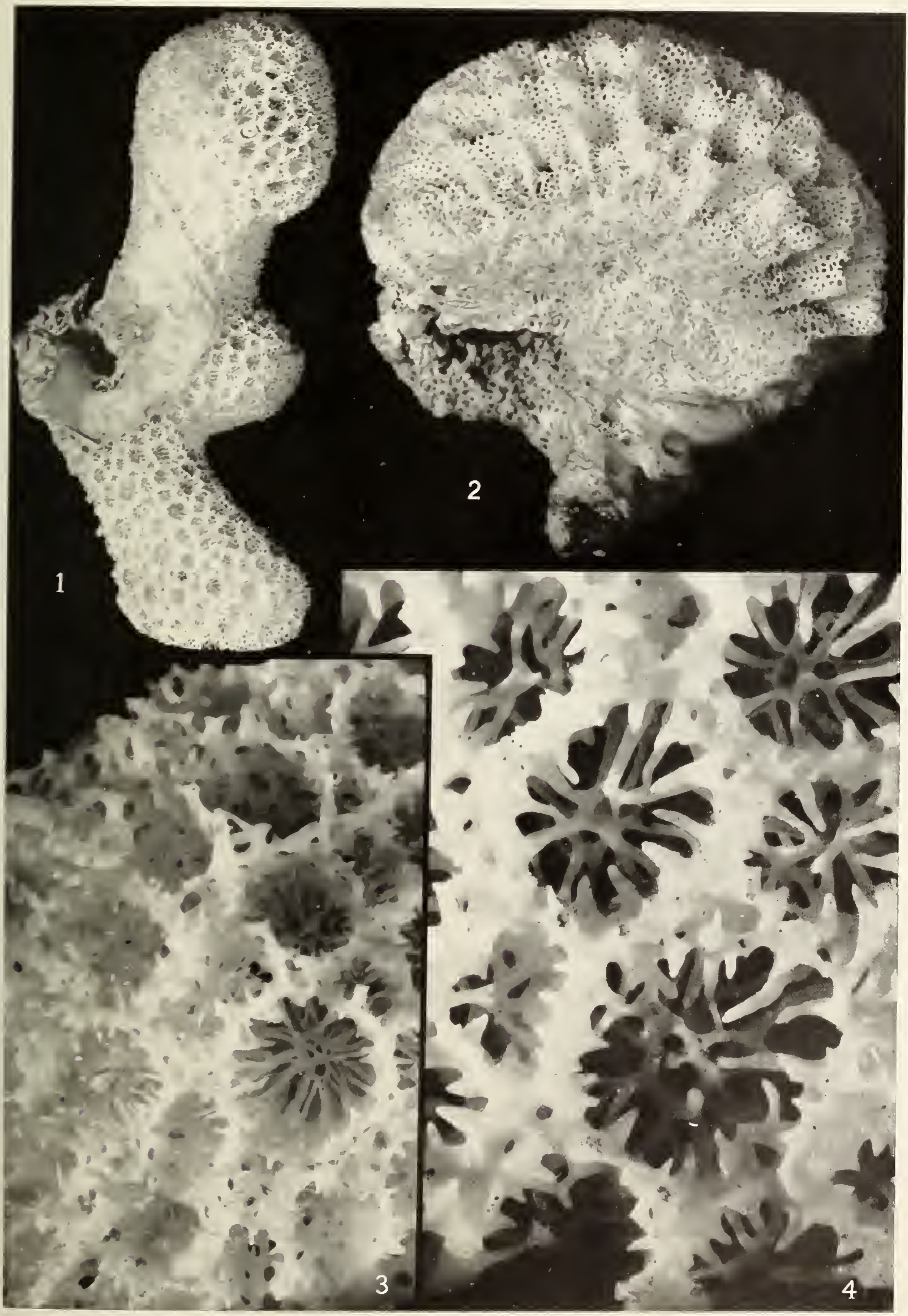
DESCRIPTION OF PLATE XLIX.

Fig. 1.—*Alveopora mortenseni*, n. sp. × 1·5.
B.M. Reg. No. 1934.5.14.411.

Fig. 2.—*Alveopora irregularis*, sp. n. × 3.
B.M. Reg. No. 1934.5.14.607.

Fig. 3.—*Alveopora mortenseni*, sp. n. × 8.
B.M. Reg. No. 1934.5.14.411.

Fig. 4.—*Alveopora mortenseni*, sp. n. × 16.
B.M. Reg. No. 1934.5.14.411.



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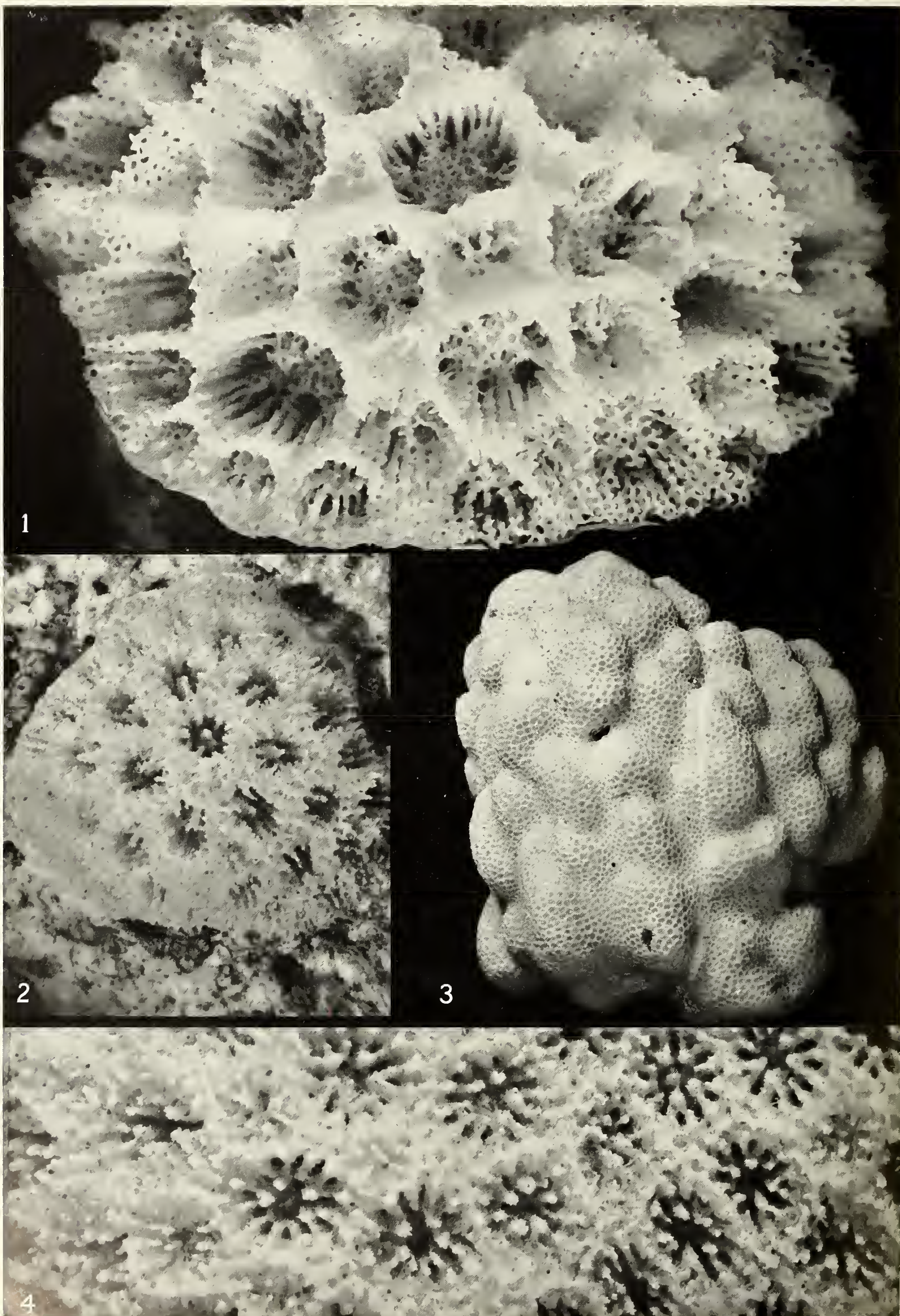


[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE L.

Fig. 1.—*Alveopora irregularis*, sp. n. × 6.
B.M. Reg. No. 1934.5.14.607.

Fig. 2.—*Stylaraea punctata* Klz. × 7.
B.M. Reg. No. 1934.5.14.387.

Fig. 3.—*Porites stephensoni*, sp. n. × 1.
B.M. Reg. No. 1934.5.14.377.

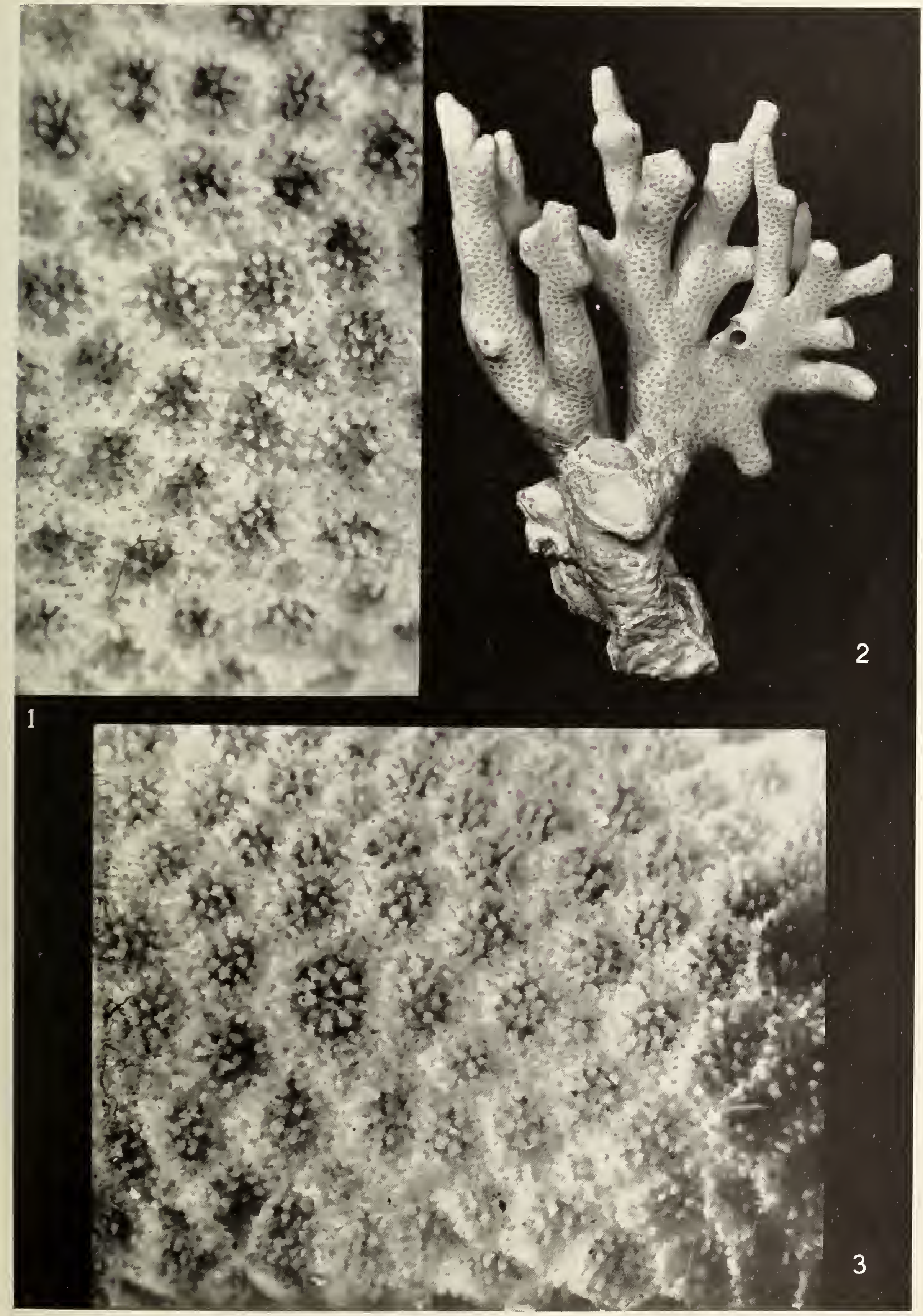
Fig. 4.—*Porites stephensoni*, sp. n. × 18.
B.M. Reg. No. 1934.5.14.377.

DESCRIPTION OF PLATE LI.

Fig. 1.—*Porites lanuginosa* Studer. × 13.
B.M. Reg. No. 1934.5.14.423.

Fig. 2.—*Porites suppressa*, sp. n. × 1.
B.M. Reg. No. 1934.5.14.371.

Fig. 3.—*Porites suppressa*, sp. n. × 13.
B.M. Reg. No. 1934.5.14.371.



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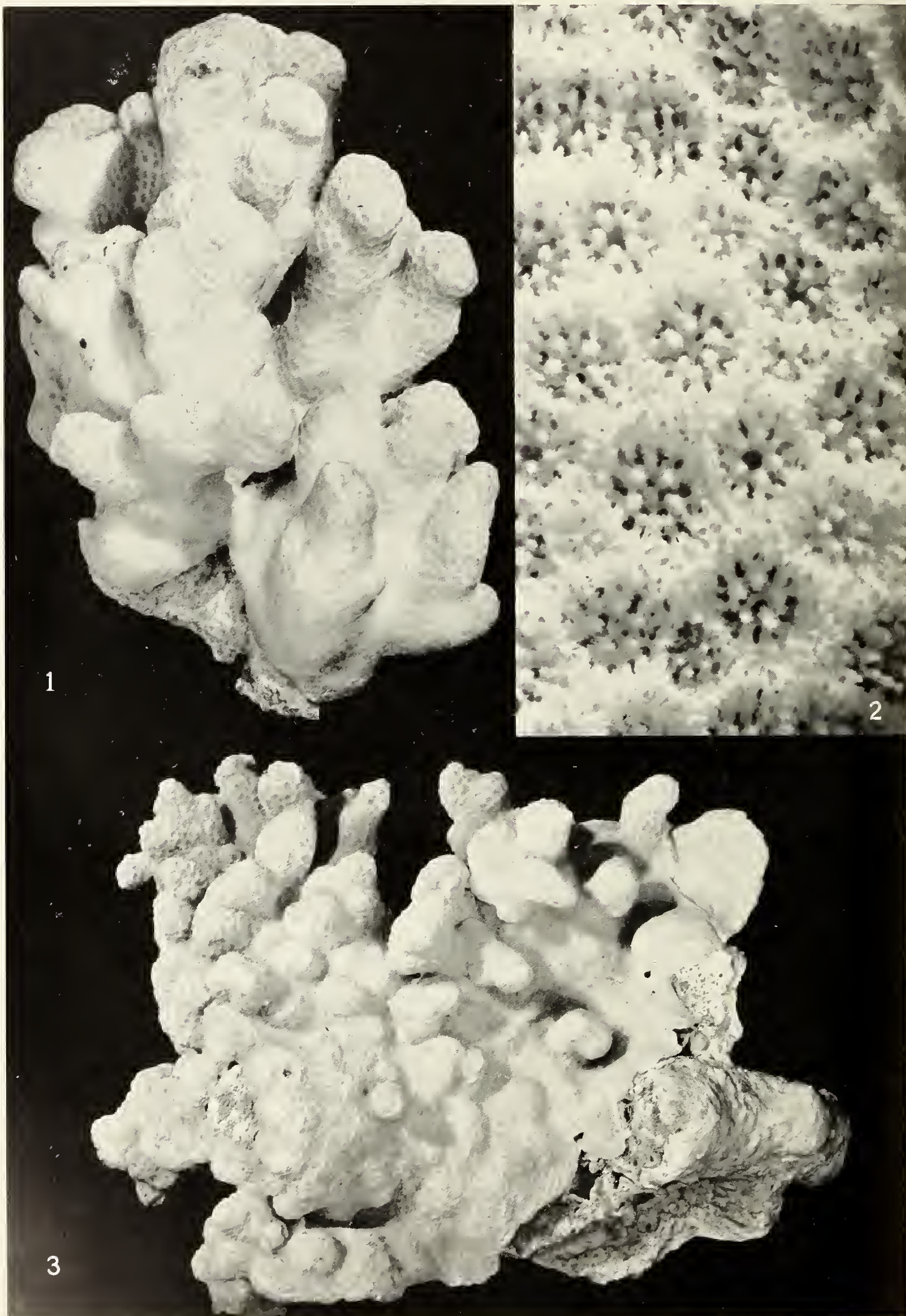


[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE LII.

FIG. 1.—*Porites annae*, nom. nov. × 1·5.
G.B.R.E. No. 15.

FIG. 2.—*Porites annae*, nom. nov. × 17.
G.B.R.E. No. 15.

FIG. 3.—*Porites annae*, nom. nov. × 1.
G.B.R.E. No. 4.

DESCRIPTION OF PLATE LIII.

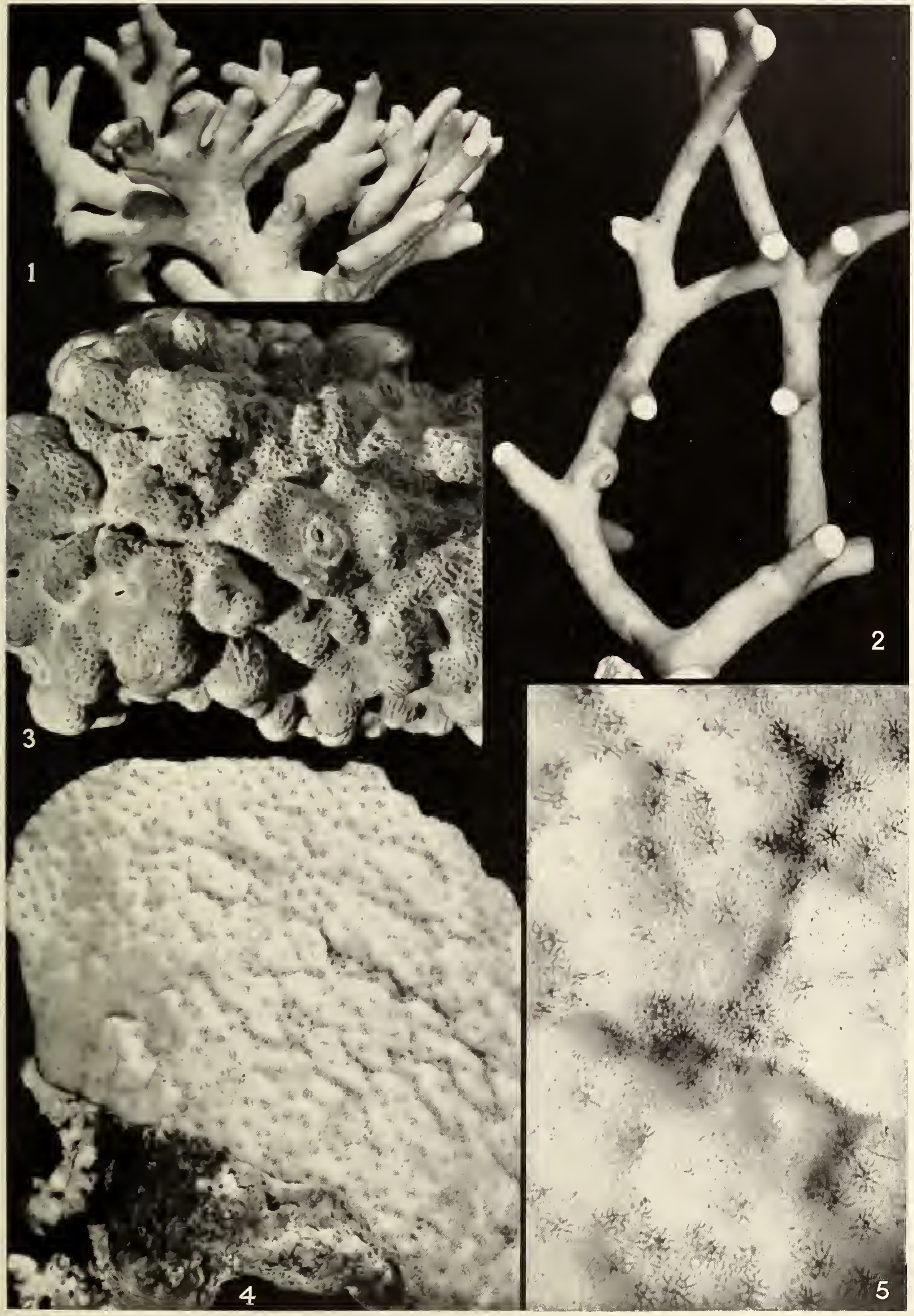
FIG. 1.—*Millepora tortuosa* Dana. × 1.
G.B.R.E. No. 96.

FIG. 2.—*Millepora tortuosa* Dana. × 1.
B.M. Reg. No. 1934.5.14.427.

FIG. 3.—*Millepora foveolata*, sp. n. × 2.
G.B.R.E. No. P20.

FIG. 4.—*Porites* (*Synaraea*) *vaughani*, sp. n. × 2.
B.M. Reg. No. 1934.5.14.491A.

FIG. 5.—*Porites* (*Synaraea*) *vaughani*, sp. n. × 6·5.
B.M. Reg. No. 1934.5.14.491A.



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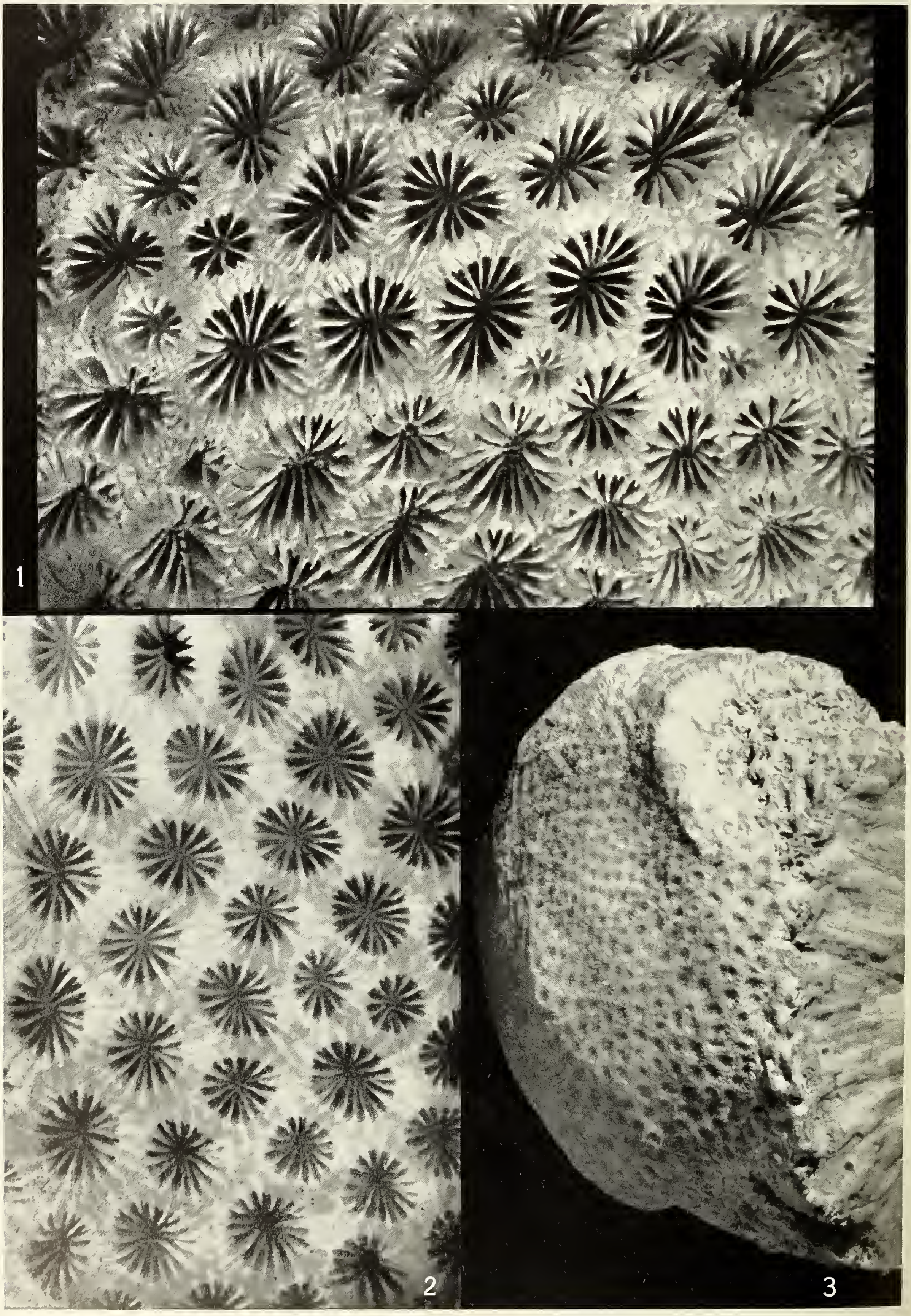


[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE LIV.

Fig. 1.—*Leptastrea transversa* Klz. × 4·5.
G.B.R.E. No. 227.

Fig. 2.—*Leptastrea transversa* Klz. × 4·5.
G.B.R.E. No. 227.

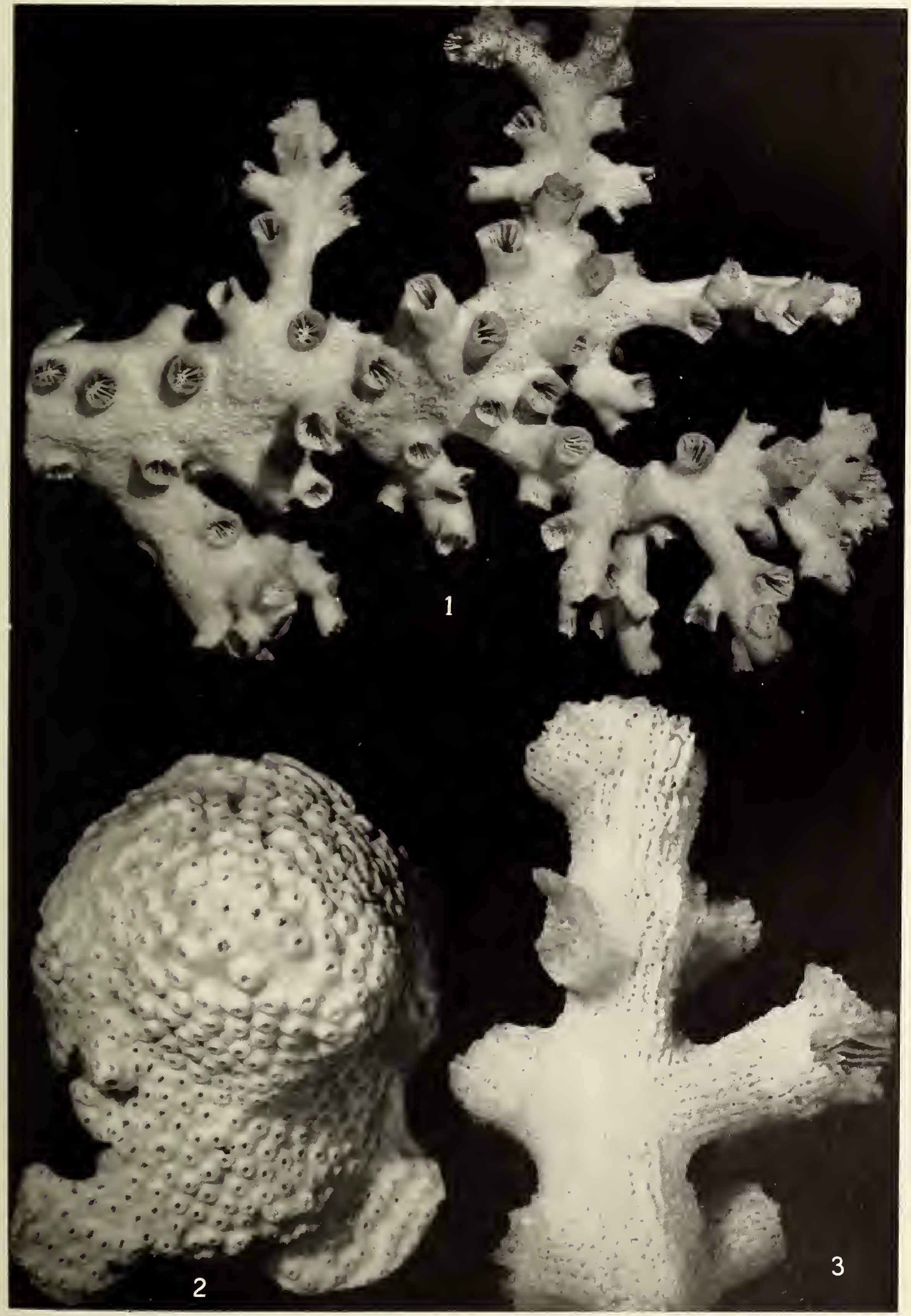
Fig. 3.—*Leptastrea transversa* Klz. × 1.
G.B.R.E. No. 227.

DESCRIPTION OF PLATE LV.

Fig. 1.—*Dendrophyllia micranthus* var. *grandis* var. n. × 1.
G.B.R.E. No. 75.

Fig. 2.—*Turbinaria stephensoni*, sp. n. × 1.
G.B.R.E. No. 449.

Fig. 3.—*Dendrophyllia velata*, sp. n. × 6·2.
B.M. Reg. No. 1934.5.14.390.



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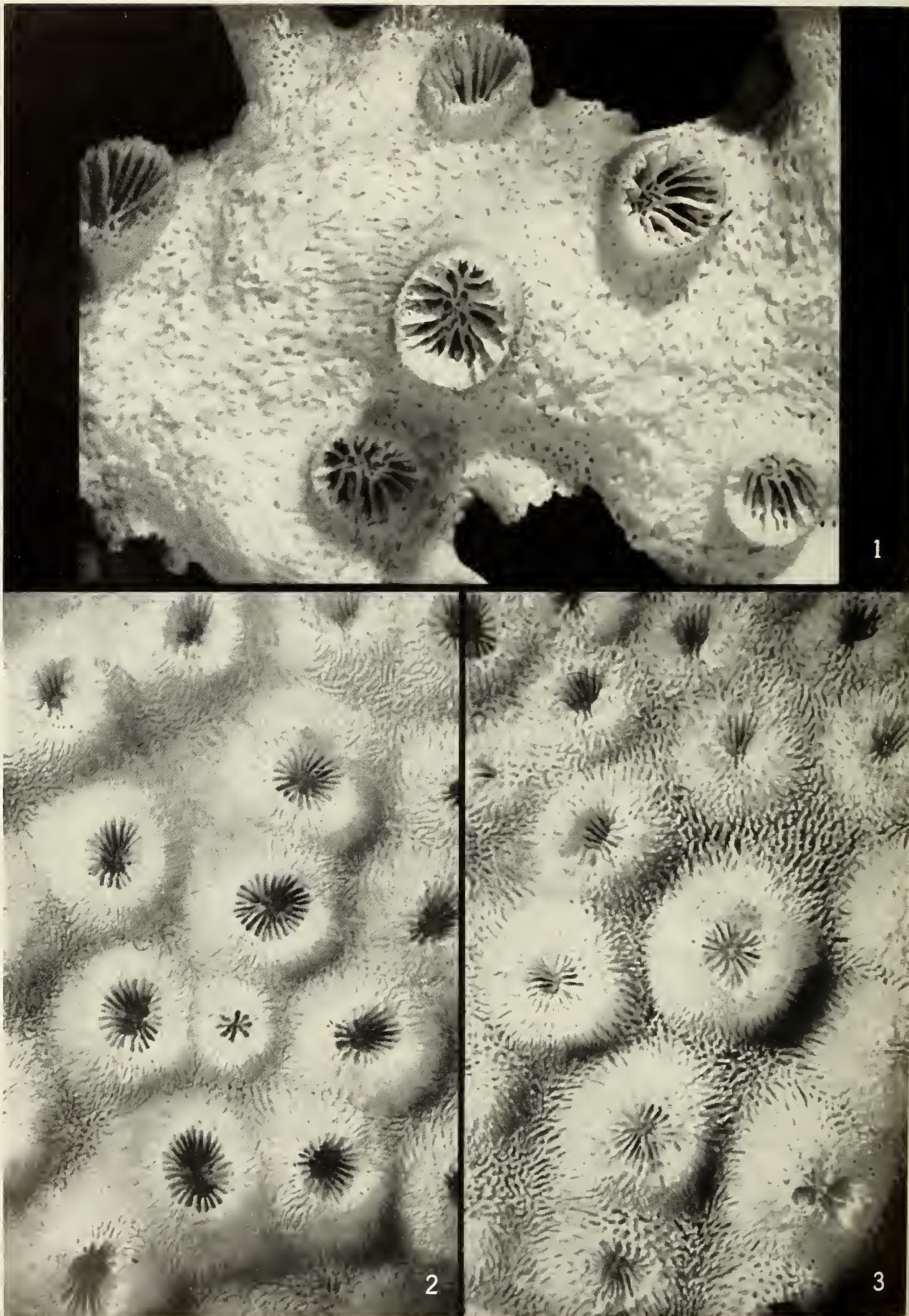

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DESCRIPTION OF PLATE LVI.

FIG. 1.—*Dendrophyllia micranthus* var. *grandis* var. n. × 3.
G.B.R.E. No. 75.

FIG. 2.—*Turbinaria stephensoni*, sp. n. × 6·3.
G.B.R.E. No. 449.

FIG. 3.—*Turbinaria stephensoni*, sp. n. × 6·3.
G.B.R.E. No. 449.