STUDIES ON THE FAUNA OF CURAÇAO AND OTHER CARIBBEAN ISLANDS, No. 130.

THE SHALLOW-WATER STONY CORALS OF THE NETHERLANDS ANTILLES

by

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PREFACE

Up till now the only description of submarine localities with regard to stony corals in the Netherlands Antilles was my paper on "Distribution of Reef Corals in Curaçao" (1964). The present – concise – review of the shallow water stony corals of the Netherlands Antilles, based on one year of field research, is intended as a continuation of this first survey.

This memoir is written for the use of my colleagues in the submarine field, for the algologist as well as the ichthyologist, the ecologist as well as the ethologist, assuming that they will at least appreciate the attempt.

Geographically it deals only with eight small islands, scattered in the Caribbean Sea. The survey is bathymetrically limited to the littoral zone above 10 m depth, which can be explored free-diving.

As a guide to identification this paper contains keys, which are to be used for corals from the Netherlands Antilles exclusively.

The investigations were financed by the "Netherlands Foundation for the Advancement of Tropical Research" (WOTRO).

During my stay in the Antilles the "Caribbean Marine Biological Institute" (Carmabi) at Curaçao was used as a base; during the interpretation of the field data and the preparation of the manuscript accomodation at the Zoological Laboratory of the State University at Utrecht was at my disposal. The ready co-operation of the

Executive Board of WOTRO, the Director of the Carmabi, dr. F. CREUTZBERG and his co-workers as well as the staff of the Zoological Laboratory is gratefully acknowledged. I am especially indebted to dr. P. WAGENAAR HUMMELINCK, whose encouragement and expert help contributed much to the completion of this paper.

Thanks are also due to the Harbourmaster and other authorities in Aruba for providing transport facilities, and to dr. E. J. VAN DER KUIP, then veterinary surgeon at that island for his generous hospitality. I am grateful to the authorities of Bonaire for their kind co-operation and to Mr. A. KRUMPERMAN, then physician at the island, for his general information and for the use of his boat. At St. Martin, Saba and St. Eustatius, the authorities were very helpful too, and especially the kind assistence of Mr. P. A. VAN DEN HEUVEL, then headmaster at St. Maarten, is gratefully acknowledged.

Dr. GEORG SCHEER generously put his Darmstadt collection at my disposal.

I should also like to express my sincere thanks to Mr. H. VAN KOOTEN and Mr. P. D. WOLTEMA of the Zoological Laboratory at Utrecht for the excellent photographs of the corals.

The manuscript was finished in 1967. After that time some smaller investigations regarding behaviour and sociology of reef corals were carried out. Since 1970 the program of the Caribbean Marine Biological Institute at Curaçao became focussed on coral reefs.

CONTENTS AND INDEX

INTRODUCTION

Although the corals and reefs of Curaçao are fairly well known (VAN DER HORST 1927, ROOS 1964, 1967), information about coral growth around the other islands of the Netherlands Antilles is still lacking.

This paper offers the first comprehensive study of the reef corals of this area: Aruba, Curaçao (with Klein Curaçao), Bonaire (with Klein Bonaire), St. Martin, Saba and St. Eustatius. Due to practical reasons, however, the survey had to be restricted in several respects.

The first restriction is a geographical one, inherent to the limitation of the national territory. The islands of the Netherlands Antilles form by no means a zoogeographical or geomorphological unity. Some localities off the French part of St. Martin were surveyed too.

Lack of time during my stay at some islands, and/or lack of filling stations for diving equipment, compelled me to confine the survey to a maximum depth of only ten metres. Down to that depth one can skindive without diving apparatus and with only little diving experience. Moreover, along the islands of the Leeward Group, at 10 m depth, there is often an abrupt dip of the bottom, which divides the reef into two parts with a different aspect and composition (see ROOS 1964).

I also restricted myself to the study of the more conspicuous stony corals of the reef, including the hermatypic corals of Hydrocorallinae and Scleractinia as described e.g. in SMITH 1948. The ahermatypic species *Tubastrea tenuilamellosa* and *Stylaster roseus* were included

too. For the enumeration of the species described see Contents and Index.

The greater part of the coast of Curaçao was investigated in 1961 (Roos 1964), supplementary data were obtained in 1965. The survey of the coast of Aruba took place in October 1965. Bonaire was investigated in September 1965 and supplementary data were obtained in August 1967. St. Martin, Saba and St. Eustatius were surveyed in July and August 1965.

As a rule no corals were collected. A representative collection from Curaçao was made already in 1961. Only specimens of new or doubtful species were taken for further identification. All these specimens have been deposited in the collection of the Zoological Museum at Amsterdam.

It is clear that without collecting, a considerably larger area can be surveyed in a given amount of time. It must be admitted, however, that when doing so, one runs the risk of false identification. In spite of this disadvantage, however, the method chosen appears to me the best one when surveying an extensive area within a short time. It is only feasible, of course, after sufficient experience with the corals in question, in the field as well as in the laboratory.

The accessibility was often decisive for the choice of the localities. Therefore most localities are to be found along the leeward coasts, while at the steep rocky coast of Saba only three localities could be investigated. In some cases reefs were visited by boat.

All explorations were carried out by skin-diving with the help of flippers, mask and snorkel only. Notes were made with a glass pencil on a plastic paper pad. The depths were estimated or measured with a wrist-model depth meter.

Museum specimens of corals from the Netherlands Antilles are present in the Netherlands and in Darmstadt, B.R.D. This German collection comprises the corals collected by GEORG SCHEER during the first Xarifa-expedition in 1953/54. He studied a reef at Bonaire *in extenso* and brought home an important and well documented collection of corals from that island.

In The Netherlands well-documented collections from the West Indies are those of WAGENAAR HUMMELINCK in the Zoological La-

boratory of the State University at Utrecht and those of the Zoological Museum at Amsterdam. The latter Museum possesses the collections of VAN DER HORST and ROOS.

WAGENAAR HUMMELINCK collected more or less incidentally specimens during his voyages to the West Indies in 1930, 1936/37, 1948/49, 1955, 1963/64 and 1967; VAN DER HORST made a collecting trip to Curaçao in 1920 and ROOS investigated the distribution and zonation of reef-corals at the same island in 1961.

The specimens figured in Pls. III, IX, XIV, XXV and XLI have been collected by H.C.M. HAKKENBERG VAN GAASBEEK and his son PETER.

The museums mentioned above, together with the State Museum at Leyden, moreover possess a great number of specimens from various other West Indian localities and collectors. All these corals have been studied for comparison, and are mentioned in the text.

The following abbreviations are used:

HLM: HESSISCHES LANDESMUSEUM, DARMSTADT. When the catalogue number is preceded by X1, the corals were collected during the Xarifa-expedition in 1953/54.

PWH: Collection of dr. P. WAGENAAR HUMMELINCK (to be deposited in the Zoological Museum, Utrecht). His numbers are Station numbers.

RMNH: RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN.

ZLU: ZOÖLOGISCH LABORATORIUM, UTRECHT.

ZMA: ZOÖLOGISCH MUSEUM, AMSTERDAM.

ZMU: ZOÖLOGISCH MUSEUM, UTRECHT.

During the preparation of the manuscript the revised list of Jamaican scleractinian corals (GOREAU & WELLS 1967) was published. This is the most extensive list we have from the West Indian region, comprising 61 species including a number of new species. Other modern lists published before, concern corals from Bimini (SQUIRES 1958), Barbados (LEWIS 1960), Cuba (DUARTE BELLO 1960), Puerto Rico (ALMY & CARRIÓN-TORRES 1963) and Curaçao (ROOS 1964).

As the composition of such lists is largely dependent on the species concept of the author, they are not comparable without further comment. As we do not know exactly what a coral species is, or a form or a variety, classification and identification is highly subjective.

The classification followed here is mainly based on SMITH (1948), VAUGHAN (1919), VAUGHAN & WELLS (1943) and VERRILL (1902) for scleractinian corals; and on BOSCHMA (1948 and 1965) for hydrozoan corals.

In the systematic part, as a rule, reference has only been made to some of the above mentioned faunistic lists. If necessary, the classification or identification is discussed.

THE AREA

The territory of the Netherlands Antilles comprises six main islands, two smaller islands and some rocks. Three of the main islands with the two smaller ones, ARUBA, CURAÇAO with KLEIN CURAÇAO and BONAIRE with KLEIN BONAIRE, are located at a distance of 30 km (Aruba) to 90 km (Bonaire) off the Venezuelan coast (Fig. 1).

The other islands, ST. MARTIN, ST. EUSTATIUS and SABA (the northern part of St. Martin being French territory) are located about 900 km NE of the former islands (Fig. 2).

The islands off the Venezuelan coast form the Leeward islands of the Netherlands Antilles. The three northern are the Windward islands of the Netherlands Antilles.

As the concepts Leeward and Windward are differently interpreted by the Dutch, the French, the Spanish and the English, attention may be drawn to following explanation given by HUMMELINCK (1940 and 1953):

West Indies	Antilles, Bahamas, Florida Keys, Bermuda, Cayman Islands, Swan Island, Old Providence, San Andrés
Antilles	Cuba to Trinidad and Aruba
Greater Antilles	Cuba to Puerto Rico
Lesser Antilles	Virgin Islands to Trinidad and Aruba
Windward Group	Virgin Islands to Grenada (Bovenwindse Eilanden, Islas de Barlovento, Îles sur le Vent, Inseln über dem Winde)
Caribbees	Sombrero to Grenada
Leeward Islands	(British denomination) Virgin Islands to Dominica

Windward Islands	(British denomination) Martinique to Grenada
Leeward Group	Los Testigos to Aruba and Los Monges (Benedenwindse Eilanden, Islas de Sotavento, Îles sous le Vent, Inseln unter dem Winde)

The Leeward Group islands, *Aruba*, *Curaçao* and *Bonaire* are located between latitudes 12°00′ N and 12°40′ N and longitudes 68°12′ W and 70°05′ W.

The Windward Group islands *St. Martin*, *Saba* and *St. Eustatius* between latitudes 17°27′ N and 18°08′ N and longitudes 62°56′ W and 63°16′ W.

The eastern trade-wind has an average velocity at Curaçao of about 15 knots (7.5 m/sec), and about 10 knots (5 m/sec) at St. Martin.

Due to this constant trade-wind the heavy surf on the windward coasts causes great differences in coastal morphology and biology with regard to the leeward sides of the islands.

The annual precipitation averages about 500 mm in the Leeward Group and about twice that amount at the Windward Group. The precipitation, however, is very erratic, with great differences in the annual average amount. Most of the rain water flows directly seawards through riverbeds only then containing water. These beds are called 'rooien' in Curaçao, Aruba and Bonaire and 'guts' in St. Martin, Saba and St. Eustatius.

The influence of great amounts of this fresh and turbid water may affect coral growth and even kill coral colonies (see also GOREAU 1964). This influence may be disastrous during the passage of a hurricane. Then the wind often turns to a westerly direction, causing heavy surf on otherwise protected coasts. This results in the destruction of a great many fragile coral specimens. This probably explains the relative poor reef development in St. Martin, Saba and St. Eustatius, as well as dead *Acropora* reefs at the leeside of Bonaire.

THE ISLANDS OF THE LEEWARD GROUP

Aruba, Curaçao and Bonaire form part of the E.-W. running arc of the Lesser Antilles, north of the Venezuelan coast. The shortest

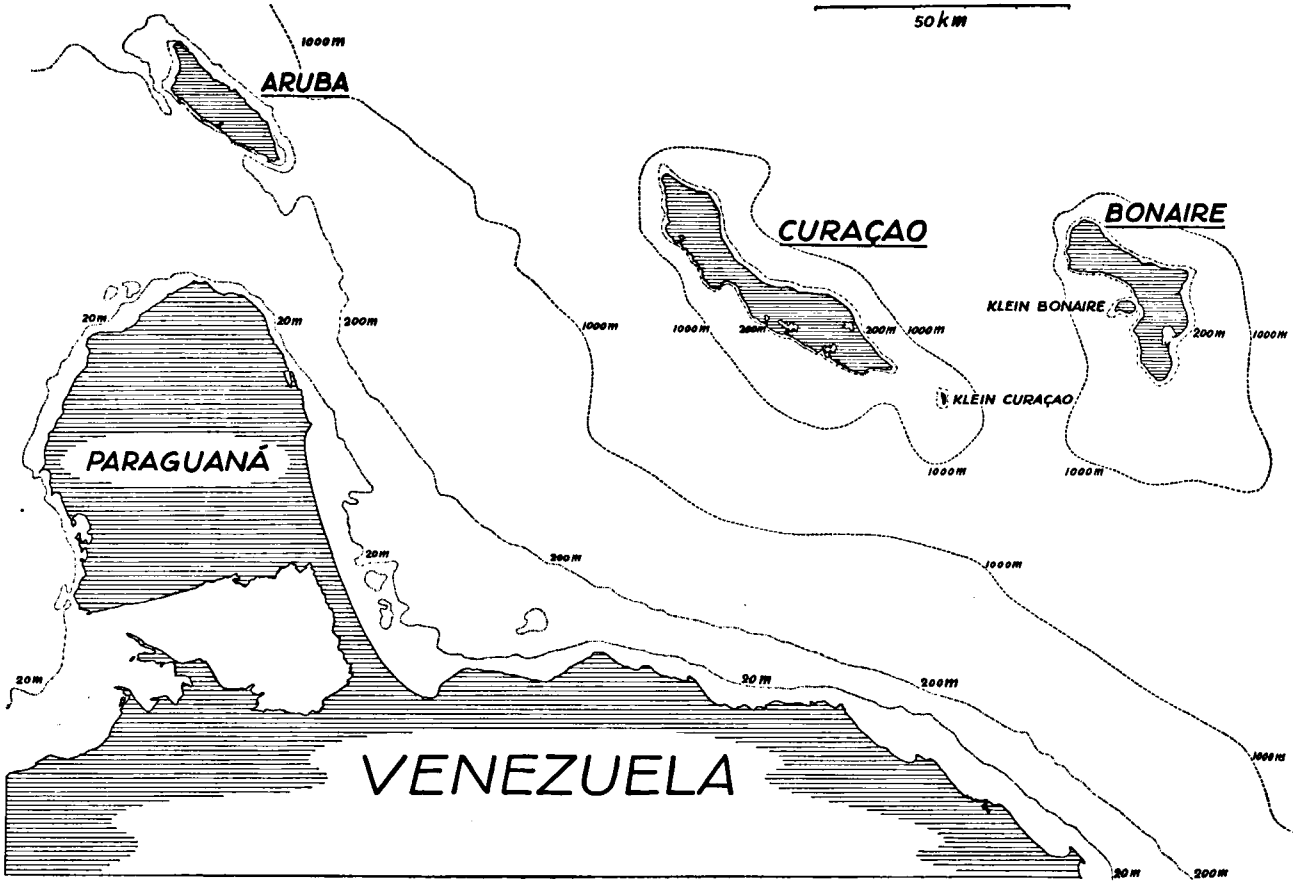


Fig. 1. The Netherlands Antilles of the Leeward Group: ARUBA, CURAÇAO and BONAIRE. – Contour intervals of 20, 200 and 1000 m deep (from Neth. Government Naut. Maps).

distance from the mainland to Aruba is 27 km, to Curaçao 66 km and to Bonaire 87 km.

Although these distances are not great, the sea between the islands and the coast of Venezuela is of a considerable depth. The greatest depth between the mainland and Aruba is 180 m (100 fathoms), between the mainland and Curaçao 1350 m (750 fathoms) and between the mainland and Bonaire 1910 m (1060 fathoms). This results in a rather steep slope of the sea bottom around the islands. It is noteworthy (Fig. 1) that the isobath of 200 m is about 1 km off the coasts of Curaçao and Bonaire. At the north coast of Aruba this depth is met with at an only slightly greater distance. The bottom at the south coast of Aruba is considerably more shallow, and therefore slopes less than it does at Curaçao or Bonaire. Only there does the reef morphology differ distinctly from the general pattern found on the Netherlands Leeward Islands.

With only one exception, at the NE coast of Aruba where the coast is formed by older formations, the islands are bordered by coral limestone or recent deposits (MOLENGRAAFF 1929, PIJPERS 1933, WESTERMANN 1932).

Steep cliffs are cut in the solid rock, beaches are formed by loose coral debris and coral sands. In the cliff generally a niche (surf notch) is present just at sea level. This niche occurs along cliffs exposed to strong wave attack as well as along leeward or sheltered coasts. Only along the windward coasts is a projecting bench present just below this niche (DE BUISONJÉ & ZONNEVELD 1960). The cliffs are interrupted by landlocked bays, which may reach far inland, by small beaches or ridges of coral debris. The landlocked bays are bordered by cliffs, coral debris or beaches at the entrance and by mangrove vegetation further inland. There also cliffs may be present.

The sea in front of the cliff is about 3 m deep. Beaches slope gradually and ridges of coral debris more steeply to that depth. Then a generally flat terrace gradually shelves towards a depth of about 10 m. At this depth the slope dips abruptly. The bottom is nearly vertical, down to about 45 m. Next a sloping area begins, covered by sand and scattered boulders. In some places a narrow terrace is present at 20 m (see also ROOS 1964).

In the niche near sealevel and in submarine caves in the cliff,

species and growth forms are encountered, which elsewhere are only found in deeper water.

In Curaçao and Bonaire sandy beaches are comparatively rare, most of the beaches consist of coarse coral debris. In Aruba, however, vast sandy beaches are present along the leeward W coast and smaller ones occur where the cliff along the windward NE coast is interrupted. In Aruba dunes are to be found. Part of the shallow sea bottom of the leeward beaches of Aruba is covered by sea-grass.

Along the S coast of Aruba a partly emerged reef is present, with a number of tiny islands, partly covered by mangroves and separated from the main islands by a long and narrow lagoon. At the sea side of the reef islands the bottom slopes down gradually, without the steep dips that are common along the other islands. As a consequence the reefs formed here are more uniform over greater distances in seaward direction than at the steep slopes along the leeward coasts of Curaçao and Bonaire.

The Islands of the Windward Group

St. Martin, Saba and St. Eustatius belong to the northernmost islands of the N-S running arc of the Lesser Antilles.

It can be easily seen from Fig. 2 that the three islands form part of different island groups. St. Martin, with Anguilla and Saint-Barthélemy (= St. Barts), is situated on a shallow submarine bank, the Anguilla Bank. In a same way St. Eustatius together with St. Christopher (= St. Kitts) and Nevis is situated on a relatively shallow bank. Saba, on the other hand, is a single island with its base on the sea bottom at a depth of about 600 m.

The greatest depth between Anguilla and St. Martin measures 20 m, between St.-Barthélemy and St. Martin 30 m, between St. Martin and Saba about 1000 m, between Saba and St. Eustatius 780 m and between St. Eustatius and St. Kitts 50 m. Saba is located at 443 km SSW of St. Martin and St. Eustatius at 27 km ESE of Saba.

As a consequence the slope of the sea bottom around St. Martin and St. Eustatius is much less than around Saba. Sandy flats, for example, are only to be found near the former islands. In contrast

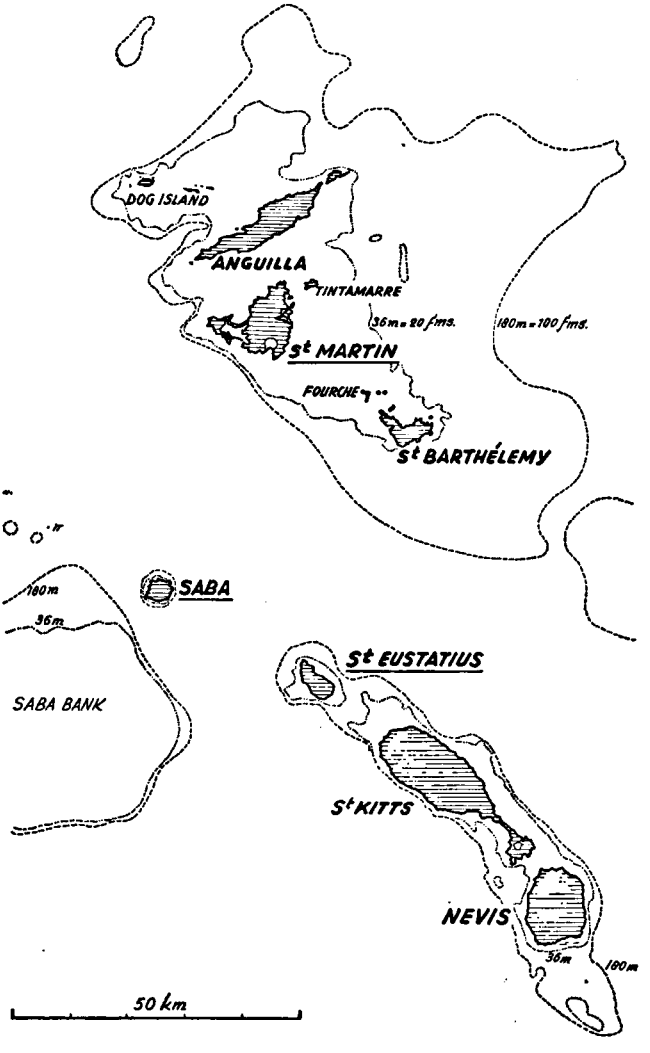


Fig. 2. The Netherlands Antilles of the Windward Group: ST. MARTIN, SABA and ST. EUSTATIUS. – Contour intervals of about 35 and 180 m deep (from U.S. Hydr. Off. Charts).

with coasts of the Leeward Islands, which are composed of rather recent coral limestone, those of the Windward islands consist mainly of rock of volcanic origin (CHRISTMAN 1953, WESTERMANN & KIEL 1961). Saba and St. Eustatius are completely volcanic in origin (WESTERMANN & KIEL 1961), with a single exception at the south coast of St. Eustatius, where a high white wall of limestone rises from the sea shore at a steep angle. Only at a few localities at the E and S coast of St. Martin does the coast consist of recent coral limestone. Older limestones are to be found at the S and W coasts of the island. The limestone cliffs closely resemble those of the Leeward Group. Sometimes a small niche is present. This niche is invariably absent in cliffs of volcanic rock.

Unless there is a sandy beach, there is always at least some water in front of a limestone cliff. The cliffs of volcanic origin may extend to a considerable depth or they may be bordered by boulders and cobbles at sea level, depending on the depth of the sea in front of the cliff. The former situation – a sheer cliff – is most common in Saba, the latter in St. Martin and St. Eustatius. Characteristic of the coast of St. Martin are numerous sandy beaches and sand bars, the latter connecting different parts of the island and enclosing lagoons (ZONNEVELD 1961).

Coral growth is scattered around these islands. The flat, sandy plateaus around St. Martin and St. Eustatius are not favourable for reef development. Nor are the surf swept rocky shores of Saba. Coral growth is mainly restricted to sheltered cliffs and cobbly bottoms, the leeside of boulders, and to some places where the underlying rock is devoid of sandy or muddy cover (see also VROMAN 1968).

DESCRIPTION OF LOCALITIES

LIST OF LOCALITIES WITH DATA ON WHICH THEY WERE VISITED

[Names following the "Topografische Kaart" of these islands, 1963]

See Figure 3.

A		ARUBA	
A	1.	Cudarebe – Arashi	6.X.1965
A	2.	Arashi	6.X.1965
A	3.	Arashi – Boca Catalina	6.X.1965
A	4.	Boca Catalina – Malmok	8.X.1965

A	5.	S.E. of Malmok	8.X.1965
A	6.	Palm Beach	6.X.1965
A	7.	Eagle Beach – Palm Beach	9.X.1965
A	8.	Barcadera	7.X.1965
A	9.	Mangel Altu	14.X.1965
A	10.	St. Nicolaasbaai	11.X.1965
A	11.	Klein Lagoen	11.X.1965
A	12.	Punta Basora	11.X.1965
A	13.	N. of Pitch Field	11.X.1965
A	14.	Andicuri	13.X.1965
C		CURAÇAO	
C	1.	Plaja Kalki	30.IV., 16.V.1961
C	2.	Westpuntbaai	10.IV., 16.V., 4 & 9.VII.1961
C	3.	Plaja Abao	25.V.1961
C	4.	Caves near Lagún	23.VII.1961
C	5.	S. of Plaja Chikitu	18.IX.1961
C	6.	Boca Santa Marta	13 & 15 & 16 & 21.IV., 20.VI., 19.VII.1961
C	7.	Portomaribaai	27.V.1961
C	8.	Daaibooibaai	27.V.1961
C	9.	Vaarsenbaai	7.VI.1961
C	10.	St. Michielsbaai	24.IV., 16.VIII.1961
C	11.	Kaap Malmeeuw	29.IV.1961
C	12.	Piscaderabaai	6 & 23 & 25.IV., 14 & 31.V., 9.VI., 22.VII.1961.–VIII.1965.–VII.1967
C	13.	Spaanse Water, entrance	7.IV., 13.VII., 23.VIII.1961
C	14.	Spaanse Water, inner part	31.VII., 1.VIII.1961
C	15.	Spaanse Water, peripheral part	4 & 30.VIII.1961
C	16.	Awa di Oostpunt	11.VII.1961
C	17.	Boca Plaja Canoa	28.IX.1961
C	18.	St. Jorisbaai	10.IX.1961
C	19.	Oostpunt	10.IX.1961
C	20.	Klein Curaçao	24.IX.1961
B		BONAIRE	
B	1.	Boca Bartól	19.IX.1965
B	2.	Plaja Frans	8.IX.1965
B	3.	Goto	9.IX.1965
B	4.	Jan Doran – Barcadera	6.IX.1965
B	5.	Barcadera	6.IX.1965
B	6.	S.E. of Lont	7.IX.1965
B	7.	Lont – Hato	7.IX.1965
B	8.	Klein Bonaire	20.IX.1965
B	9.	Plaja Sarna	9.IX.1965
B	10.	W. of Baca	13.IX.1965
B	11.	N. of Punt Vierkant	13.IX.1965
B	12.	N. of Blauwe Pan	14.IX.1965
B	13.	Blauwe Pan – Witte Pan	14.IX.1965
B	14.	Witte Pan – Oranje Pan	15.IX.1965
B	15.	Oranje Pan	15.IX.1965

B	16.	Willemstoren	16.IX.1965
B	17.	Plenchi	16.IX.1965
B	18.	Lac	17.IX.1965.–VIII.1967
B	19.	Cai	12.IX.1965.–25.VIII.1967
B	20.	Lagún	22.IX.1965
M		ST. MARTIN	
M	1.	Anse des Pères	8.VIII.1965
M	2.	Anse des Sables	7.VIII.1965
M	3.	Baie Rouge	7.VIII.1965
M	4.	Mullet Pond Bay	18.VII.1965
M	5.	Mahó Bay	18.VII.1965
M	6.	Burgeux Bay	18.VII.1965
M	7.	Simson Bay, westside	18.VII.1965
M	8.	Simson Bay, eastside	19.VII.1965
M	9.	Cay Bay	19.VII.1965
M	10.	Little Bay	20.VII.1965
M	11.	Great Bay, near Ft. Amsterdam	20.VII.1965
M	12.	Great Bay, N.W. side	5.VIII.1965
M	13.	Great Bay, eastside	16 & 17.VII.1965
M	14.	Point Blanche Bay	20.VII.1965
M	15.	Guana Bay	5.VIII.1965
M	16.	Gibb's Bay	21.VII.1965
M	17.	Babit Point	6.VIII.1965
M	18.	Oyster Pond	6.VIII.1965
S		SABA	
S	1.	Ladder Bay	1.VIII.1965
S	2.	Fort Bay	31.VII.1965
S	3.	Cove Bay	31.VII.1965
E		ST. EUSTATIUS	
E	1.	Cocoluch Bay – Jenkin's Bay	27.VII.1965
E	2.	Jenkin's Bay – Tumbledown Dick Bay	27.VII.1965
E	3.	Oranjestad Baai	27.VII.1965
E	4.	Gallows Bay	24.VII.1965
E	5.	Compagnie Baai	25.VII.1965
E	6.	Schildpadden Baai	25.VII.1965

ARUBA

A 1. Between Cudarebe and Arashi

A ridge of boulders is present, at Cudarebe very near the cliff coast; it disappears in the direction of Arashi at some distance from the shore. Many algae are attached to the boulders or loose on the bottom. On the boulders the following corals are to be found: *Acropora palmata, Agaricia agaricites, Dichocoenia stokesii, Diploria clivosa, D. strigosa, Favia fragum, Millepora* spec., *Porites astreoides* and *Siderastrea radians.* Inside the curve of the bigger boulders the bottom consists of sand with some boulders, on which *Porites astreoides* grows. Near Arashi the sea-grass *Thalassia* also occurs, with *Porites astreoides* and *Siderastrea radians.*

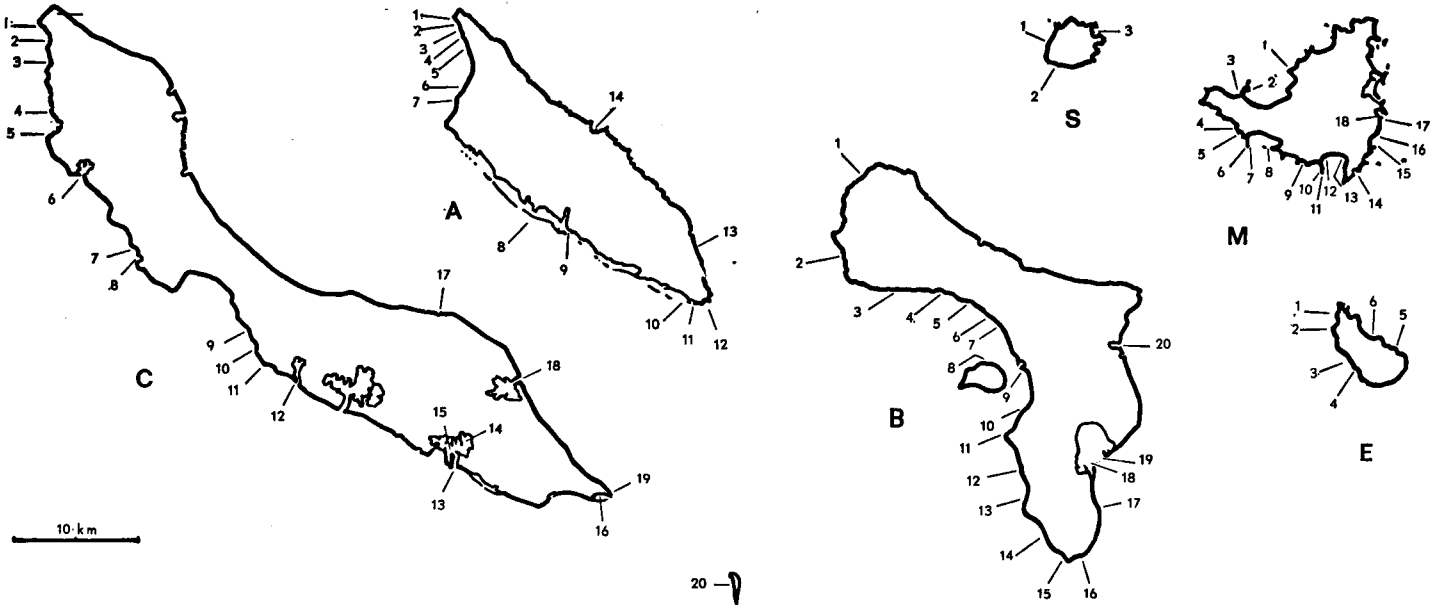


Fig. 3. Localities on ARUBA (A), CURAÇAO (C), BONAIRE (B), ST. MARTIN (M), SABA (S) and ST. EUSTATIUS (E). – The shape of the islands is true to nature; their position has been changed to get them in one scheme.

A 2. ARASHI

Shallow bottom with stones and *Thalassia*. There are large fields of *Porites porites*: a yellow and compressed form, with some superficial resemblance to *Madracis asperula*, probably *P. porites* var. *divaricata*. Also *Porites astreoides* and *Siderastrea radians* are present.

A 3. BETWEEN ARASHI AND BOCA CATALINA

Shallow bottom with sand and scattered boulders. The following corals are present: *Acropora palmata, Agaricia agaricites, Dichocoenia stokesii, Diploria clivosa, D. strigosa Favia fragum, Isophyllia sinuosa, Millepora complanata, Montastrea annularis, Porites astreoides, P. porites* and *Siderastrea radians*. There is also much *Thalassia* and the sea weed *Sargassum*.

A 4. BETWEEN BOCA CATALINA AND MALMOK

A steep cliff with a niche; at some places caves are present. On the cliff the following corals: *Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria strigosa, Eusmilia fastigiata, Favia fragum, Isophyllastrea rigida, Isophyllia sinuosa, Madracis decactis, Meandrina meandrites, Millepora complanata, Montastrea annularis, M. cavernosa, Porites astreoides, Siderastrea siderea, S. radians, Stephanocoenia intersepta* and *Tubastrea tenuilamellosa*. In front of the cliff a boulder is present on which only *Diploria clivosa* occurs.
The bottom in front of the cliff is flat, with many algae and scattered corals: *Dichocoenia stokesii Diploria clivosa, D. strigosa, Madracis asperula* and *Siderastrea radians*.
In this region also *Manicina areolata* was collected by brother RAPHAEL in May 1955.

A 5. SOUTHEAST OF MALMOK AT THE END OF THE CLIFF

The cliff is barren; the bottom is stony with many algae. The corals grow scattered: *Acropora palmata, Agaricia agaricites, Diploria clivosa, D. strigosa, Favia fragum, Isophyllia sinuosa, Meandrina meandrites, Millepora complanata, Montastrea annularis, Porites astreoides, P. porites, Siderastrea radians* and *Stephanocoenia intersepta*.

A 6. DIVING TOWER AT ARUBA PALM BEACH CLUB

Iron diving tower on barren sand. At the foot of the 5½ year old tower (6 Oct. '65) the following corals are present: *Favia fragum, Porites* species and *Siderastrea radians*. The diameter of the colonies is about 5 or 6 cm, indicating an annual increase of 1 cm. The young *Porites* colonies are encrusting and yellow; they may be *P. astreoides* as well as *P. porites* similar to the colonies at Arashi (A 2).

A 7. CLIFF BETWEEN EAGLE BEACH AND PALM BEACH

The cliff is barren and eroded. The plateau in front is flat and stony, with some *Thalassia* and sand, on which grow scattered: *Acropora palmata, Agaricia agaricites, Diploria clivosa, D. labyrinthiformis, D. strigosa, Isophyllia sinuosa, Millepora complanata, Montastrea annularis, Porites astreoides, P. porites, Siderastrea radians* and *Stephanocoenia intersepta*.

A 8. OUTER REEF AT BARCADERA (Fig. 4)

Three zônes are to be distinguished. First there is an upper reef with *Acropora palmata, Agaricia agaricites, Dendrogyra cylindrus, Diploria clivosa, D. strigosa, Favia*

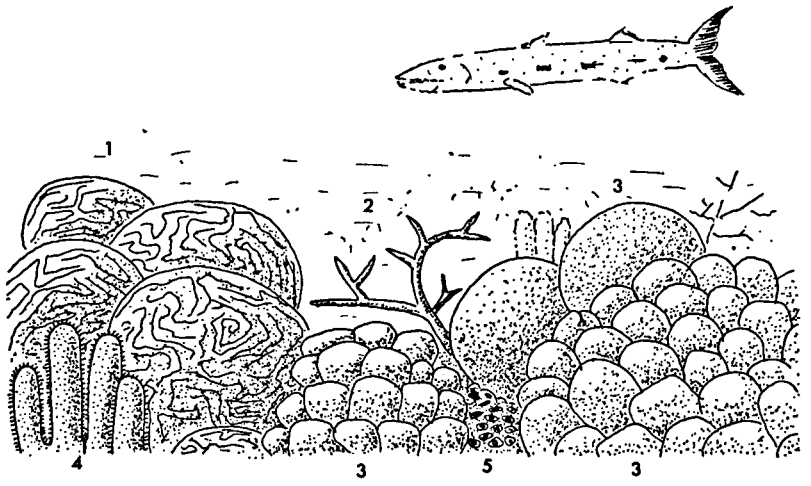


Fig. 4. Outer reef at Barcadera, ARUBA. – 1 *Diploria labyrinthiformis*, 2 *Acropora cervicornis*, 3 *Montastrea annularis*, 4 *Dendrogyra cylindrus*, 5 *Eusmilia fastigiata*.

fragum, Meandrina meandrites, Millepora complanata, Montastrea annularis, Porites astreoides and *P. porites*.

Then there is a mid-reef, extending from 5 to 10 m depth, in which *Montastrea annularis* predominates, in various growth forms. This coral forms the framework of a dense reef, in which the underlying bottom is not visible. This is the only reef of this density in the Netherlands Antilles. Between the *Montastrea annularis* colonies: *Acropora cervicornis, Agaricia agaricites, Colpophyllia natans, Dendrogyra cylindrus, Diploria labyrinthiformis, D. strigosa, Eusmilia fastigiata, Favia fragum, Madracis asperula, Meandrina meandrites, Montastrea cavernosa, Mycetophyllia lamarckana, Porites astreoides* and *P. porites*.

The lower reef is more open. There is much sand on which Gorgonians occur abundantly together with *Dendrogyra cylindrus, Dichocoenia stokesii, Diploria clivosa, D. labyrinthiformis, Favia fragum, Meandrina meandrites, Millepora complanata, Montastrea annularis, M. cavernosa* and *Siderastrea siderea*.

Where the upper- and lower reef meet or nearly meet, the bottom is open. There the mid-reef is replaced by large boulders of *Colpophyllia natans*.

A 9. MOUTH OF SPAANS LAGOEN AT MANGEL ALTU (Fig. 5)

On mangrove roots along the shore: *Agaricia agaricites, Favia fragum* and *Porites porites*. In front of the mangroves the bottom is flat and sandy, with *Thalassia* and stones. On these stones *Favia fragum, Montastrea annularis, Porites porites* and *Siderastrea radians* grow.

At the edge of the deeper part of the lagoon on the sand small reefs of *Montastrea annularis* with *Favia fragum* and *Porites astreoides* are present. The depth of the lagoon is about 10 m, the bottom is sandy with scattered boulders of *Montastrea annularis* and *Colpophyllia natans*.

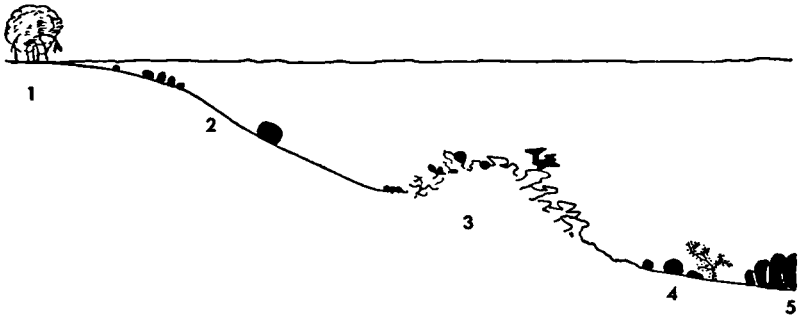


Fig. 5. Reef at Mangel Altu, ARUBA. – 1 Mangrove roots, 2 Deeper part, 3 Overturned *Acropora* reef, 4 Zone with Gorgonids, 5 Outer reef.

Along the inner barrier reef, at a depth of about 6 m, *Madracis asperula* occurs. The reef barrier, separating the lagoon from the sea, reaches to a depth of 1 m or more. The base of the reef is formed by dead *Acropora*. At the inner side *Acropora cervicornis* and *A. palmata* occur; at the outer side *A. palmata* only. The dead colonies are all in growth position. On this base the following corals grow: *Acropora prolifera, Colpophyllia natans, Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Meandrina meandrites, Millepora complanata, Montastrea annularis, Porites astreoides, P. porites* and *Siderastrea siderea*.
Outside this barrier the bottom is covered with sand, on which *Gorgonians* and *Agaricia agaricites, Colpophyllia natans, Diploria labyrinthiformis, D. strigosa, Eusmilia fastigiata, Favia fragum, Madracis asperula, Montastrea annularis, M. cavernosa, Mycetophyllia lamarckana, Porites astreoides, P. porites* and *Siderastrea siderea* were observed. Deeper, but at some places reaching the dead *Acropora* reef, the dense *Montastrea* reef as described above at the outer reef of Barcadera (A 8) is to be found.

A 10. ST. NICOLAASBAAI AT ESSO-CLUB

Inside the lagoon the water is shallow with a stony bottom with *Sargassum* and *Siderastrea radians*. Outwards less algae are to be found, and more corals: *Diploria strigosa, Favia fragum, Millepora complanata, Porites astreoides* and *P. porites*.
Over the barrier stands only one metre of water. The barrier is bare with scattered *Acropora palmata* (dead but in natural position), *Diploria strigosa, Favia fragum, Millepora complanata, Montastrea annularis, Porites porites, Siderastrea radians*, forming rounded boulders, Gorgonians and Zoantharia.

A 11. KLEIN LAGOEN (BABY-LAGOON)

Sandy bottom. At the innerside of the eastern spit of land *Porites astreoides* and *Siderastrea radians* occur. Inside the entrance of the lagoon there are small reefs with some Gorgonids and *Diploria clivosa, Favia fragum, Montastrea annularis, Porites astreoides* and *Siderastrea radians*.

A 12. SOUTH OF PUNTA BASORA

From the shore to the breakers there is a shallow flat with mainly Zoantharia and *Millepora complanata*. Also *Diploria strigosa, Favia fragum* and *Porites astreoides* are

to be found. Under and beyond the breakers the same corals occur amidst a great number of *Acropora palmata.*

A 13. NORTH OF PITCH FIELD

From Rincón to beyond Boca Grandi there is a small, shallow barrier reef. The width of the lagoon is about 50 m. It has a sandy bottom, with scattered boulders of *Agaricia agaricites, Diploria strigosa, Favia fragum, Montastrea annularis, Porites astreoides* and *Siderastrea radians.* Also *Sargassum* and *Penicillus* are to be found. On the reef *Acropora palmata, Diploria clivosa, Millepora complanata* and *Porites porites* occur.

A 14. ANDICURI (Fig. 6)

On the stony bottom of the bay *Siderastrea radians* occurs, also, on small rocky boulders, *Diploria clivosa* and *Porites astreoides.* Alongside the steep SW-side of the cape incrustating *Diploria clivosa* and *Porites astreoides.* At the end of the cape on the same steep cliff, *Acropora palmata* is likewise encrusting.
On the shallow flat between the cape and the small rocky island in front of it the following species are to be found: *Acropora palmata, Diploria clivosa, D. strigosa, Favia fragum, Millepora complanata, Porites astreoides, Siderastrea radians* and *Tubastrea tenuilamellosa,* with Gorgonians and Zoantharia.

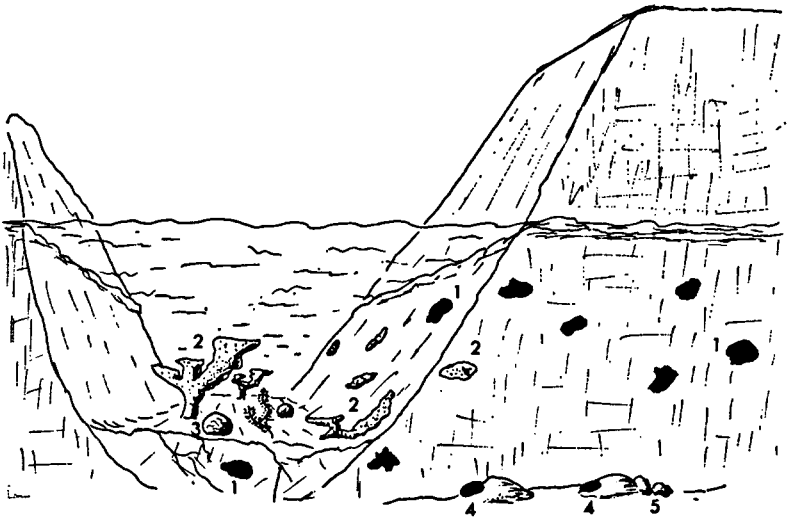


Fig. 6. Coral growth at Andicuri, ARUBA. – 1 *Diploria clivosa,* 2 *Acropora palmata,* 3 *Diploria strigosa,* 4 *Siderastrea radians,* 5 *Porites astreoides.*

22

CURAÇAO

C 1. NORTH OF WESTPUNTBAAI, PLAJA KALKI

Above the flat sandy terrace, from the shore to a depth of 5 m are found: *Acropora cervicornis, A. palmata, Agaricia agaricites, Dendrogyra cylindrus, Diploria labyrinthiformis, D. strigosa, Favia fragum, Madracis asperula, Millepora* spec., *Montastrea annularis, M. cavernosa* and *Porites astreoides.*

On the plateau at a depth of 5 m: *Colpophyllia natans* and *Porites astreoides.* Along the blue edge, from 7–10 m deep: *Agaricia agaricites, Diploria labyrinthiformis, D. strigosa, Eusmilia fastigiata, Madracis asperula, Millepora* spec., *Montastrea annularis, Mussa angulosa, Mycetophyllia lamarckana* and *Siderastrea siderea.*

C 2. WESTPUNTBAAI

North of Westpuntbaai along the cliff as far as Plaja Kalki the following corals are to be found: *Acropora palmata, Agaricia agaricites, Colpophyllia natans, Dendrogyra cylindrus, Dichocoenia stokesii, Diploria clivosa, D. labyrinthiformis, D. strigosa, Isophyllia sinuosa, Montastrea annularis, M. cavernosa, Porites astreoides, Siderastrea radians, S. siderea* and *Tubastrea tenuilamellosa.* The bay proper has a sandy bottom, from 3–5 m deep. The shallower parts are covered with algae and scantily with corals: *Acropora cervicornis, A. palmata, Diploria labyrinthiformis, D. strigosa, Montastrea annularis, Porites astreoides* and *Siderastrea siderea.*

South of the bay the following corals are to be found along the cliff: *Acropora palmata, Agaricia agaricites, A. fragilis, Dendrogyra cylindrus, Dichocoenia stokesii, Diploria clivosa, D. labyrinthiformis, D. strigosa, Eusmilia fastigiata, Favia fragum, Isophyllastrea rigida, Madracis asperula, Millepora, Montastrea annularis, M. cavernosa, Porites astreoides, P. porites, Siderastrea siderea* and *Tubastrea tenuilamellosa.* On the sand in front of the cliff there are some boulders and smaller corals with: *Dichocoenia stokesii, Diploria clivosa, D. strigosa, Meandrina meandrites, Montastrea annularis, M. cavernosa, Porites astreoides* and *Siderastrea siderea.*

C 3. PLAJA ABAO

Along the cliff and on boulders west of the bay the following corals grow: *Acropora palmata, Agaricia agaricites, Dendrogyra cylindrus, Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Millepora, Montastrea annularis, M. cavernosa, Porites astreoides, P. porites, Siderastrea radians, Stylaster roseus* and *Tubastrea tenuilamellosa.*

On the sandy flat in front of the cliff and in the bay proper are to be found: *Acropora cervicornis, Colpophyllia natans, Dendrogyra cylindrus, Dichocoenia stokesii, Diploria labyrinthiformis, D. strigosa, Eusmilia fastigiata, Madracis asperula, Meandrina meandrites, Millepora alcicornis, Montastrea annularis, M. cavernosa, Porites astreoides, P. porites* and *Siderastrea siderea.*

Corals occurring on the cliff and on boulders east of the bay are: *Acropora palmata, Agaricia agaricites, Dendrogyra cylindrus, Diploria strigosa, Favia fragum, Meandrina meandrites, Millepora* spec., *Montastrea annularis, M. cavernosa, Porites astreoides, Siderastrea radians* and *Tubastrea tenuilamellosa.*

C 4. CAVES NEAR LAGÚN

Between Plaja Lagún and Boca Santa Cruz, at or just below sea level, there are a number of small caves in the cliff. The third one, S of Lagún, is rather shallow in a

horizontal direction, and has a large opening. In this cave some corals grow which show adaptations to light intensities as low as may be encountered in deeper water. In addition to the Antipatharian *Cirripathes* the following corals are present: *Agaricia agaricites, A. fragilis, Meandrina meandrites* and *Montastrea cavernosa.*

C 5. SMALL BOCA SOUTH OF PLAJA CHIKITU

In the entrance scattered *Acropora palmata, Montastrea annularis, M. cavernosa* and *Stephanocoenia intersepta* grow. More inside *Diploria strigosa* occurs abundantly, which in shallower water is replaced by *D. clivosa* with the yellow Zoantharian *Palythoa.* The uppermost part at sea level is covered by the green and blue *Zoanthus.*

C 6. BOCA SANTA MARTA

Along the steep coast, beginning at a depth of about 10 m, and down to a depth of about 50 m, there is a distinct zonation of coral-growth (see Roos 1964).
At the plateau above 10 m the following corals are to be found: *Acropora cervicornis, A. palmata, Colpophyllia natans, Diploria labyrinthiformis, D. strigosa, Eusmilia fastigiata, Favia fragum, Meandrina meandrites, Millepora complanata, Montastrea annularis, Porites astreoides* and *Siderastrea siderea.*
In the small lagoon between the cliff and the debris ridge, only *Siderastrea radians* occurs.

C 7. PORTOMARIBAAI

Along the beach on the sandy bottom and shallow boulders *Agaricia agaricites, Dendrogyra cylindrus, Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Millepora complanata, Montastrea annularis, Porites astreoides, P. porites* and *Siderastrea radians* occur.
On detached rocks in front of the cliff, and the cliff proper up to Daaibooibaai: *Acropora palmata, Dendrogyra cylindrus, Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Madracis asperula, Millepora complanata, Montastrea annularis, Porites astreoides* and *Tubastrea tenuilamellosa.*
On a flat area in front of the cliff, with many Gorgonids and *Thalassia,* close to Daaibooibaai: *Acropora cervicornis, Colpophyllia natans, Dendrogyra cylindrus, Dichocoenia stokesii, Diploria labyrinthiformis, D. strigosa, Madracis asperula, Meandrina meandrites, Montastrea annularis, M. cavernosa* and *Siderastrea radians.*

C 8. DAAIBOOIBAAI

A survey has been made of the north side of the bay only. The following corals are present along the cliff and on detached rocks: *Acropora cervicornis, A. palmata, Colpophyllia natans, Dichocoenia stokesii, Diploria strigosa, Favia fragum, Meandrina meandrites, Millepora complanata, Porites astreoides, P. porites, Siderastrea siderea* and *Tubastrea tenuilamellosa.*

C 9. VAARSENBAAI

Along the cliff in the western part of the bay are many boulders, on which grow: *Acropora, Colpophyllia natans, Diploria clivosa, D. strigosa, Favia fragum, Millepora, Montastrea annularis, M. cavernosa, Porites astreoides, P. porites, Siderastrea radians* and *S. siderea.* On the bottom there are many fragments of dead *Acropora cervicornis.*
On the cliff and boulders in the eastern part of the bay the following corals occur: *Agaricia agaricites, Colpophyllia natans, Dendrogyra cylindrus, Dichocoenia stokesii,*

Diploria clivosa, D. strigosa, Favia fragum, Millepora complanata, Montastrea annularis, Porites astreoides, P. porites and *Tubastrea tenuilamellosa.*
On the flat sandy terrace in front of the cliff and bay are found: *Agaricia agaricites, Dendrogyra cylindrus, Dichocoenia stokesii, Diploria clivosa, D. labyrinthiformis, D. strigosa, Eusmilia fastigiata, Madracis asperula, Meandrina meandrites, Montastrea annularis, M. cavernosa, Mussa angulosa, Porites astreoides, P. porites* and *Siderastrea siderea.*

C 10. SINT MICHIELSBAAI

In front of the cliff, north of the bay, there is a flat sandy terrace, with many Gorgonids and *Dendrogyra cylindrus, Diploria strigosa, Favia fragum, Montastrea annularis* and *Siderastrea siderea.*

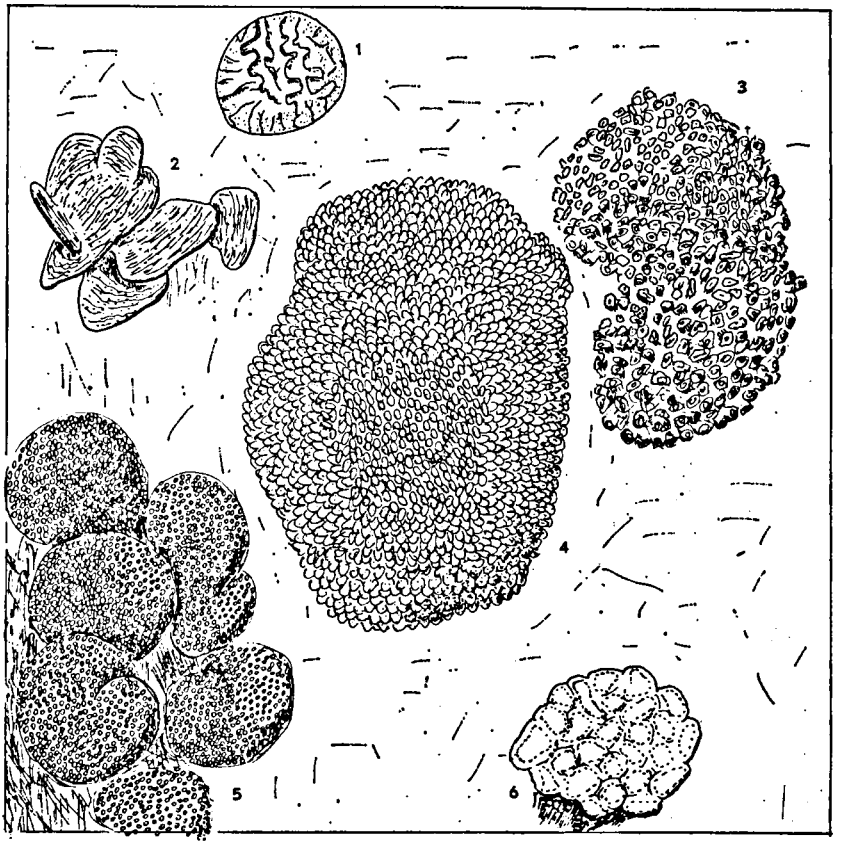


Fig. 7. Coral growth in Piscaderabaai, CURAÇAO, at a depth of 10 m, as sketched within a wire frame of 2 × 2 m. – 1 *Diploria strigosa*, 2 *Agaricia agaricites*, 3 *Eusmilia fastigiata*, 4 *Madracis asperula*, 5 *Montastrea annularis*, 6 *Mussa angulosa.*

The northern part of the bay consists of a shallow rocky flat with many *Siderastrea radians*. In front of the bay there is a bare open space with scattered *Acropora cervicornis, Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria labyrinthiformis, D. strigosa, Favia fragum, Montastrea annularis, M. cavernosa, Mussa angulosa, Porites astreoides, P. porites, Siderastrea radians* and *S. siderea*. From a depth of 6 m, Mr. VAN RIJD collected (April 1966) *Oculina valenciennesi*, up till now the only specimens known from the Netherlands Antilles.
Explorations were also carried out at a depth of about 15 m (see Roos 1964).
On and along the cliff south of the bay, with sandy bottom in front of it were found: *Colpophyllia natans, Diploria strigosa, Eusmilia fastigiata, Madracis asperula, Montastrea annularis, Porites porites, Stylaster roseus* and *Tubastrea tenuilamellosa*.

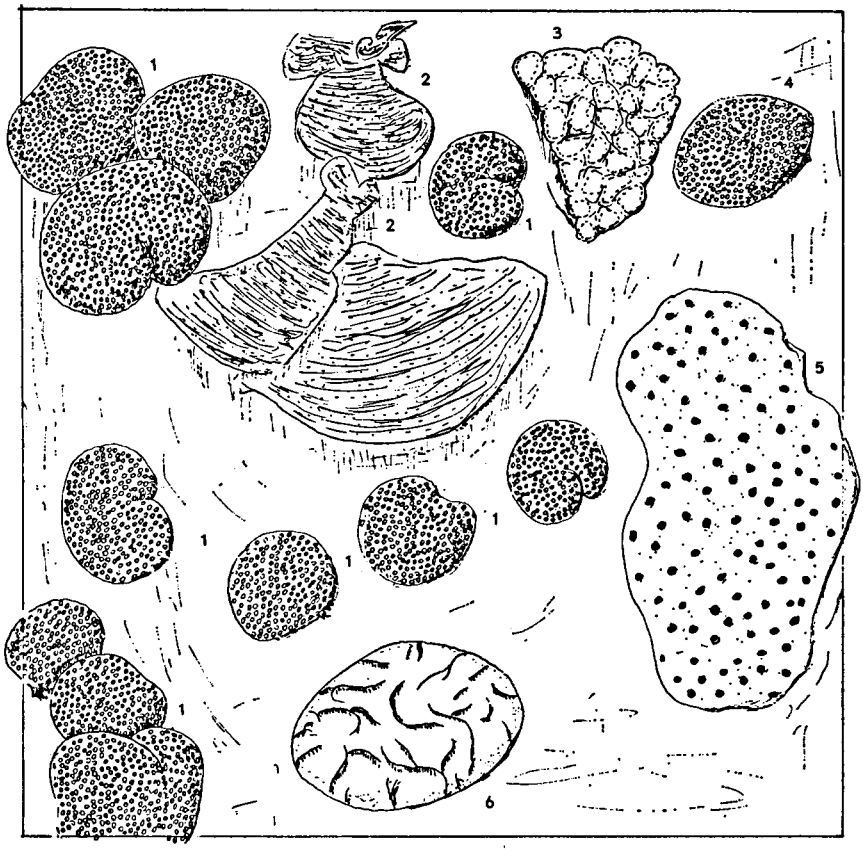


Fig. 8. Coral growth in Piscaderabaai, CURAÇAO, at a depth of 10 m, as sketched within a wire frame of 2 × 2 m. – 1 *Montastrea annularis*, 2 *Agaricia agaricites*, 3 *Mussa angulosa*, 4 *Solenastrea bournoni*, 5 *Montastrea cavernosa*, 6 *Colpophyllia natans*.

C 11. KAAP MALMEEUW

Explorations were carried out only at a depth of about 20–30 m along the seaward slope of a 20 m-deep plateau; see Roos 1964.

C 12. PISCADERABAAI (Figs. 7–8)

For zonation deeper than 10 m, see Roos 1964.
On the submarine terrace in front of the Marine Biological Institute the following corals are found: *Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria strigosa, Eusmilia fastigiata, Favia fragum, Madracis asperula, Meandrina meandrites, Millepora complanata, Montastrea annularis, M. cavernosa, Porites astreoides, Siderastrea siderea, Stephanocoenia intersepta* and *Tubastrea tenuilamellosa.*
West of the bay the same corals are present, and also *Dendrogyra cylindrus*, scattered between abundantly growing Gorgonids.
East of the bay are found: *Colpophyllia natans, Dendrogyra cylindrus, Dichocoenia stokesii, Diploria clivosa, D. strigosa, Eusmilia fastigiata, Favia fragum, Meandrina meandrites, Montastrea annularis, M. cavernosa, Porites astreoides, P. porites* and *Siderastrea siderea.*
Below the cliff along the western side of the inner bay *Porites astreoides* and *Siderastrea radians* occur. In the rear part of the inner bay and along the entire eastern side of it only *Siderastrea radians* is to be found along cliffs and between mangroves.

C 13. ENTRANCE OF SPAANSE WATER (Fig. 9)

For localities outside the sill, down to 30 m deep, see Roos 1964.
In the outer part of the entrance, at the western side, the following corals are present: *Acropora cervicornis, A. palmata, Diploria clivosa, D. strigosa, Eusmilia fastigiata,*

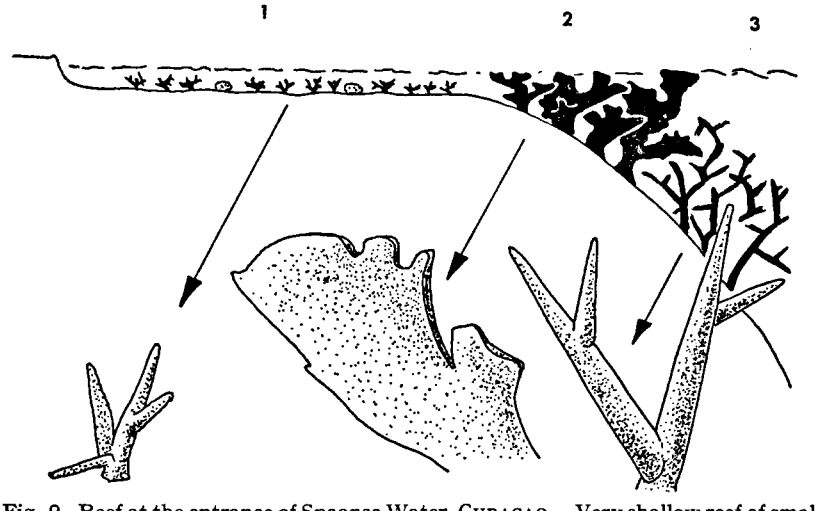


Fig. 9. Reef at the entrance of Spaanse Water, CURAÇAO. – Very shallow reef of small *Acropora cervicornis* with *Porites astreoides*, 2 Reef of *Acropora palmata*, 3 Reef of *Acropora cervicornis.*

Favia fragum, Millepora complanata, Montastrea annularis, Porites astreoides, P. porites, Siderastrea radians and *S. siderea.*
Under the lee of the large colonies of *Acropora palmata* finely branching *A. cervicornis* is present in great numbers together with many Zoantharia and a few *Porites astreoides* colonies.
At the eastern side there is a steep, bare sandy slope with rounded pieces of dead coral having a scanty coral growth of *Dichocoenia stokesii, Diploria strigosa* and *Mussa angulosa.*
On shoals in the narrow part of the entrance: *Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria labyrinthiformis, D. strigosa, Eusmilia fastigiata, Madracis asperula, Montastrea annularis, Porites astreoides, P. porites, Siderastrea radians, S. siderea* and *Tubastrea tenuilamellosa.*

C 14. INNER PART OF THE SPAANSE WATER

Around islands or spits of land are to be found: *Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Millepora complanata, Mussa lacera, Porites astreoides, P. porites, Siderastrea radians* and *S. siderea.*

C 15. PERIPHERAL PART OF THE SPAANSE WATER

Near the mangroves bordering the inner part of the Spaanse Water, including some small bays, and a few islands, *Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria strigosa, Eusmilia fastigiata, Favia fragum, Mussa lacera, Porites astreoides, P. porites, Siderastrea radians* and *S. siderea* are found.

C 16. AWA DI OOSTPUNT

At the northern side, along low cliffs and on the limestone bottom in front of small sandy beaches are to be found: *Diploria strigosa, Favia fragum, Millepora complanata, Porites astreoides, P. porites, Siderastrea radians* and *S. siderea.*
Along the western shores scattered *Porites porites* grow, and along the inner side of the land spit on the south coast *Favia fragum, Porites astreoides, P. porites* and *Siderastrea radians* are present.

C 17. BOCA PLAJA CANOA

On the eastern side corals occur particularly in hollows in a flat rocky terrace: *Diploria clivosa, Porites astreoides* and *P. porites.*

C 18. ENTRANCE OF SINT JORISBAAI

In the inner part of the narrow entrance only *Siderastrea radians* and a few specimens of *S. siderea* occur. Midway this narrow part also *Porites astreoides* and very low *P. porites* are to be found. In the outer part of the entrance *Acropora palmata, Diploria clivosa* and *D. strigosa* are growing too. The strong water movements in the outer part proved to influence the shape of the *Acropora* colonies considerably.

C 19. EASTSIDE OF OOSTPUNT

Along the cliff *Diploria clivosa* and *Tubastrea tenuilamellosa* occur; on the bottom *Acropora palmata* and *Millepora.* The *Acropora* found in the middle of a recess in the reef had a spiral growth. *Diploria strigosa* and *Porites astreoides* occur in crevices in the limestone bottom.

C 20. KLEIN CURAÇAO

At the landing-place corals are restricted to the cliff and the submerged rocks. Here *Dichocoenia stokesii, Diploria clivosa, D. strigosa, Favia fragum, Porites astreoides, P. borites* and *Siderastrea radians* are to be found.
Along the cliff north of the landing-place the same corals are present and also *Diploria labyrinthiformis, Montastrea annularis* and *Siderastrea siderea*. There were many fragments of dead *Acropora cervicornis*.
Along the northern part of the west coast and in front of the cliff *Acropora cervicornis, Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria clivosa, D. strigosa, Favia fragum, Montastrea annularis, M. cavernosa, Porites astreoides, Siderastrea radians* and *Stephanocoenia intersepta* occur.

BONAIRE

B 1. BOCA BARTÓL

Perpendicular to the coast there are a few parallel limestone ridges, which abruptly end at some distance in the sea, where they dip to about 10 m. The slopes are densely covered with corals. The following species were found: *Acropora cervicornis* which also may be *A. prolifera, A. palmata, Agaricia agaricites, Colpophyllia natans, Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Isophyllastrea rigida, Isophyllia sinuosa, Meandrina meandrites, Millepora alcicornis, M. complanata, Montastrea annularis, M. cavernosa, Mycetophyllia lamarckana, Porites astreoides, P. porites, Siderastrea radians, S. siderea, Solenastrea bournoni* and *Tubastrea tenuilamellosa*. This is the only place known to the author where a zonation of corals between 10 m depth and sea level is found. This zonation exactly fits that of the steep slopes deeper than 10 metres, which are generally present around the islands of the Windward Group.

B 2. PLAJA FRANS

Sandy bottom with large colonies of *Acropora palmata*. In between grow *Agaricia agaricites, Diploria labyrithiformis, D. strigosa, Favia fragum, Millepora complanata, Porites astreoides, P. porites, Siderastrea radians* and *Stephanocoenia intersepta*.
Somewhat deeper there are also colonies of *Acropora palmata*, but these are dead at the tops. In between grow: *Acropora cervicornis, Colpophyllia natans, Diploria clivosa, D. labyrinthiformis, D. strigosa, Isophyllia sinuosa* and *Montastrea annularis*. Deeper there are great masses of dead colonies of *Acropora cervicornis* and *A. palmata* covered with calcareous algae. On this the following living colonies are to be found: *Agaricia agricites, Colpophyllia natans, Diploria labyrinthiformis, Eusmilia fastigiata, Isophyllastrea rigida, Madracis asperula, Millepora complanata, Montastrea annularis* and *Porites astreoides*. Between those dead *Acropora* colonies there are open patches of sand, on which living *A. palmata, Dendrogyra cylindrus, Diploria labyrinthiformis, D. strigosa, Montastrea annularis* and *Siderastrea siderea* occur.

B 3. GOTO

In very shallow water on stones and sandy bottom occur: *Acropora palmata, Diploria strigosa, Favia fragum, Porites astreoides* and *Stephanocoenia intersepta*. Deeper there is a dense growth of *Acropora palmata*, the branches of which, however, end in *A.*

cervicornis – like structures. Furthermore *Acropora cervicornis, A. palmata, Colpophyllia natans, Dichocoenia stokesii, Diploria clivosa, D. labyrinthiformis, D. strigosa, Eusmilia fastigiata, Favia fragum, Millepora complanata, Montastrea annularis, M. cavernosa, Porites astreoides* and *Siderastrea siderea* were found.

B 4. Between Jan Doran and Barcadera (Fig. 10)

Here a dense reef of *Acropora palmata* grows, the tops of which reach the water surface. At the deeper side there are wholly live colonies; in shallower water, where the tops become exposed to the air, these tops are dead. In places where they are submerged for most of the time, they are covered by Zoantharia or *Millepora*; where they are dry for most of the time (but living in a kind of splash-zône) they are covered and cemented together by calcareous algae. Thus the algae and the tops of the branches form roofs over holes in the reef, in which fish abounds.

Below this reef, on a sandy flat, the following corals are to be found: *Acropora cervicornis, A. palmata, Agaricia agaricites, Colpophyllia natans, Dendrogyra cylindrus, Dichocoenia stokesii, Diplora clivosa, D. labyrinthiformis, D. strigosa, Eusmilia fastigiata, Favia fragum, Isophyllastrea rigida, Madracis asperula, Millepora alcicornis, M. complanata, Montastrea annularis, Mycetophyllia lamarckana, Porites astreoides* and *Siderastrea siderea.*

Where *Acropora cervicornis* is growing immediately below *A. palmata,* sometimes branches of both species grow together.

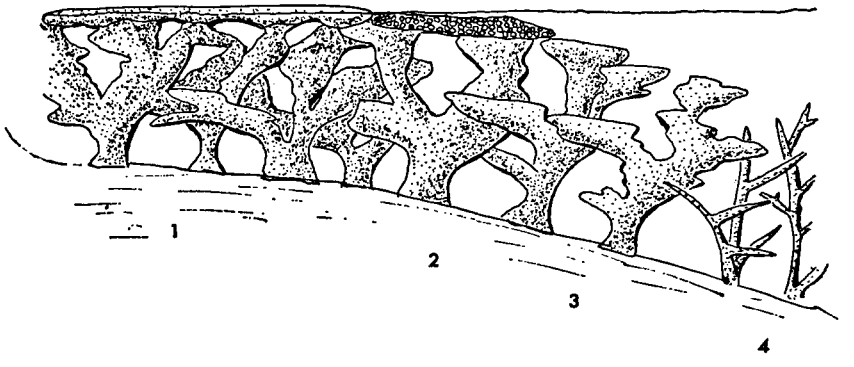


Fig. 10. Reef between Jan Doran and Barcadera, Bonaire. – 1 Dead *Acropora palmata* overgrown by calcareous algae, 2 Dead *Acropora palmata* overgrown by *Zoanthus,* 3 Living *Acropora palmata,* 4 Living *Acropora cervicornis.*

B 5. Barcadera

Pebble beach, with a flat sandy bottom in front of it. The same corals occur as between Jan Doran and Barcadera (B 4). *Acropora cervicornis* predominates except at the lower edge where *Montastrea annularis* takes the lead.

Under the cliff, southeast of the beach are to be found: *Acropora cervicornis, A. palmata, Diploria clivosa, D. strigosa, Favia fragum, Millepora complanata, Millepora* spec., *Montastrea annularis, M. cavernosa* (in niche), *Porites astreoides* and *Tubastrea tenuilamellosa.*

B 6. SOUTHEAST OF LONT, NEAR RUIN

On a cliff *Acropora palmata, Agaricia agaricites, Diploria clivosa, D. strigosa, Millepora complanata, Porites astreoides* and *Tubastrea tenuilamellosa* are found.
In front of the cliff there is a pebbly plateau with: *Acropora cervicornis, A. palmata, Diploria labyrinthiformis, D. strigosa, Favia fragum, Millepora complanata, Montastrea annularis* and *Porites astreoides.*
Along the deeper edge of the terrace *Acropora cervicornis, Agaricia agaricites, Colpophyllia natans, Dendrogyra cylindrus, Diploria labyrinthiformis, D. strigosa, Eusmilia fastigiata, Madracis asperula, Meandrina meandrites, Millepora complanata, Montastrea annularis, Mycetophyllia lamarckana, Porites astreoides* and *Siderastrea siderea* are to be found.
To the south the pebbly bottom is replaced by a sandy one. Here *Acropora cervicornis, Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria labyrinthiformis, Eusmilia fastigiata, Favia fragum, Madracis asperula, Meandrites meandrites, Millepora, Montastrea annalaris, M. cavernosa, Porites astreoides, P. porites* and *Siderastrea siderea* occur.

B 7. HALFWAY LONT AND RUIN, NEAR HATO

Directly under the cliff large colonies of *Acropora palmata* are present. Close to the water surface are to be found on these colonies *Millepora complanata* and Zoantharia, and deeper *Diploria clivosa, D. strigosa* up to the surface, and *Tubastrea tenuilamellosa.* On the bottom *Acropora cervicornis, Colpophyllia natans, Isophyllia sinuosa, Millepora complanata, Porites astreoides* and *P. porites* grow.
In deeper water *Acropora cervicornis* occurs closely together and in between: *Colpophyllia natans, Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Madracis asperula, Meandrina meandrites, Millepora alcicornis, M. complanata, Montastrea annularis, M. cavernosa, Porites astreoides* and *Siderastrea siderea.*

B 8. KLEIN BONAIRE AT LANDING PLACE

A small and shallow lagoon is present behind a reef of dead *Acropora palmata* and living *Millepora complanata.*
In the lagoon the following corals occur: *Acropora cervicornis, A. palmata, Agaricia agaricites, Favia fragum, Porites astreoides, P. porites* and *Tubastrea tenuilamellosa.*
On the dead *Acropora,* at the outer side: *Acropora cervicornis, Agaricia agaricites, Colpophyllia natans, Diploria strigosa, Eusmilia fastigiata, Favia fragum, Madracis asperula, Meandrina meandrites, Millepora complanata, Montastrea annularis, Porites astreoides, P. porites* and *Tubastrea tenuilamellosa.*
At the foot of the *Acropora* reef: *Agaricia agaricites, Colpophyllia natans, Dendrogyra cylindrus, Diploria clivosa, Millepora complanata, Montastrea cavernosa* and *Siderastrea siderea.* In front of the reef there is a sloping sandy bottom, with *Acropora cervicornis, Colpophyllia natans, Diploria labyrinthiformis, D. strigosa, Favia fragum, Madracis asperula, Meandrina meandrites, Millepora complanata, Montastrea annularis, Porites astreoides* and *P. porites.*
At a depth of about 10 m the gently sloping sandy bottom curves sharply downward. Along that edge the following corals occur: *Agaricia agaricites, Colpophyllia natans, Dendrogyra cylindrus, Diploria strigosa, Eusmilia fastigiata, Montastrea annularis, M. cavernosa* and *Mycetophyllia lamarckana.*

B 9. PLAJA SARNA

In shallow water, down to about 1 m, there is a sandy bottom with scattered stones. Here *Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Millepora complanata, Montastrea annularis, Porites astreoides, Siderastrea radians* and *S. siderea* are to be found. Deeper, to a depth of about 6 m, *Acropora cervicornis* grows closely together. In between on the remaining open bottom: *Acropora cervicornis, Colpophyllia natans, Diploria labyrinthiformis, D. strigosa, Favia fragum, Millepora complanata, Montastrea annularis, Porites porites* and *Siderastrea siderea.*
Below this *Acropora*-zône occur *Acropora cervicornis, Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii* (some of them with exceptionally long corallites), *Diploria labyrinthiformis, D. strigosa, Eusmilia fastigiata, Favia fragum, Madracis asperula, Meandrina meandrites, Millepora alcicornis, M. complanata, Montastrea annularis, M. cavernosa, Mycetophyllia lamarckana, Porites astreoides, P. porites* and *Siderastrea siderea.*

B 10. WEST OF BACA (Fig. 11)

Between the shore and the shallow reef in front of it, the following corals are present in scattered patches: *Acropora palmata, Agaricia agaricites, Diploria strigosa, Favia fragum, Millepora complanata, Montastrea annularis, Porites astreoides* and *Stephanocoenia intersepta.*

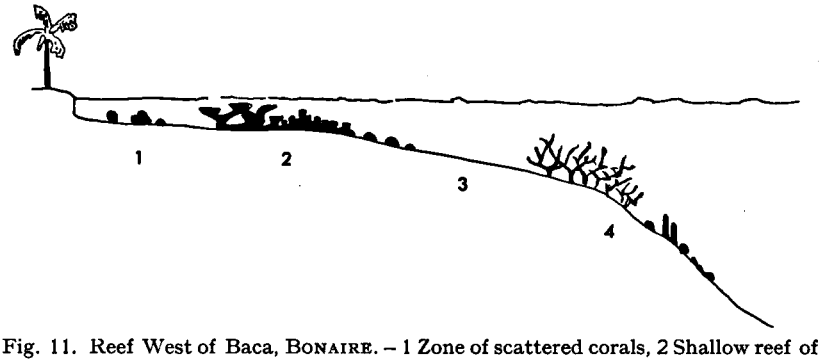


Fig. 11. Reef West of Baca, BONAIRE. – 1 Zone of scattered corals, 2 Shallow reef of *Acropora palmata* and *Millepora complanata,* 3 Sandy bottom, 4 Reef at the top of the steep slope.

The shallow reef consists mainly of *Acropora palmata* and *Millepora complanata.* At the sea side also *Tubastrea tenuilamellosa* abounds. *Agaricia agaricites, Madracis asperula, Montastrea annularis* and *Porites porites* are found too. In front of the reef, on the flat sandy bottom in scattered patches *Colpophyllia natans, Diploria strigosa, Eusmilia fastigiata, Porites astreoides* and *Tubastrea tenuilamellosa* occur.
Along the rim of the steep slope: *Acropora cervicornis, Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria labyrinthiformis, D. strigosa, Favia fragum, Isophyllia sinuosa, Meandrina meandrites, Millepora complanata, Montastrea cavernosa* and *Siderastrea siderea.*

B 11. North of Punt Vierkant

Along the cliff the following corals are present: *Acropora palmata, Diploria clivosa, D. strigosa, Favia fragum, Isophyllia sinuosa, Millepora complanata, Porites astreoides* and *Siderastrea radians.*
From the shore to the rim of a steep slope, at about 200 m from the shore there is a flat sandy bottom. Here *Acropora cervicornis, A. palmata, Colpophyllia natans, Dichocoenia stokesii, Diploria labyrinthiformis, D. strigosa, Favia fragum, Isophyllia sinuosa, Millepora complanata, Montastrea annularis, M. cavernosa, Porites astreoides* and *Siderastrea radians* are found.
From about 150 m from the shore, at a depth of about 5 m, to the steep slope, at 200 m and 10 m deep, *Acropora cervicornis* grows densely together. Scattered among these colonies other corals are found.

B 12. North of Blauwe Pan

Conditions of sea bottom and coral growth seem to be exactly the same as those in the next locality, B 13, and will therefore not be dealt with separately.

B 13. Between Blauwe Pan and Witte Pan

Very shallow water with a bottom consisting of sand, stones and beachrock, on which *Acropora palmata, Diploria clivosa, D. strigosa, Favia fragum, Isophyllia sinuosa, Millepora complanata, Montastrea annularis* and *Porites astreoides* grow.
From a depth of about 1 m to about 8 m at approximately 100 m from the shore, there is a thin layer of sand covering the beachrock on which the above corals grow scattered.
Deeper there is a dense growth of *Acropora cervicornis* down to the upper edge of the steep slope, which here is at about 250 m from the shore at a depth of 10 m. There are to be found: *Acropora cervicornis, Agaricia agaricites, Colpophyllia natans, Dendrogyra cylindrus, Dichocoenia stokesii, Diploria labyrinthiformis, D. strigosa, Eusmilia fastigiata, Favia fragum, Isophyllastrea rigida, Madracis asperula, Meandrina meandrites, Millepora alcicornis, M. complanata, Montastrea annularis, M. cavernosa, Porites astreoides* and *Siderastrea siderea.*

B 14. Between Witte Pan and Oranje Pan

Near the surface of the water the rocky bottom is covered by scanty algae only. Somewhat deeper sand and coral are present. First *Diploria clivosa, D. strigosa, Favia fragum, Porites astreoides* and *Siderastrea radians* are to be encountered. Still somewhat deeper *Acropora cervicornis, A. palmata, Dichocoenia stokesii, Diploria labyrinthiformis, Isophyllia sinuosa, Millepora complanata, Montastrea annularis* and *Siderastrea siderea* are found too. This is also the upper limit of the dense growth of *Acropora cervicornis,* which continues to a depth of 10 m at about 100 m from the shore.

B 15. Oranje Pan

Near the surface the bottom is rocky; at about ½ m deep some sand is present; below this, at a depth of about 1 m, there is a narrow ridge of round stones, separating the rocky bottom from a bare sand flat. This sand extends over the upper edge of the steep slope at a depth of 10 m.
Near the surface grow very scattered: *Acropora palmata, Diploria clivosa, D. strigosa, Millepora complanata, Montastrea annularis* and *Siderastrea annularis.* These corals occur mainly on the ridge of round stones, together with: *Acropora cervicornis, Col-*

pophyllia natans, Dichocoenia stokesii, Diploria labyrinthiformis, Meandrina meandrites, Porites astreoides and *Siderastrea siderea.*
The sand flat proper is devoid of corals, except some places near the upper edge of the steep slope, where *Diploria labyrinthiformis, D. strigosa* and *Montastrea annularis* occur.

B 16. WILLEMSTOREN

Rocky bottom with much algae. In water less than about 1 m deep no corals grow. Below this the following species are to be found: *Diploria clivosa, D. strigosa, Millepora complanata, Porites porites* (flat branched colonies, lying loose in depressions of the bottom), *Siderastrea radians, S. siderea* and *Stephanocoenia intersepta.* Some Gorgonids also grow scattered between the algae.

B 17. PLENCHI

An eroded basin into which heavy surf enters. Few corals grow here. The following are recognizable from the cliff: *Acropora palmata, Millepora complanata, Porites astreoides, P. porites* and *Siderastrea radians.*

B 18. LAC

This large lagoon, several miles wide, is almost completely separated from the sea by a rocky barrier on which, and in the lee of which corals grow. The bottom of the lagoon is partially limestone, partially sand consisting of fragments of *Halimeda,* and partially mud in the vicinity of the mangrove vegetation that almost completely borders the lagoon at the land side. Scattered amidst *Thalassia* and *Syringodium* in the western part of the lagoon *Porites porites* is to be found. On the rocky bottom in the entrance of a southern bay (Boca Jewfish) a number of *Siderastrea radians* colonies occur. A shallow flat in front of the southern spit of land (Sorobon) is covered with algae except the most central part, on which *Thalassia* and *Lithothamnion* with *Porites astreoides* and *Porites porites* grow.
The bottom of the deeper central part, at about 3 m, is bare rock, with scattered *Agaricia agaricites, Dichocoenia stokesii, Porites astreoides, P. porites* (in *clavaria-* as well as *divaricata*-like varieties) and *Siderastrea radians.*
In the lee of the barrier (Dam) locally a great number of *Acropora cervicornis* colonies occur, which have a sheared appearance, all tips of the branches being levelled off near the water surface. Here also *Acropora palmata, Diploria clivosa, D. strigosa, Favia fragum, Millepora complanata, Montastrea annularis, Porites astreoides, P. porites* and *Siderastrea radians* are to be found.
Under influence of the surf, but not in the breaker zône, the prevailing *Acropora* is *palmata,* occurring together with some smaller corals: *Acropora prolifera, Agaricia agaricites, Diploria clivosa, Favia fragum, Isophyllastrea rigida, Millepora alcicornis, M. complanata, Porites astreoides, P. porites* and *Siderastrea siderea.*
In the surf great boulders of *Diploria strigosa* are found with *Acropora palmata, Diploria clivosa, Favia fragum, Millepora complanata* and *Porites astreoides.*

B 19. CAI, ENTRANCE OF LAC

At the entrance the bottom gently slopes from the lagoon towards the sea. The depth of the entrance is about 8 m. From a depth of 6 m upward the bottom of the lagoon is covered by *Thalassia* and *Syringodium.* The bottom of the entrance consists of bare sand. Some boulders are present, on which Gorgonids occur and large colonies of *Di-*

ploria labyrinthiformis and *Siderastrea siderea*. Also *Agaricia agaricites, Favia fragum* and *Porites porites* are present here. These three coral species are also to be found along the steep pebbly slope that forms the northern side of the entrance. The southern side is formed by the barrier, which is less steep than the pebbly slope.

B 20. LAGÚN, SOUTHERN PART OF ENTRANCE

The bottom of the bay consists of sandy mud, with sea-grasses. Corals only occur on rocks in the narrow entrance. The number of coral colonies increases towards the sea, but over the accessible part of the entrance, in which the breakers freely enter, only *Dichocoenia stokesii, Favia fragum, Porites astreoides* and *Siderastrea radians* are to be found. In one crevice in the cliff some small colonies of *Siderastrea siderea* occur.

ST. MARTIN

M 1. ANSE DES PÈRES

In front of a cobbly beach the bottom consists of sand with cobbles and algae. Here only *Siderastrea radians* is to be found. In deeper water Gorgonids and fields of *Thalassia* and *Syringodium* occur with *Favia fragum, Isophyllia sinuosa, Manicina areolata, Millepora alcicornis, Porites astreoides* and *P. porites*.
On rocks in front of a small cliff to the west *Acropora palmata, Dichocoenia stokesii, Diploria clivosa, Isophyllastrea rigida, Manicina areolata, Millepora alcicornis, Porites astreoides* and *Siderastrea radians* are to be found.

M 2. ANSE DES SABLES

The shallow and flat bottom consists of sand with many cobbles. Many algae are present. Only *Favia fragum, Porites astreoides* and *Siderastrea radians* occur in scattered patches.

M 3. BAIE ROUGE

A long sandy beach with flat beachrock deposits. Some Gorgonids and *Siderastrea radians* are scattered over the sandy bottom. To the east the beach ends in a cliff showing an open arch, with boulders in front. On the boulders *Acropora palmata, Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria clivosa, D. labyrinthiformis, D. strigosa, Isophyllastrea rigida, Isophyllia sinuosa, Meandrina meandrites, Millepora sp., Montastrea annularis, M. cavernosa, Porites astreoides, P. porites* and *Siderastrea siderea* occur.

M 4. MULLET POND BAY

A sandy beach, with a bare sandy bottom in front, scattered with stones on which *Siderastrea radians* grows.
On the steep side of the cliff to the east the following corals occur: *Acropora palmata, Dichocoenia stokesii, Diploria clivosa, D. labyrinthiformis, D. strigosa, Isophyllastrea rigida, Millepora* spec., *Montastrea annularis, M. cavernosa, Porites astreoides* and *P. porites*. Near the water-line many Zoantharia grow. On boulders near the underside of the cliff mainly *Dichocoenia stokesii, Diploria strigosa* and *Isophyllastrea rigida* are to be found.
Apart from these corals, at the outer side of the small cape *Colpophyllia natans, Meandrina meandrites* and *Siderastrea siderea* occur.

M 5. MAHÓ BAY

A sandy beach with a cliff at the westside. On stones in the sand *Porites astreoides* and *Siderastrea radians* grow.
Along the cliff *Acropora palmata, Agaricia agaricites, Diploria clivosa, D. strigosa, Meandrina meandrites, Millepora species* and *Porites astreoides* occur.
The same corals are to be found on boulders in front of the cliff. Here *Acropora palmata* is larger and nearly unbranched like saucers on a pedestal. In deeper water *Dichocoenia stokesii, Isophyllastrea rigida, Isophyllia sinuosa, Montastrea cavernosa* and *Siderastrea siderea* occur. On boulders in deeper water many Gorgonids are present and along the water-line Zoantharia. More to the east, at about the middle of the bay, there are rocks. The bottom consists of sand to some hundreds of metres into the sea. At a depth of about 6 m there is the beginning of a large field of *Thalassia.*

M 6. BURGEUX BAY

A shallow and sandy bottom in front of a cliff, with scattered cobbles and boulders. On these stones grow *Acropora cervicornis, A. palmata, Agaricia agaricites, Diploria clivosa, D. strigosa, Favia fragum, Isophyllia sinuosa, Millepora complanata, Porites astreoides* and *Siderastrea radians.* Also Gorgonids and Zoantharia occur.

M 7. SIMSON BAY, WESTSIDE

This side of the bay is rather rugged. Directly below the steep cliff of the cape between Burgeux Bay and Simson Bay the depth of the water is about 5 m. On the rocky bottom the following corals grow: *Acropora palmata* (especially under the cliff in great colonies), *Diploria clivosa, D. strigosa, Isophyllia sinuosa* and *Porites astreoides.*

M 8. SIMSON BAY, EASTSIDE

This part of the bay is very shallow. In front of the spit of land between the bay and Simson Bay Lagoon, the shore to the east and the dry rocks in the south, the deepest point is about 1½ m. The bottom is sandy, with *Thalassia* and scattered cobbles, on which *Diploria clivosa, Favia fragum, Porites astreoides* and *Siderastrea radians* occur. Near the dry rocks the bottom is rocky and irregular. Here *Acropora palmata* is abundant, with *Agaricia agaricites, Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Isophyllastrea rigida, Isophyllia sinuosa, Millepora species, Montastrea annularis, M. cavernosa, Porites astreoides, P. porites* and *Siderastrea siderea.* Between these rocks and the shore the bottom consists of sand with *Thalassia* and cobbles with *Favia fragum.*

M 9. CAY BAY

In front of the narrow beach there is a sandy bottom with rocks. On cobbles in the sand *Isophyllastrea rigida, Porites astreoides* and *Siderastrea radians* are to be found. On the submerged rocks and boulders *Acropora cervicornis, A. palmata, Agaricia agaricites, Diploria clivosa, D. strigosa, Favia fragum, Isophyllia sinuosa, Millepora, Porites astreoides* and *Siderastrea siderea* occur. At a greater distance from the shore, on top of the boulders *Isophyllastrea rigida, Montastrea annularis* and *M. cavernosa* grow. There the bottom is sandy with fields of *Thalassia.*

M 10. Little Bay near Fort Amsterdam

In front of the low and narrow part of the spit of land to the east of the bay, the bottom is sandy with cobbles on which *Siderastrea radians* occurs. Deeper the bottom is covered by sea-grasses.
In front of the cliff there are also cobbles in deeper water. Here the following corals are present: *Agaricia agaricites, Diploria labyrinthiformis, Millepora species, Porites astreoides, P. porites* and *Siderastrea radians.*
More towards the cape the cobbles are replaced by large boulders on which moreover juvenile *Acropora* species, *Diploria labyrinthiformis, D. strigosa, Montastrea annularis, Porites porites* and *Stephanocoenia intersepta* grow. In the lee of the highest cliff *Porites porites* predominates. Under the cape also *Diploria clivosa* is to be found. There are more *Gorgonids* than Scleractinian corals in this locality.

M 11. Great Bay near Fort Amsterdam

Under the cliff the following corals are present: *Acropora palmata, Diploria labyrinthiformis, D. strigosa, Isophyllia sinuosa, Meandrina meandrites, Millepora spec., Montastrea annularis, M. cavernosa, Porites astreoides, P. porites* and *Siderastrea radians.*
North of the cliff the bottom is flat, with cobbles and *Thalassia.* Here *Acropora palmata, Agaricia agaricites, Colpophyllia natans, Dichocoenia stokesii, Diploria clivosa, Favia fragum, Isophyllia sinuosa, Meandrina meandrites, Montastrea annularis, M. cavernosa, Porites astreoides, P. porites, Siderastrea radians, S. siderea* and *Stephanocoenia intersepta* occur. *Acropora palmata* is always to be found on top of the larger boulders.

M 12. Great Bay, northwestside

The bottom at a depth of about 1 m is flat and sandy. Large fields of *Thalassia* and *Syringodium* are present. Between these sea-grasses on cobbles, and on boulders under the cliff, *Diploria clivosa, Porites astreoides* and *Siderastrea radians* are to be found. The latter coral occurs in the greatest quantity.

M 13. Great Bay, eastside

Cobbles and boulders are present along the road to Point Blanche. The sandy bottom is covered by sea-grasses. Deeper than 1.5 m no corals occur. At that depth rather large colonies of *Montastrea annularis* are found. Above that depth *Agaricia agaricites, Diploria strigosa, Favia fragum, Porites astreoides, P. porites, Siderastrea radians* and *Stephanocoenia intersepta* grow.

M 14. Point Blanche Bay

Here the water was rough and turbid. In front of the beach there are cobbles with *Siderastrea radians.*
In deeper water and under the cliff large boulders lie, on which coral growth is scanty, except in the lee between the boulders. The following corals are to be found: *Acropora palmata* (always on top of the boulders), *Diploria clivosa, D. strigosa, Millepora alcicornis, M. complanata, Montastrea annularis, M. cavernosa, Porites astreoides* and *Siderastrea radians.* In sheltered places also *Colpophyllia natans, Favia fragum* and *Isophyllia sinuosa* occur.

M 15. GUANA BAY NEAR GUANA BAY POINT

In front of the beach near Guana Bay Point there are flat rocks, with scanty coral growth. At a depth of 3 m the bottom is bare sand. On the rocks many algae grow and some Gorgonids. Relatively few colonies of *Siderastrea radians* occur; other corals grow also rather scattered: *Acropora palmata, Diploria clivosa, D. strigosa, Favia fragum, Isophyllia sinuosa, Millepora alcicornis, M. complanata, Montastrea cavernosa, Porites astreoides* and *P. porites.*

M 16. GIBB'S BAY

A sandy beach with a rocky bottom in front of it. In very shallow water *Siderastrea radians* occurs. Deeper also *Acropora palmata, Diploria clivosa, D. strigosa, Favia fragum, Isophyllia sinuosa, Porites astreoides* and *P. porites.*

There are many dead colonies of *Acropora palmata,* which are jumbled together and overgrown by calcareous algae. Moreover there is a great number of large boulders, obviously dead *Montastrea annularis,* many of which are connected at the top, leaving holes and tunnels below. These too are covered by calcareous algae. In deeper water live *Acropora* colonies spring from the dead ones. In one case new *Montastrea* colonies arise from a dead boulder.

On the dead boulders, and on cobbles in between, *Agaricia agaricites, Diploria clivosa, D. strigosa, Isophyllia sinuosa* and *Millepora* occur.

M 17. BABIT POINT (Fig. 12)

In front of the cliff there is an old reef, comparable to that of Gibb's Bay. The upper side of the old and dead *Montastrea* boulders is flat and about 1 m or less below the surface of the water. In deeper water, from 6 to 10 m below the surface, there is an old *Acropora palmata* reef. Nearly all the dead *Acropora* colonies are lying upside down. On top of these old colonies new ones have arisen, so that occasionally these colonies are symmetrical, the upper half live, the lower half dead. The main difference with Gibb's Bay is that here the dead *Montastrea* boulders are covered with a growth of algae and Zoantharia. Also some Gorgonids are present. The following corals are to be found on and between the old boulders: *Acropora palmata, Agaricia agaricites, Diploria clivosa, D. strigosa, Favia fragum, Isophyllia sinuosa, Millepora* spec., *Montastrea annularis, Porites astreoides, P. porites* and *Siderastrea radians.*

M 18. OYSTER POND

On stones in shallow water between *Thalassia* only *Siderastrea radians* grows.

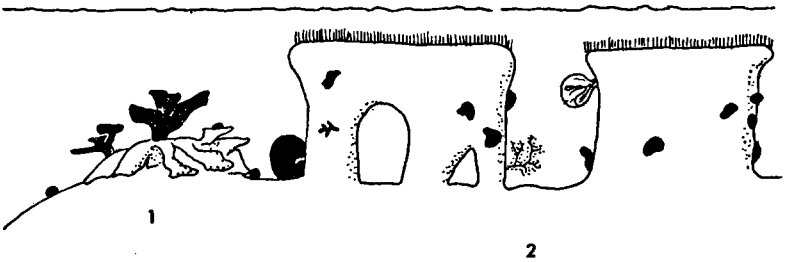


Fig. 12. Old reef at Babit Point, ST. MARTIN. – Overturned and prolifering *Acropora palmata,* 2 Dead *Montastrea* boulders.

SABA

S 1. LADDER BAY

In front of the cobbly beach the bottom consists of sand with cobbles and large boulders. Coral only grows on the boulders. The following are to be found: *Acropora palmata, Diploria clivosa, D. strigosa, Millepora species, Montastrea annularis, Porites astreoides, Siderastrea radians* and *Tubastrea tenuilamellosa.* The last coral is only present in very small and scattered colonies at the leeward sides of great boulders. Found dead on the beach: *Montastrea cavernosa.*

S 2. FORT BAY

The shore and the shallow sea bottom consist of rocks, boulders and cobbles. Deeper than 12 m there is a sand bottom with large ripple marks. On rocks and boulders the following corals occur: *Acropora palmata, Agaricia agaricites, Dichocoenia stokesii, Diploria clivosa, D. labyrinthiformis, D. strigosa, Isophyllia sinuosa, Millepora* spec., *Montastrea annularis, M. cavernosa, Porites astreoides, P. porites* and *Siderastrea radians.* With the exception of *Acropora palmata* most of the corals are small and encrusting. *Porites porites* only occurs in low colonies.

S 3. COVE BAY

The northern shore consists of a cliff, a steep rock and a small cobbly beach. In the sea a number of submerged rocks are present, the top of which is bare, or in deeper places covered by Zoantharia. On these rocks occur: *Acropora palmata, Agaricia agaricites, Colpophyllia natans, Diploria clivosa, D. strigosa, Favia fragum, Isophyllastrea rigida, Isophyllia sinuosa, Millepora* spec., *Montastrea annularis, M. cavernosa, Porites astreoides, P. porites* and *Siderastrea siderea.*
At the northern corner of the entrance the submerged cliff dips down to over 15 m. On the steep side grow *Agaricia agaricites,* much *Millepora* and *Porites astreoides.* The central part of the bay has a sandy bottom at a depth of 15 m. Here ripple marks are visible. More to the western shore boulders are present with *Acropora palmata, Diploria strigosa, Favia fragum, Millepora alcicornis, M. complanata, Porites astreoides* and *P. porites.* Rocks and boulders to the west have the same corals as the rocks in the northern part of the bay.

ST. EUSTATIUS

E 1. BETWEEN COCOLUCH BAY AND JENKIN'S BAY

The bottom, 10 m deep, consists of boulders on sand. On these boulders small reefs have developed. The following corals are to be found: *Acropora cervicornis, A. palmata, Agaricia agaricites, Colpophyllia natans, Diploria clivosa, D. labyrinthiformis, D. strigosa, Eusmilia fastigiata, Isophyllia sinuosa, Millepora alcicornis, Millepora* spec., *Montastrea annularis, M. cavernosa, Porites astreoides, P. porites* and *Siderastrea radians.*

E 2. BETWEEN JENKIN'S BAY AND TUMBLE DOWN DICK BAY

The following corals are to be found on scattered cobbles on sand, 6 m deep: *Acropora cervicornis, A. palmata, Agaricia agaricites, Colpophyllia natans, Diploria clivosa,*

D. labyrinthiformis, D. strigosa, Isophyllia sinuosa, Millepora, Montastrea annularis, M. cavernosa, Porites astreoides, P. porites and *Siderastrea radians.*

E 3. WRECK IN ORANJESTAD BAAI

On the bare sandy bottom of the bay, at a depth of 10 m, the wreck of the "Quo Vadis" rests, sunk in October 1954. Here a number of corals are growing. The colonies are flat and rounded and remarkably uniform in size. The diameter of colonies varies from 10 to 15 cm at the date of investigation in July 1965. The following corals occur on the ship: *Colpophyllia natans, Diploria clivosa, D. labyrinthiformis, D. strigosa, Favia fragum, Isophyllia sinuosa, Millepora* and *Siderastrea radians.*

E 4. GALLOWS BAY

A sandy beach with a cliff to the south and ruins of the former lower town of Oranjestad. In front of the beach in shallow water there are cobbles with *Siderastrea radians.* On scattered cobbles in deeper water also *Millepora, Porites astreoides* and *P. porites* grow.

On the reef at a depth of about 3 m, and on strikingly regular large boulders, which may be remnants of submerged ruins, the following corals are to be found: *Acropora palmata, Agaricia agricites, Colpophyllia natans, Dichocoenia stokesii, Diploria strigosa, Favia fragum, Isophyllastrea rigida, Isophyllia sinuosa, Millepora alcicornis, Montastrea annularis, M. cavernosa, Porites astreoides, P. porites, Siderastrea radians* and *S. siderea.*

In the middle of the bay on cobbles grow: *Diploria clivosa, Isophyllia sinuosa* and *Siderastrea radians.*

On submerged ruin walls in shallow water many Zoantharia are present and scattered *Diploria clivosa, Favia fragum, Isophyllia sinuosa, Porites astreoides* and *Siderastrea radians.*

E 5. COMPAGNIE BAAI

As the breakers on rocks and boulders prevented investigation of the reefs in front of the cliff, the corals in the shingle along the coast were studied. Fragments of the following species were found: *Acropora palmata, Diploria clivosa, D. strigosa, Favia fragum, Isophyllia sinuosa, Montastrea annularis, M. cavernosa* and *Siderastrea radians.*

In very shallow water, in the lee of boulders acting as breakwaters grow: *Acropora palmata, Agaricia agaricites, Favia fragum, Porites astreoides* and *P. porites.*

E 6. SCHILDPADDEN BAAI (Fig. 13)

A gently sloping sandy beach, with low cliffs and boulders to the east. In front of the beach on the bare bottom there are cobbles with *Porites astreoides* and *Siderastrea radians.* In deeper water cobbles and boulders are found on which these corals occur beside Zoantharia, *Acropora palmata, Diploria clivosa, D. strigosa, Isophyllia sinuosa* and *Millepora.*

In front of the cliff, under the breakers large colonies of *Acropora palmata* occur in great numbers, and a few colonies of *Montastrea annularis.* Between these colonies very low and encrusting colonies of *Diploria clivosa, D. strigosa, Isophyllia sinuosa* and *Millepora* occur.

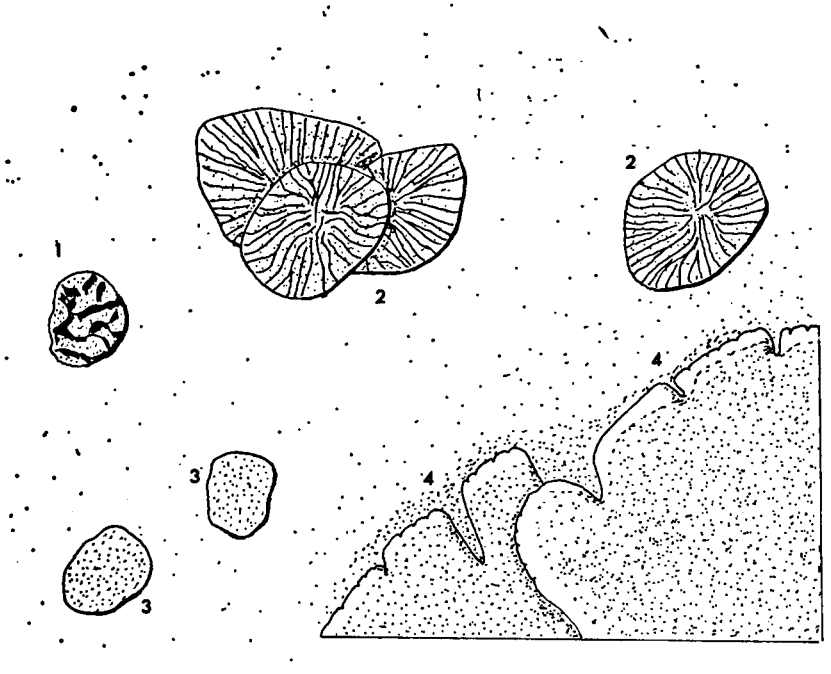


Fig. 13. Bottom of Schildpaddenbaai, St. Eustatius. – 1 *Isophyllia sinuosa*, 2 *Diploria clivosa*, 3 *Porites porites*, 4 *Acropora palmata*.

On the reef there are small rock pools, in which small colonies of *Acropora cervicornis*, *A. palmata*, *Diploria clivosa*, *Favia fragum*, *Millepora alcicornis*, *Porites astreoides*, *P. porites*, *Siderastrea radians* and *Stephanocoenia intersepta* are to be found.

SYSTEMATICS

In this chapter the corals are treated in a systematic order as given in the "Contents."

Each taxon (order, family, genus or species), comprising more than a single unit, is preceded by a Key. So there are keys to the orders of stony corals, to the families of Scleractinia, to several genera and to several species. All these keys are new, and restricted to the material of the Netherlands Antilles known to the author. They are to be used with caution, only as a guide, and never without comparison of the descriptions and figures or plates.

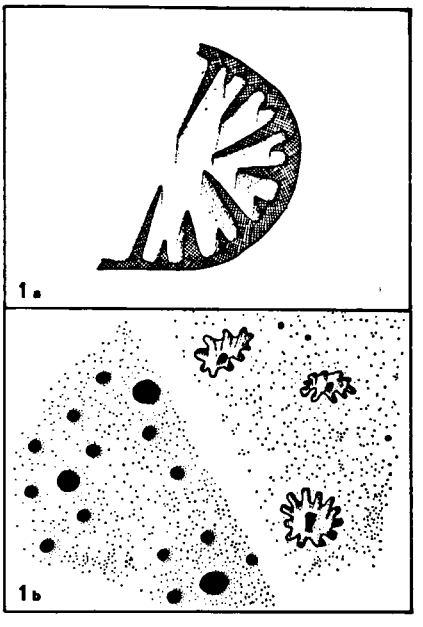
The Literature cited comprises some faunal lists: ALMY & CARRIÓN-TORRES 1963 (Puerto Rico), DUARTE BELLO 1960 (Cuba), LEWIS 1960 (Barbados), ROOS 1964 (Curaçao) and SQUIRES 1958 (Bimini); some papers used for identification and classification: BOSCHMA 1948, 1965, SMITH 1948, VAUGHAN 1919, VAUGHAN & WELLS 1943 and VERRILL 1902; other scientific papers in which corals from the Netherlands Antilles are mentioned: DE BUISONJÉ & ZONNEVELD 1960, VAN DER HORST 1927, HUMMELINCK & ROOS 1969, ROOS 1969 and VROMAN 1968, and finally a few popular books in which recognizable underwater pictures of specimens from the Netherlands Antilles occur: HAKKENBERG VAN GAASBEEK 1955, HASS 1941, 1947, 1954, 1955, VAN VENLO 1950.

This is followed by a short Diagnosis; an enumeration of Museum specimens from the Netherlands Antilles and other Caribbean Islands, in which the localities are given for the Netherlands Antilles, whilst in other cases only the islands are mentioned; a reference to the Distribution map, if present; remarks on Habitat, Ecology, Colour of the living colony, and Nomenclature, if necessary.

KEY TO ORDERS OF SHALLOW WATER STONY CORALS

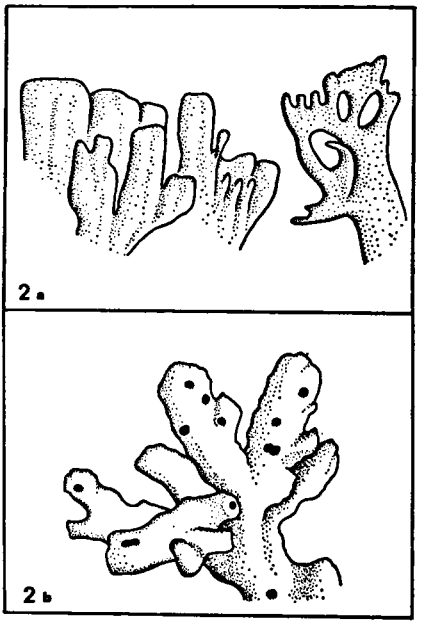
1a. Surface of the colony broken by corallites, which may also be present only at the end of branches; always with distinct septa . . . . . SCLERACTINIA (= Madreporaria)

1b. Plate-like, branched or encrusting colonies with small holes in a smooth surface; without septa, but edge of hole may have regular radial indentations 2



2a. Corals encrusting, plate-like or finger-like, often large and covering considerable parts of underlying rock; yellow to brown . . MILLEPORINA

2b. Corals small, irregularly branched, often with small knobs on the branches; purplish-blue . . . . . STYLASTERINA



Order MILLEPORINA

Family MILLEPORIDAE

Genus **Millepora**

According to BOSCHMA (1948b) there are three species of this genus present in the Caribbean. In their typical forms they are easily to be distinguished. Often however, the colonies are encrusting, or grow into irregular lobes. In those cases identification is impossible. Therefore no remarks on distribution of species are made in this paper (cf. Fig. 14).

KEY TO SPECIES OF MILLEPORA IN THE NETHERLANDS ANTILLES

(based on BOSCHMA 1948b)

1a. Colony of variable shape, at the growing edge divided into branches, which may be fingerlike or laterally compressed. In older parts the branches are generally united. . . . . *Millepora alcicornis*

1b. Colony forming upstanding plates without branches 2

2a. Upstanding plates thin, with lateral expansions which may be united. Surface of colony frilled . . . . . *Millepora squarrosa*

2b. Upstanding plates of varying dimensions, with smooth surface. Free edge as a rule truncated . . . . . *Millepora complanata*

Millepora alcicornis Linnaeus

(Pl. II)

SMITH 1948, p. 100; BOSCHMA 1948b, p. 18 fig. 6, pl. 14 fig. 3; SQUIRES 1958, p. 259, pl. 28 fig. 1–2; ALMY & CARRIÓN-TORRES 1963, p. 144, pl. 2a; VROMAN 1968, p. 50, 53, 56–57, 63. – HASS 1955, p. 47.

Branched coral. Branches may be finger-like or flattened, spread into all directions or in one plane. Older branches are united.

CURAÇAO. Caracasbaai: PWH 1334A. Curaçao: ZMU 14.
BONAIRE. Slagbaai: HLM X1–24–18, X1–25–30, X1–25–31, X1–25–33, X1–27–10, X1–27–11, X1-53-11.

KLEIN BONAIRE: HLM X1–155–13, X1–155–14.
BERMUDA: HLM EX 127, EC 340.
FLORIDA. Soldier Key: PWH 1413. Elliott Key: PWH 1414.
ANGUILLA: PWH 1142.
MARTINIQUE: PWH 1439.
TOBAGO: PWH 1142.

Generally not occurring as near to the watersurface as both other *Millepora* species. Growing in very quiet to stirred water on both leeward and windwardside of the islands.

Colour of the living coral yellow or brown.

Millepora squarrosa Lamarck

(Pl. I)

BOSCHMA 1948, p. 19, pl. 8–9; ALMY & CARRIÓN-TORRES 1963, p. 144, pl. 3a. – VENLO 1950, p. 45; HAKKENBERG VAN GAASBEEK 1955, p. 59, 82.

Coral forming flat upstanding plates. Surface of the colony frilled. Lateral expansions of adjacent plates often united.

KLEIN BONAIRE: PWH 1367; HLM X1–155–12.
ANGUILLA: PWH 1142.
MARTINIQUE: PWH 1439.
TORTUGA: PWH 1211.

Often building reefs, covering bare rock or dead corals. Also growing in heavy surf. May be exposed to the air in troughs of the sea.

Colour of the living colony yellow or brown.

Millepora complanata Lamarck

(Pl. III)

BOSCHMA 1948b, p. 20, fig. 2a–b & 11, pl. 7 fig. 2; SQUIRES 1958, p. 259, pl. 43 fig. 3; ALMY & CARRIÓN-TORRES 1963, p. 144, pl. 2b. – HASS 1941, pl. p. 44, 128 bottom; VENLO 1950, p. 60; HASS 1954, pl. p. 33 bottom.

Coral forming upstanding plates of variable size. Plates connected only at the base. Surface of the colony smooth.

CURAÇAO. Caracasbaai: PWH 1334A.
BONAIRE. Slagbaai: HLM X1–25–27; X1–30–2.

Covering rock and dead corals. Also forming reefs near the water surface or deeper, apparently not as exposed as *M. squarrosa.*

Colour of the living colony yellow or brown.

Order STYLASTERINA

Family STYLASTERIDAE

Genus **Stylaster**

Stylaster roseus (Pallas)

(Pl. IVa–b)

Roos 1964, p. 18; Boschma 1965, p. 227, pl. 1–3.

Branched colony, generally consisting of a main trunk with a number of side branches. Small, not exceeding 10 cm in height, generally 5–6 cm. Cyclosystems, consisting of one gastropore with surrounding dactylopores opening to it, mostly in rows. On thicker branches scattered dactylopores. Often wartlike knobs are present.

Curaçao. Knipbaai: PWH 1017 in RMNH. St. Michielsbaai: ZMA 1107. Piscaderabaai: ZMA 1840.
Bonaire. Slagbaai: HLM X1–24–19, X1–40–13. Noordpunt: HLM X1–26–3, X1–26–4, X1–26–5.

Scattered among other corals, especially deeper than 10 m. Abundant in niches near the water surface, often together with *Tubastrea tenuilamellosa* (cf. Fig. 15).

Colour of the living colony: purplish or red. The skeleton is somewhat lighter in colour.

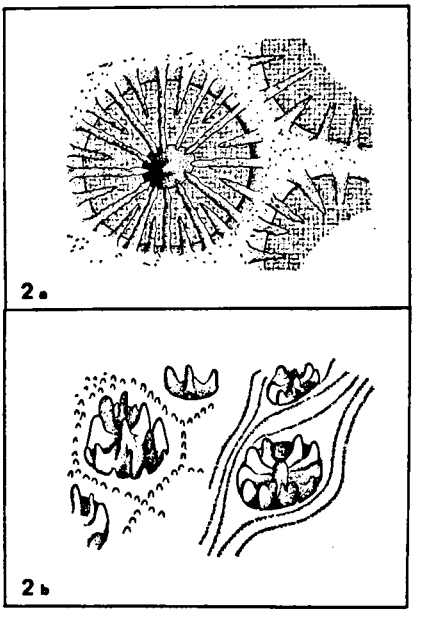
Order SCLERACTINIA (= Madreporaria)

KEY TO FAMILIES OF SHALLOW WATER SCLERACTINIA

1a. Columella massive, either styliform or laterally compressed 2

1b. Columella papillose, trabecular, lamellar, spongy or absent 3

2a. Twenty-four septa, pali present. Peritheca, if developed, costate. . . . . ASTROCOENIIDAE

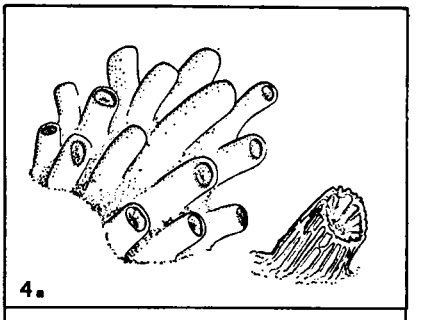


2b. Generally ten septa. Peritheca, if developed, noncostate, with knobs or grooves SERIATOPORIDAE

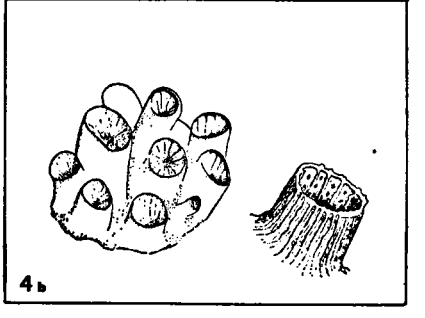
3a. Corallites are porous protruding tubes. Peritheca porous and fenestrate . 4

3b. No porous tubes . . . 5

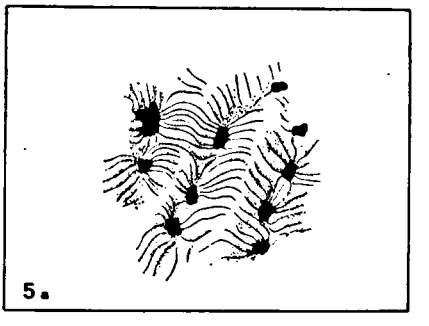
4a. Corallites small, mostly less than 5 mm, densely packed; coral branched or encrusting . ACROPORIDAE



4b. Corallites about 10 mm; corallum plocoid . . . . . DENDROPHYLLIIDAE

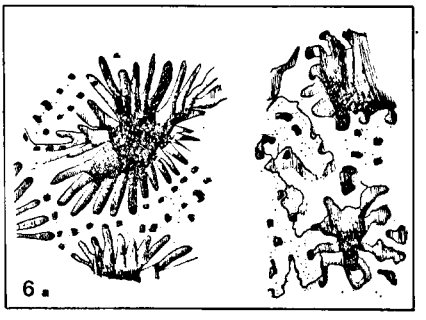


5a. Corallites cerioid in parallel rows between prominent ridges . AGARICIIDAE



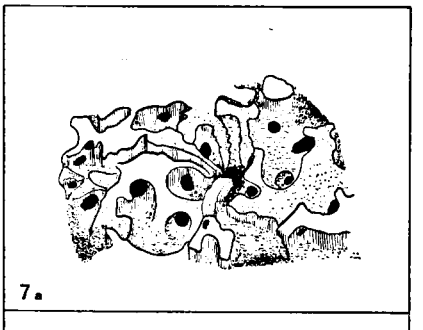
5b. Corallites not forming ridges when cerioid . . 6

6a. Walls fenestrate or porous 7

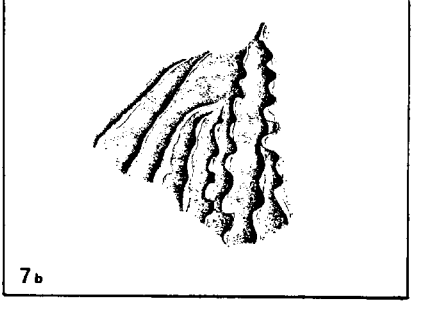


6b. Walls massive. Peritheca when present solid or vascular 8

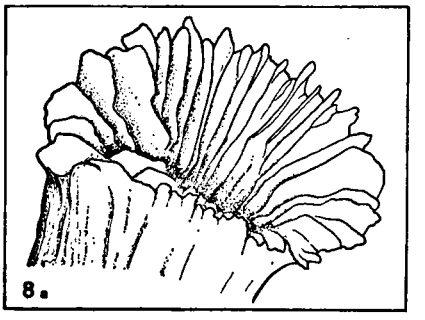
7a. Septa porous and fenestrate . . . . PORITIDAE



7b. Septa apparent laminar, with serrate margins. . . . . SIDERASTREIDAE

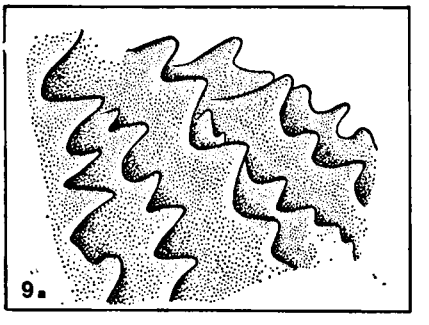


8a. Septal margins smooth . . . . CARYOPHYLLIIDAE


8.

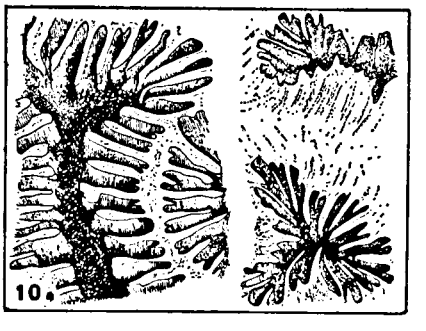
8b. Septal margins dentate or minutely beaded. . 9

9a. Septal margins and costae with coarse and sharp dentations . . . . . MUSSIDAE


9.

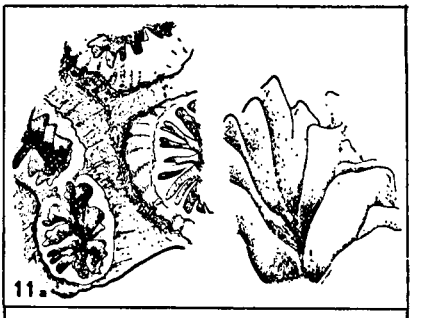
9b. Septal dentations not prominent, coarse and sharp. 10

10a. Corallites united to meandroid polycentric series, or at least some corallites elongated, bi- or tricentric 11

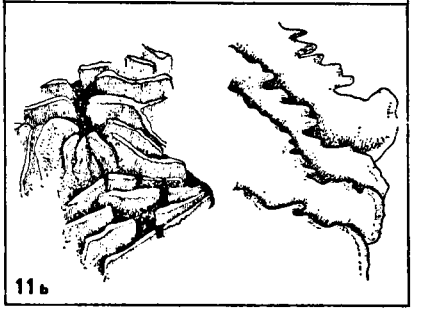

10.

10b. Corallites monocentric 12

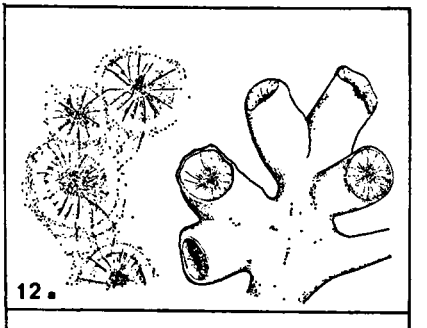
11a. If mono- to tricentric, walls free or separated by non-costate peritheca; if meandroid, septal margins smooth without paliform lobes . . . . . TROCHOSMILIIDAE



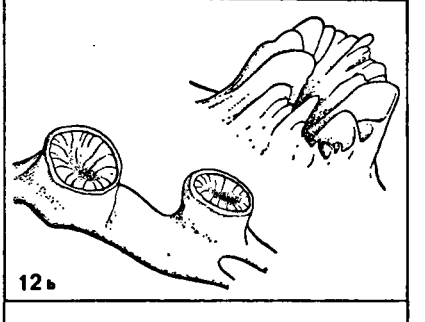
11b. If mono- to tricentric, walls united, costate; if meandroid, septal margins dentate, paliform lobes present . . . . . FAVIIDAE, subfamily FAVIINAE



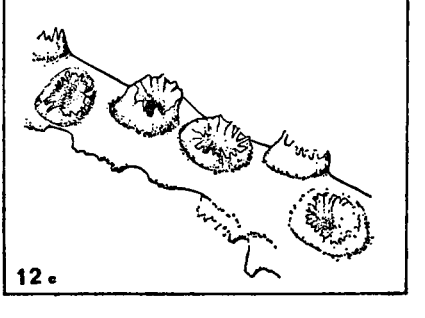
12a. Colonies either massive and plocoid, or phaceloid with each short branch ending in a small cup. . . . FAVIIDAE, subfamily MONTASTREINAE



12b. Reptoid colonies, cylindrical corallites, sometimes crowded and apparent plocoid . . . . . RHIZANGIIDAE



12c. Dendroid colonies, corallites alongside branches, separated by dense peritheca . . ORCULINIDAE



Family ASTROCOENIIDAE

Genus **Stephanocoenia**

Stephanocoenia intersepta (Esper)

(P. IVc, Va–b)

Stephanocoenia michelini (Edwards & Haime), SMITH 1948, p. 74; SQUIRES 1958, p. 246, pl. 32 fig. 1–2; ALMY & CARRIÓN-TORRES 1963, p. 144, pl. 3b; ROOS 1964, p. 6.

Columella massive, more or less laterally compressed. Septa in three cycles, the first two with pali or paliform lobes attached to the columella.

CURAÇAO. Piscaderabaai: PWH 1457, 1459; ZMA 1104, 1105.
BONAIRE. Slagbaai: HLM X1–57–10.

Rather commonly found, but not abundant. Not in inner bays (cf. Fig. 16).

Coral mostly encrusting, brown when living.

Both SMITH and SQUIRES include in their synonymy *Stephanocoenia intersepta* (Esper). As this is the older synonym, the name of this coral has to be *Stephanocoenia intersepta*, and not *Stephanocoenia michelini*.

Specimen ZMA 1104 (Pl. IVc), which closely correlates to that depicted in SQUIRES 1958, comes from a depth of 1 m, and is the most common form of this coral. ZMA 1105 (Pl. Vb) corresponds to *Plesiastrea goodei* Verrill (VERRILL 1902, pl. 31 fig. 1–1a), also considered as a synonym of *Stephanocoenia michelini* by SMITH and SQUIRES. This specimen is from 40 m deep.

Family SERIATOPORIDAE

KEY TO THE GENERA OF SERIATOPORIDAE IN THE NETHERLANDS ANTILLES

1a. Peritheca covered with long, curved striae . . . . . *Axhelia*
1b. Peritheca with granulations on the borders of the corallites . . . . . *Madracis*

Genus **Axhelia**

Axhelia myriaster Milne-Edwards & Haime

(Pl. VI–VII)

Columella styliform, ten septa, peritheca covered with long, curved striae. No granulations on borders of corallites.

ARUBA: RMNH 61.

As far as the author knows, only one specimen of this genus has been found in the Netherlands Antilles. The coral is more wildly branched than the *Madracis* species, and also the striation of the peritheca seems to be a more or less distinctive characteristic. In modern literature, however, *Axhelia* belongs to *Madracis*.

Genus **Madracis**

KEY TO SPECIES OF MADRACIS IN THE NETHERLANDS ANTILLES

1a. Coral encrusting, lobate or branched, the branches more or less in one plane . . . . . *Madracis decactis*

1b. Coral in dense tufts, branches dichotomous, densely packed . . . . . *Madracis asperula*

Madracis decactis (Lyman)

(Pl. VIIIa–b)

VAN DER HORST 1927, p. 159; SMITH 1948, p. 75, pl. 1; ROOS 1964, p. 7, pl. 6a.

Columella styliform, usually ten septa. Peritheca granulated. Encrusting, sometimes with hillocks or lobes. When branched, branches more or less in one plane. Tips of branches not densely packed and about at the same height.

CURAÇAO. Caracasbaai: PWH 1334, 1334A. Piscaderabaai: ZMA 632, 633, 683. Michielsbaai: ZMA 630.
BONAIRE. Slagbaai: HLM X1–27–5; X1–30–2; X1–32–15; X1–32–17; X1–40–8; X1–40–10; X1–47–3; X1–47–4; X1–52–3; X1–53–9; X1–54–5; X1–57–10; X1–57–28.

This species is restricted to somewhat deeper water, the shallowest record from the material examined being 9.4 m (X1–30–2, cf. Fig. 17).

The colour of the living colony is brown or purplish.

In the HLM collection there is one remarkable specimen (X1–57–28), which has the habitus of an *Axhelia* or a loosely branched *Madracis*. The peritheca is covered with granulations, which are not restricted to the borders of the corallites, as is generally the case in *Madracis*. The characteristics of columella and septa are those of *Madracis*, the number of septa, however, is constantly eight.

Madracis asperula Milne-Edwards & Haime

(Pl. IXb, X)

Roos 1964, p. 7, pl. 6b.

Columella styliform, ten septa. Peritheca with granules on borders of corallites. Usually dichotomously branched. The tips of the branches are densely crowded.

CURAÇAO. Piscaderabaai: PWH 1465A; ZMA 628, 629, 631, 681, 682, 1842. BONAIRE. Slagbaai: HLM X1–25–36, X1–29–2; X1–30–3; X1–32–13; X1–40–4; X1–40–7; X1–156–12.

This species is restricted to shallower parts of the open sea. The deepest record of the material examined is 16 m (HLM X1–40–7; cf. Fig. 18).

Colour of the living colony bright yellow.

Family ACROPORIDAE

Genus **Acropora**

KEY TO SPECIES OF ACROPORA IN THE NETHERLANDS ANTILLES

1a. Coral encrusting, forming broad fronds, or thick rounded or flat branches, without distinct axial corallites . . *Acropora palmata*

1b. Distinct axial corallites present 2

2a. Coral loosely branched, all branches circular in cross section . . . . . *Acropora cervicornis*

2b. Corals branched, but branches fused at crossings or parallel branches sometimes fused at considerable distance . . . . . *Acropora prolifera*

Whether these are real species, or only variations of one species, is not quite clear. VAUGHAN (1919) was right in stating that one rarely finds a specimen that cannot be referred instantly to one of the three species. Nevertheless some doubt remains.

Sometimes *Acropora palmata* shows branched structures on the fonds which are to be considered *Acropora prolifera* when growing free on the bottom, instead of being outgrowths of *A. palmata* (cf. ALMY & CARRIÓN-TORRES 1963, ROOS 1964). This author found in Bonaire branches of neighbouring colonies of *Acropora cervicornis* and *Acropora palmata* incidently touching each other. In one case, a horizontally growing flat branch of *A. palmata* bore on its upper surface a vertical branch of *A. cervicornis*. Evidently the growing *palmata* branch reached an already present *cervicornis* branch, and at the place of contact the corals were fused completely, without any visible boundary in skeleton or living tissue. But, beyond the fusion, the *palmata* branch has the same direction and shape as before the fusion (Fig. 47). The individuality of both branches remains unaffected. Directly below the *Acropora palmata* there is no branch of *A. cervicornis*, but somewhat deeper the stump of that branch is still visible. Probably the part in the shadow of the *palmata* branch died for want of light.

If fusion of two different colonies takes place they have to be closely allied (cf. BOSCHMA 1948, YONGE 1963). If, on the contrary, the branches retain their individuality after fusion, they differ more than is to be expected from variations of only one species.

Acropora cervicornis (Lamarck)

(Pl. IXa, XIIa)

VAN DER HORST 1927, p. 161; WAGENAAR HUMMELINCK 1933, p. 301 (sub. *A. muricata*); SMITH 1948, p. 75, pl. 2; DE BUISONJÉ & ZONNEVELD 1960, p. 136–137, phot. 10–12, 17; ALMY & CARRIÓN-TORRES 1963, p. 145, pl. 4a; ROOS 1964, p. 6, pl. 12a; VROMAN 1968, p. 55, 60; ROOS 1969, p. 16. – HASS 1947, pl. p. 273; VENLO 1950, p. 11, 14, 39, 46, 48, 54; HAKKENBERG VAN GAASBEEK 1955, p. 43, 113; HASS 1955, p. 81, 87.

Branched colonies, each branch with one axial corallite, and numerous smaller radial corallites. Corallites porous and tubular.

CURAÇAO. Westpuntbaai: ZMA 29, 55, 56, 57, 167. Piscaderabaai: 1459. Caracasbaai: ZMA 33, 52, 53, 54. Curaçao: ZMA 31, 63, 645; RMNH 816, 841, 851, ZMU 4.
BONAIRE. Slagbaai: HLM X1–23–5, X1–25–32, X1–50–2. Palu Lechi: PWH 1056C.
FLORIDA. Elliott Key: PWH 1414.
TOBAGO: PWH 1386.
TORTUGA: PWH 1211.
LOS ROQUES: HLM X1–11–24.
SAN BLAS: HLM X1–121–14.

Occurring well below the surface but not deeper than about 10 metres. In shallow water only in quiet bays and the lee side of the islands. Generally not in inner bays. On sandy bottom, often in clusters of considerable size (cf. Fig. 19).
Height of the colony varying from some centimetres to more than one metre. Colour of living colony light, greyish to yellowish-brown.

Acropora prolifera (Lamarck)

(Pl. XI)

VAN DER HORST 1927, p. 161; SMITH 1948, p. 76 (sub *prolifers* in errore); ALMY & CARRIÓN-TORRES 1963, p. 146, pl. 5a.

Branched colonies, tips of branches with axial corallites. Often fusion takes place at crossings of branches or between parallel branches, sometimes resulting in broad fronds in which the underlying structure of the original branches remains mostly visible.

CURAÇAO. Caracasbaai: ZMA 81, 82, 83. Curaçao: ZMA 650, 651, 652, 654; RMNH 655, 674, 689, 690, 706, 815.
LOS ROQUES: HLM X1–11–20.

Same distribution as *Acropora cervicornis*, but more scattered, never found in such bushy extensions.
Height not as much as full-grown *Acropora cervicornis*. Colour when alive more brownish.

Acropora palmata (Lamarck)

(Pl. XIIb)

VAN DER HORST 1927, p. 161; WAGENAAR HUMMELINCK 1933, p. 302; SMITH 1948, p. 75, pl. 3; SQUIRES 1958, p. 246, pl. 34 fig. 1; DE BUISONJÉ & ZONNEVELD 1960, p. 136, phot. 14–15; ALMY & CARRIÓN-TORRES 1963, p. 146, pl. 4b; Roos 1964, p. 7,

pl. 4a, 13; VROMAN 1968, p. 50, 55–57, 60; ROOS 1969, p. 14–15. – HASS 1941, pl. behind p. 24, in front 25, 25 bottom, 32, 44–45, 96, 112, 132 top; HASS 1947, pl. p. 113, 128, 148, 160, 273; VENLO 1950, p. 24, 34, 41, 50; HASS 1954, pl. p. 17, 32, 33 top, 112 top; HAKKENBERG VAN GAASBEEK 1955, p. 39, 43, 64; HASS 1955, p. 17.

Encrusting or branched colony. Branches mostly thick and horizontally flattened or frondlike plates, sometimes turbinate. Axial corallites, if present, hardly distinguishable.

CURAÇAO. Westpuntbaai: ZMA 168. Caracasbaai: ZMA 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 1838. Curaçao: ZMU s.n.; RMNH 656, 657.
BONAIRE. Slagbaai: HLM X1–25–19, 156–2.
SABA. Fort Bay: PWH 1120A.
FLORIDA: HLM EC 110.
ANTIGUA: PWH 1540A.
DOMINICA: PWH 1546.
GUADELOUPE: ZMA 1834.
Antilles: ZMA 649, 657, 837. – Sea of America: RMNH 842.
VENEZUELA: ZMA 653.

Distribution, cf. Fig. 20.
Common, reaching into the surf; not in inner bays. Where *A. palmata* occurs together with *A. cervicornis*, both in large clusters, *A. palmata* always grows at the shallower side.

This coral is probably the most adaptive to prevailing water-movements (SHINN 1963; ROOS 1964, 1966). In heavy surf it may be encrusting; in calm water it spreads its thick, flattened branches into all directions. Bent in the direction of the coast where rollers come in from the open sea; highly streamlined where tidal currents go to and fro; turbinate where eddies prevail.

Family AGARICIIDAE

Genus **Agaricia**

Agaricia agaricites (Linnaeus)

(Pl. XIVa–b, XV)

VAN DER HORST 1927, p. 160; SMITH 1948, p. 76–77, pl. 4–5 (+ *A. fragilis* + ? *A. nobilis*); SQUIRES 1958, p. 247–248, pl. 32 fig. 3, 33 fig. 1–3 (+ var. *crassa* + var. *purpurea*); ALMY & CARRIÓN-TORRES 1963, p. 146–147, pl. 5–7a (+ ? *A. cucullata*); ROOS 1964, p. 8–9, pl. 12b (+ *A. fragilis*); VROMAN 1968, p. 56. – HASS 1941, pl. p. 148 bottom, 257 bottom.

Corallum cerioid, some ridges between the corallites prominent, mostly parallel. Coral encrusting or leaf-like, with corallites on both flat sides or on one side only. Sometimes small and gibbous, then ridges not parallel and enclosing only few corallites.

CURAÇAO. Plaja Lagun: ZMA 164. Playa Hulu: PWH 1023A. Piscaderabaai: PWH 1457, 1460, 1460A; ZMA 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 165, 166, 170, 171. Caracasbaai: ZMA 554; PWH 1334A. Spaanse Baai: PWH 1037A. Spaanse Water: PWH s.n.; ZMA 106–118, 120–122, 555. Fuikbaai: PWH 1038, 1344. Curaçao: ZMA 123, 124, 134; ZMU 6; RMNH 908, 909.
BONAIRE. Slagbaai: HLM X1–23–4, X1–25–24, X1–25–25, X1–25–34, X1–25–38, X1–27–8, X1–29–3, X1–31–4, X1–31–5, X1–53–6, X1–54–9, X1–54–10, X1–55–4, X1–55–8, X1–56–15, X1–57–26, X1–57–27, X1–156–11. Boca Lac: PWH 1068A. Lac, Binnenklip: PWH 1568.
KLEIN BONAIRE: HLM X1–155–9, X1–155–10.
ST. MARTIN. Great Bay: PWH s.n.
FLORIDA. Elliott Key: PWH 1414. Florida: HLM EC 111.
PUERTO RICO: ZMA 79, 80.
ST. BARTS: PWH s.n.
LOS ROQUES: HLM X1–11–8 to X1–11–12, X1–11–15.
SAN BLAS: HLM X1–123–13.
Antilles: RMNH 861, 867, 911. West Indies: ZMA 125–127. America: RMNH 910.

Distribution cf. Fig. 21.
Common. In open sea scattered among other corals; in inner bays sometimes on mangrove roots. From sea-level to the lower depth limit of the reef, which may be at 60 metres.

This species, in its widespread distribution, shows a number of growth-forms, which sometimes are considered varieties or even species. There seems to exist some correlation between growth-form and submarine light intensity. In shallow water the coral is small, mostly gibbous or encrusting (var. *crassa*), but, in the shadow of a cliff, or in caves, pedicelled with a thin corallum, sometimes saucer-like, with corallites on the upper face only (var. *fragilis*). In somewhat deeper water the typical form of *Agaricia agaricites* exists, with thick leaf-like outgrowings, and corallites on all sides of the colony. In water deeper than about 10 metres the coral forms broad vertical scales, up to half a metre in diameter, with corallites on one side only (var. *purpurea*).

Agaricia cucullata (= *A. nobilis*) is placed in the synonymy of

Agaricia agaricites, because of the occurrence of parts of *A. agaricites* var. *purpurea*, which closely resemble VERRILL's *Agaricia nobilis* (Pl. 15).

The colour is brown, sometimes rather light.

Family PORITIDAE

Genus **Porites**

KEY TO SPECIES OF PORITES IN THE NETHERLANDS ANTILLES

1a. Branched colonies . . . . . *Porites porites*
1b. Massive colonies 2

2a. Surface of colony smooth. Pali forming a distinct ring . . . . . *Porites branneri*
2b. Surface of the colony smooth or bumpy. Pali present or absent, but never forming a closed ring . . . . . *Porites astreoides*

Porites porites (Pallas)

(Pl. XVIa–b, XVIIa–b)

VAN DER HORST 1927, p. 161 (+ *P. furcata*); SMITH 1948, p. 80–81, pl. 8–10 (+ *P. divaricata* + *P. furcata*); SQUIRES 1958, p. 251, pl. 38 fig. 1–3, 39 fig. 1; ALMY & CARRIÓN-TORRES 1963, p. 149, pl. 8–9; ROOS 1964, p. 10; VROMAN 1968, p. 53, 56, 60; HUMMELINCK & ROOS, p. 7, 20, fig. 10.

Colonies cerioid and branched. Peritheca and septa porous and fenestrate.

ARUBA. Malmok: PWH 1301. Paardenbaai: PWH 1303.
CURAÇAO. Westkust: ZMA s.n. St. Michielsbaai: ZMA 885, 887. Kaap Malmeeuw: ZMA 884. Piscaderabaai: PWH 1029A, 1460A; ZMA 883. Caracasbaai: ZMA 1045. Punta Caballero: ZMA 879, 882, 886. Spaanse Water: ZMA 881, 1031, 1032, 1034–1040, 1042–1044, 1046, 1047, 1095. Awa di Oostpunt: ZMA 880. Curaçao: ZMU 7, RMNH 441, 443.
BONAIRE. Slagbaai: HLM X1–25–14, X1–25–15, X1–29–1, X1–40–9, X1–156–7. Sorobon: PWH 1373A, 1565, 1566. Lac, Binnenklip: PWH 1568. Lac, Palu Calbas: PWH 1569.
KLEIN BONAIRE: HLM X1–137–2.
ST. MARTIN. Great Bay: PWH 1126.

SABA. Fort Bay: PWH 1120.
BERMUDA: RMNH s.n.
FLORIDA. Elliott Key: PWH 1414.
HISPANIOLA. Haïti: RMNH 440.
PUERTO RICO: PWH 1418; ZMA 281, 854.
ST. JOHN: PWH 1407, 1408.
BARBUDA: PWH 1386, 1534, 1537.
ANTIGUA: PWH 1540B.
DOMINICA: PWH 1456.
ISLOTE AVES (W. of Dominica): PWH 1115.
MARTINIQUE: PWH 1439.
TOBAGO: PWH 1386.
LOS ROQUES: HLM X1-11-13, X1-11-17, X1-11-22, X1-11-23.
SAN BLAS: HLM X1-123-11.

Distribution, see Fig. 22.
Very common at a depth less than approximately 25 m. Scattered or crowded, among other corals, in *Thalassia* fields or on open bottom. Also in inner-bays.

Sometimes distinct growth-forms are to be distinguished, which were considered to be different by various authors (e.g. VAN DER HORST 1927, SMITH 1948). For the sake of completeness a key to the different growth-forms is given here. It is, however to be kept in mind that these varieties represent extremes, and that often colonies are found which cannot be referred to one of these forms.

KEY TO VARIETIES OF PORITES PORITES

(adapted from SMITH 1948, and ALMY & CARRIÓN-TORRES 1963)

1a. Branches less than 6 mm in diameter, colonies in small clumps . . . . . var. *divaricata* Lesueur
1b. Branches 10 mm or more in diameter 2

2a. Corals in thick clumps; branches swollen at ends. Usually six pali . . . . . var. *clavaria* Lamarck
2b. Corals more openly and dichotomously branched; branches without swollen ends. Usually five pali . . . . . var. *furcata* Lamarck

On the Netherlands Antilles more "varieties" can be found: On the reef in the open sea, and in the entrance of the Spaanse Water

Porites porites colonies occur which consists of only a few erect branches, with a diameter of 2 cm or more. – Near Willemstoren, at the south coast of Bonaire, colonies of *Porites porites* are found lying on the sand, in small depressions of the bottom. The colonies consist of a slightly curved main branch with some sidebranches. The colonies are laterally compressed and rest on one side. – More closely branched colonies, but also lying loose, can be found at other localities too, see Pl. 17 depicting such a specimen from Boca Bartól, Curaçao.

Most of the *Porites porites* colonies are either var. *clavaria* or var. *furcata*. The latter occurs abundantly in inner bays.

At Arashi, Aruba, *Porites porites* var. *divaricata* forms pavements in very shallow water. At first sight it may be confused with such pavements of *Madracis asperula*, because of the density of the tips of the branches which are in one plane, and the yellow colour. The other colonies of *Porites porites* are usually white or grey.

Porites branneri Rathbun

(Pl. XVIIIb–XIXb)

VAN DER HORST 1927, p. 161; SMITH 1948, p. 80.

Colonies massive and cerioid. Walls and septa porous and fenestrate. Inner edges of pali fuse and form a columelliform ring. Surface of the colony smooth.

ARUBA. Bucuti: PWH 1005A.
CURAÇAO. Caracasbaai: ZMA 1023.
BONAIRE. Slagbaai: HLM X1–25–4, X1–25–5. Lac: ZMA 5572.

This coral has been observed at only a few places at Aruba (Arashi, Boca Catalina, Bucuti), Curaçao (Caracasbaai) and Bonaire (Slagbaai, Lac).

On the few localities *Porites branneri* was recognized with some certainty (cf. remark under *P. astreoides*), it seems to be restricted to very shallow places.

The colour of the living colony is blue.

Porites astreoides Lamarck

(Pl. XVIIIa, XIXa)

VAN DER HORST 1927, p. 161; SMITH 1948, p. 79, pl. 11; SQUIRES 1958, p. 250, pl. 39 fig. 2–3; ALMY & CARRIÓN-TORRES 1963, p. 149, pl. 8a; ROOS 1964, p. 9–10, pl. 9; HUMMELINCK & ROOS 1969, p. 7, 20, fig. 10; ROOS 1969, p. 12–13. – HASS 1955, p. 47.

Colonies massive and cerioid. Walls and septa fenestrate and porous. Surface of the colony smooth or knobby, great variation in shape and presence of septa and pali, but no columelliform ring.

CURAÇAO. Westpuntbaai: ZMA 869, 873. Plaja Hulu: PWH 1023A. Piscaderabaai: PWH 1463A; ZMA 870, 871, 875, 876, 3738–3741, 3746; RMNH s.n. Caracasbaai: ZMA 1013, 1015, 1016, 1018–1020. Punta Cabellero: ZMA 872, 874, 877, 878. Spaanse Water: ZMA 1009–1012, 1014, 1017, 3742–3745. Curaçao: ZMA 1021; ZMU 3.
BONAIRE. Slagbaai: HLM X1–25–1 to X1–25–3, X1–25–6, X1–25–7, X1–25–11 to X1–25–13, X1–31–6, X1–156–1. N. of Punt Vierkant: PWH 1059.
KLEIN BONAIRE: HLM X1–155–11.
ST. MARTIN. Great Bay: PWH 1125A, 1126.
ST. EUSTATIUS. Gallows Bay: PWH 1116B.
BERMUDA: HLM EC122, EC128.
PUERTO RICO: ZMA 858.
ST. JOHN: PWH 1407.
ST. KITTS: PWH 1398.
ANTIGUA: PWH 1540A.
DOMINICA: PWH 1546.
MARTINIQUE: PWH 1439.
SAN BLAS: HLM X1–123–12.

Distribution, see Fig. 23.
This coral can be found in almost every locality above its lower depth limit. It occurs in muddy inner bays amongst or on mangrove-roots as well as in the open sea, in quiet bays as well in heavy surf.
The colour of the living colony is dull brown to bright yellow.

Near the lower depth limit and in localities where not much light penetrates, this coral shows a conspicuous flattening in relation to ambient light conditions (ROOS 1967). Apart from this variation in growth form, the characteristics of the corallites greatly vary. The same applies to the amount of crowding. Sometimes there is hardly any wall; other corals show thick walls with deep calyces. As to the septal arrangement, the number and presence of pali, the number and distribution of dentations of skeletal elements, there is great

variation too. Also the colony surface may be smooth or with a number of irregular knobs; the size of the corallites may be greater or smaller; these characteristics being approximately constant in each colony.

Since these skeletal elements, which are subject to great variation, are used as specific charactersistics, there can be some doubt whether *Porites astreoides*, *Porites branneri* and probably also *Porites verrilli* are real species.

Family SIDERASTREIDAE

Genus **Siderastrea**

KEY TO SPECIES OF SIDERASTREA IN THE NETHERLANDS ANTILLES

1a. Fourth cycle of septa incomplete (less than 48 septa); corallites angular with narrow cavity . . . . . *Siderastrea radians*

2b. Fourth cycle of septa complete, in large corallites some septa of fifth cycle present (48 septa or more); corallites round, with wide cavity . . . . . *Siderastrea siderea*

Siderastrea radians (Pallas)

(Pl. XX–XXI)

VAN DER HORST 1927, p. 160; SMITH 1948, p. 78, pl. 6; SQUIRES 1958, p. 248, pl. 35 fig. 1–4, pl. 36 fig. 3; ALMY & CARRIÓN-TORRES 1963, p. 148, pl. 7b; ROOS 1964, p. 9.

Septa appearing laminar; walls fenestrate. Fourth cycle of septa incomplete. Corallites angular when crowded.

CURAÇAO. Westpuntbaai: ZMA 1109. St. Michielsbaai: ZMA 1106. Piscaderabaai: PWH 1460A, 1463B; ZMA 1108; RMNH s.n. Punta Caballero: ZMA 1110. Caracasbaai: ZMA 1129, 1130, 1352, 1354. Spaanse Water: ZMA 1101, 1131, 1353, 1355. Curaçao: ZMA 1351, 1356.
BONAIRE. Slagbaai: HLM X1–25–37.
ST. MARTIN. Great Bay: PWH 1125, 1127, 1128A.
ST. EUSTATIUS. Billy's Gut: PWH 1117.
BERMUDA: HLM EC121.
FLORIDA: HLM EC112.
ST. KITTS: PWH 1397.

ANTIGUA: PWH 1540A.
TOBAGO: PWH 1388.
BRASIL: HLM EC244.

Distribution, see Fig. 24.
This coral is one of the most common species, and obviously shows no preference for certain localities. It occurs from the water surface of muddy inner bays, down till approximately 25 m in the open sea.

In quiet and deeper water the shape of the colony is hemispherical. In shallow water, just below the water surface, and at very exposed localities the colony spreads over the surface. The diameter of the massive colony does not exceed 20 cm; the extent of the spreading colonies is variable, on soft bottom mostly about 5–10 cm. Sometimes unattached globular or egg-shaped colonies can be found, completely covered by living tissue.

The colour of the colony is brown. It differs slightly from the colour of *Siderastrea siderea*.

Siderastrea siderea (Ellis & Solander)

(Pl. XIIIa–b)

VAN DER HORST 1927, p. 160; SMITH 1948, p. 79, pl. 7; SQUIRES 1958, p. 249, pl. 36 fig. 1–2; ALMY & CARRIÓN-TORRES 1963, p. 148, pl. 7c; ROOS 1964, p. 9. – HASS 1955, p. 114.

Septa appearing laminar, walls fenestrate. Four complete cycles of septa, fifth cycle incomplete in large corallites. Most corallites round, even when crowded.

CURAÇAO. Piscaderabaai: PWH 1511; RMNH s.n. Spaanse Haven: ZMA 1135. Spaanse Water: ZMA 1133, 1134, 1136–1139, 1141, 1143, 1358–1368, 1370–1375.
BONAIRE. Slagbaai: HLM X1–53–7.
BERMUDA: RMNH s.n., HLM EC337.
MARTINIQUE: PWH 1439.
ANTILLES: ZMA 1144, 1357.

Distribution, see Fig. 25.
This species occurs both in inner bays and in the open sea. It is, however, more restricted in its distribution than *Siderastrea radians*.

It does not occur on muddy bottoms, nor near the water surface. It is generally present at depths of less than 40 m, and common at approximately 10 metres.
In shallow water the coral may be encrusting, but more often hemispherical masses are encountered. At the reef, at a depth of about 10 m, the diameter of the colonies may exceed 1 m.
The colour of the living colony is mostly light reddish-brown.

Family FAVIIDAE

Key to Genera of Faviidae in the Netherlands Antilles

1a. Corallites monocentric, round (Subfamily Montastreinae) . . 2
1b. Corallites polycentric or at least elongated and di- or tricentric (Subfamily Faviinae) 4

Montastreinae

2a. Ramose colonies, each short branch ending in a corallite . . . . . *Cladocora*
2b. Massive colonies 3

3a. No pali or paliform lobes. Broad columella of interlacing trabeculae. Last cycle of septa not joining columella. Greater costae of adjacent corallites meeting . . . . . *Montastrea*
3b. Pali or paliform lobes present. First two cycles of septa fuse with columella, third cycle of septa short. Costae of adjacent corallites separated . . . . . *Solenastrea*

Faviinae

4a. Corallites mono-, di- or tricentric . . . . . *Favia*
4b. Corallites polycentric 5

5a. Most of the septa with paliform lobes, separated from main part of septum by a notch 6
5b. Septal lobes may be inclined towards columella, but never with a notch . . . . . *Diploria*

6a. Linkage trabecular . . . . . *Manicina*
6b. Linkage lamellar . . . . . *Colpophyllia*

Genus **Cladocora**

Cladocora arbuscula (Lesueur)

(Pl. XXIIa–b)

SMITH 1948, p. 30, pl. 22.

Ramose colonies, with each short, cylindrical branch ending in a corallite. Outer surface of corallite wall with fine costae. Septal surface dentate, columella consisting of interlacing trabeculae.

ST. MARTIN. Great Bay: PWH 480.
FLORIDA: PWH 1413.
ST. KITTS: PWH 1397.

Apart from the fragments from St. Martin, PWH 480, no other corals of this species are known from the Netherlands Antilles. Some unnumbered fragments from Bonaire and Klein Bonaire in the PWH collection probably belong to this species too.

Genus **Montastrea**

KEY TO SPECIES OF MONTASTREA IN THE NETHERLANDS ANTILLES

1a. Diameter of corallites under 3 mm. Three complete cycles of septa, only the first two reaching to columella . . . . . *Montastrea annularis*

1b. Diameter of corallites 5 mm or more. Three cycles of septa reaching columella. Fourth cycle may be incomplete . . . . . *Montastrea cavernosa*

Montastrea annularis (Ellis & Solander)

(Pl. XXIVb, XXVb)

VAN DER HORST 1927, p. 160 (sub *Orbicella annularis*); SMITH 1948, p. 89, pl. 25–26; SQUIRES 1958, p. 256, pl. 40 fig. 3, 41 fig. 1–2; BUISONJÉ & ZONNEVELD 1960, p. 136; ALMY & CARRIÓN-TORRES 1963, p. 154, pl. 14a; ROOS 1964, p. 11, pl. 11; ROOS 1969, p. 12. – HASS 1941, pl. p. 128 bottom, 129, 132 top, 148 bottom; HASS 1947, pl. p. 257; VENLO 1950, p. 15 bottom, 35, 48; HASS 1955, p. 114, 128–129.

Massive colonies, size of the colony varying, sometimes forming boulders up to 2 m diameter. Columella of interlacing trabeculae

about one third of the corallite. Three cycles of septa, the first two of them reaching the columella. Corallites circular, sometimes protruding above peritheca, not over 4 mm in diameter.

CURAÇAO. Westpuntbaai: ZMA 802. Plaja Hulu: PWH 1023. Santa Marta: ZMA 808. St. Michielsbaai: ZMA 791, 798. Kaap Malmeeuw: ZMA 803, 804. Piscaderabaai: ZMA 790, 794, 807, 1403; PWH 1473A; RMNH s.n. Caracasbaai: PWH 1334A; ZMA 841, 843–845, 847, 848, 852; Punta Caballero: ZMA 792; Curaçao: ZMU 2; RMNH 245–247.
BONAIRE. Slagbaai: HLM X1–24–20, X1–24–21, X1–25–28, X1–25–29, X1–27–9, X1–28–1, X1–32–14, X1–36–4, X1–156–5, X1–156–6, X1–156–11.
KLEIN BONAIRE: HLM X1–155–6.
BERMUDA: RMNH s.n.; HLM EC125.
FLORIDA: Elliott Key: PWH 1414.
MARTINIQUE: PWH 1439.
LOS ROQUES: HLM X1–11–16, X1–11–21.

Distribution, see Fig. 26.

Generally present at the reef in open sea. Absent in landlocked bays. Lower depth limit approximately 30 m. Often abundant at a depth of approx. 10 m, where it then forms the bulk of the reef.

This is the most important reef building coral of the region. Its large colonies are very conspicuous. They are often spherical, with or without broad vertical ridges. Mostly there is a depression at the top. Rarely massive pillars of 2 metres height are encountered. Also crowded pillarlike colonies occur, the top of the pillars being hemispherical, with living tissue at the upper part of the colony only. These colonies may occur in rows, or in crowded clumps resulting in big spherical masses (Fig. 4). Near the lower depth limit the colonies are flat and horizontal, at shadowed vertical surfaces the colonies may be shingle-like vertical plates.

Colour of the colony brown, the oral discs are sometimes green.

Montastrea cavernosa (Linnaeus)

(Pl. XXIIc, XXIII)

SMITH 1948, p. 90, pl. 27; SQUIRES 1958, p. 225, pl. 40 fig. 1–2; ALMY & CARRIÓN-TORRES 1963, p. 154, pl. 14b; ROOS 1964, p. 11.

Massive colonies, sometimes irregular spherical masses, often encrusting, with irregular knobs and hillocks. Corallites more than

5 mm across, generally protruding above peritheca. Four, mostly incomplete, cycles of septa, the first three of which reach the columella. The broad columella consists of interlacing trabeculae.

CURAÇAO. St. Marta: ZMA 797. Piscaderabaai: ZMA 805, 806. Caracasbaai: PWH 1334A. Curaçao: RMNH 241–243, 407.
BONAIRE. Slagbaai: HLM X1–40–11, X1–40–12, X1–51–20.
KLEIN BONAIRE: HLM X1–155–5.
BERMUDA: RMNH s.n.
FLORIDA. Key Biscayne: PWH 1410. Florida: RMNH 399.
Antilles: RMNH 240.

Distribution, see Fig. 27.

Restricted to the open sea, not occurring in inner bays. It is more common in deeper water than *M. annularis*, although it may be present in dim caves or niches in shallow water. It also extends deeper than *M. annularis*, it may be found throughout the reef, down to 50 metres or more.

Irregular spherical colonies sometimes 1 m across. Colonies mostly smaller, more or less encrusting. Always encrusting near depth limit of living reef or in dim localities. No shingle-like colonies.

Colour of the living colony brown, olive, green purplish or blue.

Genus **Solenastrea**

Solenastrea bournoni Edwards & Haime

(Pl. XXIVa, XXVa)

SMITH 1948, p. 88; ALMY & CARRIÓN-TORRES 1963, p. 154, pl. 13; ROOS 1964, p. 11.

Massive colonies. Circular corallites, with three cycles of septa, first two cycles reaching columella with pali or paliform lobes. Third cycle of septa short. Peritheca blistered. Costae of adjacent corallites not meeting.

CURAÇAO. Piscaderabaai: ZMA 1103. Caracasbaai: PWH 1334A.
BONAIRE. Slagbaai: HLM X1–56–14.
MARTINIQUE: PWH 1439.

Distribution, see Fig. 28.

Scattered among other reef corals in open sea. Becoming more common at depths more than 10 m. Deeper than 20 metres more or less replacing *Montastrea annularis*.

Colonies generally not more than 25 cm in diameter.

Colour mostly light brown.

Genus **Favia**

Favia fragum (Esper)

(Pl. XXVIa–b, XXVII, XXVIIIa)

VAN DER HORST 1927, p. 160; SMITH 1948, p. 82, pl. 12–13; SQUIRES 1958, p. 253, pl. 34 fig. 2–3; ALMY & CARRIÓN-TORRES 1963, p. 150, pl. 10a; ROOS 1964, p. 10.

Plocoid colonies with mono-, di- and tricentric corallites. Costate, costae and septa with irregular dentations. Number of septa varying from 36 to 40. Colonies encrusting or spherical, not exceeding 10 cm in diameter.

ARUBA. Paardenbaai: PWH 1303.
CURAÇAO. St. Michielsbaai: ZMA 325. Piscaderabaai: PWH 1029, 1457, 1460, 1460A, 1461A; ZMA 326, 327, 329, 330. Caracasbaai: PWH 1334A; ZMA 595. Punta Caballero: ZMA 331. Spaanse Water: PWH s.n.; ZMA 100, 318–320, 594. Awa di Oostpunt: ZMA 323, 328, 332. Curaçao: RMNH 238, 400.
BONAIRE. Slagbaai: HLM X1–25–8 to X1–25–10, X1–156–3, X1–156–4. Lac, Binnenklip: PWH 1568.
KLEIN BONAIRE. PWH 1367.
ST. MARTIN. Great Bay: PWH s.n.
SABA. Fort Bay: PWH 1120.
BERMUDA: RMNH s.n.
FLORIDA. Elliot Key: PWH 1414. Florida: RMNH 398.
ST. THOMAS: HLM EC119.
BARBUDA: PWH 1395.
DOMINICA: PWH 1546.
MARTINIQUE: PWH 1439.
TOBAGO: PWH 1386.
LOS ROQUES: HLM X1–11–7, X1–11–9.
SAN BLAS: HLM X1–121–19.
America: RMNH 381.

Distribution, see Fig. 29.

Generally present at depths less than 15 m, mostly scattered among

other corals on the reef. In inner bays if not too much polluted. Sometimes on mangrove roots.

Colonies generally spherical or cap-shaped. Seldom encrusting. Some colonies on a stone from Vreedeberg, Spaanse Water (PWH s.n.) are apparently not in a good condition; they are phaceloid (Pl. XVII).

Colour of the living colony varying from bright yellow to brown.

Genus **Diploria**

KEY TO SPECIES OF DIPLORIA IN THE NETHERLANDS ANTILLES

1a. Septa more than 30 per cm. Valleys not interconnecting, sometimes short or even monocentric . . . . . *Diploria clivosa*
1b. Septa less than 20 per cm 2

2a. Wall sometimes grooved, at edge of colony. Some valleys interconnecting. Generally a great number of parallel valleys . . . . . *Diploria strigosa*
2b. Walls may be broader than valleys, always with groove at top. Valleys twisting, nearly all interconnected. Only few valleys parallel . . . . . *Diploria labyrinthiformis*

Diploria clivosa (Ellis & Solander)

(Pl. XXIIIb, XXX, XXXI)

VAN DER HORST 1927, p. 160 (sub *Maeandra clivosa*); SMITH 1948, p. 83, pl. 14–15; SQUIRES 1958, p. 253, pl. 42 fig. 2; ALMY & CARRIÓN-TORRES 1963, p. 151, pl. 10b; ROOS 1964, p. 10.

Meandroid colonies with rather narrow walls and valleys. Valleys not interconnecting, sometimes short or even monocentric. 35–45 septa per cm. Columella of interlacing trabeculae.

CURAÇAO. Punta Caballero: ZMA 259. Curaçao: RMNH 216, 258.
BONAIRE. N of Punt Vierkant: ZMA 3733. Slagbaai: HLM X1–25–21, X1–25–22, X1–156–8.
BERMUDA: RMNH s.n.
FLORIDA: RMNH 402.

Distribution, see Fig. 30.

Rather common at depths less than 25 m. Mostly on bare rock. Often encrusting sometimes with round hillocks. Also in heavy surf at the windward sides.

In quiet water the coral tends to develop more and more elevated knobs and hillocks, and may even form hemispherical colonies. In water with much sand, the coral tends to develop shorter valleys and then resembles *Maeandra agassizii* from the Bahamas (VERRILL 1901) or *Diploria clivosa* from West Africa (CHEVALIER 1966). The author found this form only in Bonaire. In rough water the coral only forms a flat encrusting colony. Where different colonies meet, they do not grow together.

Colour of the living colony varying, even at the same locality, bright yellow, green, bluish or grey.

Diploria strigosa (Dana)

(Pl. XXIXa–b)

VAN DER HORST 1927, p. 160 (sub *Maeandra strigosa*); SMITH 1948, p. 84, pl. 16; SQUIRES 1958, p. 253, pl. 42 fig. 1; ALMY & CARRIÓN-TORRES 1963, p. 151, pl. 10b; ROOS 1964, p. 11. – VENLO 1950, p. 32, 38; HASS 1954, pl. p. 112 top; HAKKENBERG VAN GAASBEEK 1955, p. 59; HASS 1955, p. 95, 131.

Meandroid colonies, with columella of interlacing trabeculae. Prominent septa with paliform lobes. Septa 15–20 per cm. Walls not grooved except in some instances at the edge of the colony. Several walls may run parallel over some distance.

CURAÇAO. St. Martabaai: ZMA 262, 863. St. Michielsbaai: ZMA 263. Caracasbaai: ZMA 741, 743, 750, 816. Spaanse Haven: ZMA 744. Curaçao: ZMU 12; RMNH 215, 217, 218, 222; HLM EC120.
BONAIRE. Kralendijk, buoy: PWH 1053. Slagbaai: HLM X1–15–20, X1–25–23.
KLEIN BONAIRE: HLM X1–155–7.
BERMUDA: HLM EC124.

Distribution, see Fig. 31.

More widely distributed than the other species of *Diploria*, also in landlocked bays. Lower depth limit abt. 25 m.

Like the following species this coral grows often in large spherical or hemispherical boulders. Sometimes it forms small encrusting colonies.

The colour of the living colony is yellow or brown.

Diploria labyrinthiformis (Linnaeus)

(Pl. XXXIIa–b)

VAN DER HORST 1927, p. 160 (sub *Maeandra labyrinthiformis*); SMITH 1948, p. 84, pl. 16; ALMY & CARRIÓN-TORRES 1963, p. 151, pl. 11a; ROOS 1964, p. 10. – HASS 1941, pl. p. 44, 132 top; HAKKENBERG VAN GAASBEEK 1955, p. 69.

Meandroid colonies. Columella of interlacing trabeculae. Prominent septa with paliform lobes. Walls invariably grooved. Septa abt. 15 per cm. Valleys seldom parallel, but mostly strongly curved.

CURAÇAO. Westcoast: ZMA 758. St. Martabaai: ZMA 261, 861, 862. Piscaderabaai: ZMA 260. Caracasbaai: ZMA 732, 749. Curaçao: RMNH 221.
BONAIRE. Slagbaai: HLM X1–156–9, X1–156–10.
KLEIN BONAIRE: PWH 1367; HLM X1–155–1, X1–155–2.
BERMUDA: HLM EC123, EC336.
SAN BLAS: HLM X1–121–16.
Antilles: RMNH 223, 224. American Sea: ZMA 265.

Distribution, see Fig. 32.

Probably the most restricted species of the genus *Diploria*. It does not occur in inner bays, and is found in the open sea in somewhat deeper water than the other *Diplorias*. It may be, however, abundant, especially at a depth of 10 m.
It often forms large boulders with a diameter of 1 m or more. As, in that case, the groove in the walls may be very broad and shallow, the colonies appear to be smooth spheres, grooved by strongly winding corallites. In smaller colonies the relative width of the groove in the walls varies greatly. One specimen (HLM X1–121–16) had a groove in the wall abt. three times as wide and deep as the corallites.

Colour of the living colony yellow or brown.

Genus **Manicina**

Manicina areolata (Linnaeus)

(Pl. XXXVa–b)

SMITH 1948, p. 86, pl. 19–21; SQUIRES 1958, p. 254, pl. 37 fig. 1–3; ALMY & CARRIÓN-TORRES 1963, p. 152, pl. 11b. – *non Maeandra areolata* VAN DER HORST 1927, p. 160.

Meandroid colonies, with mostly one main valley and several side valleys. Septa with paliform lobes, columella trabecular. Main valley lengthwise in colony, which is more or less oval in circumference. Short, central stalk at the underside.

ARUBA. Malmok: PWH s.n. Palm Beach: PWH s.n.
CURAÇAO: RMNH 405.
BONAIRE. Slagbaai: HLM X1–39–2, X1–156–19.
ST. MARTIN. Anse des Pères: ZMA 3734, 3735.
BERMUDA: RMNH s.n.
FLORIDA: RMNH s.n. HLM EC114, EC115.
HISPANIOLA. Haïti: RMNH 313.
PUERTO RICO: ZMA 854.
BARBUDA: PWH 1396.
MARTINIQUE: PWH 1439.
LOS ROQUES: HLM X1–11–19.
Antilles: ZMA 726, 731. Caribbean Sea: HLM EX252.

Distribution, see Fig. 33.

Generally restricted to flat, shallow and muddy bottom, where the coral lies loose on the sea floor. The St. Martin specimens are from a muddy bottom covered by the sea-grasses *Thalassia testudinum* and *Syringodium filiforme*, and from a shallow reef amidst other corals respectively, both from a depth of abt. 1.50 m. This agrees with the data in literature. Therefore the specimen from Bonaire (HLM X1–39–2), which comes from a depth of 14 m, is noteworthy.

Generally there is only one valley system in the colony. When there are more, then the general shape of the colony does not differ from those with only one valley system. The two or more systems are not interconnected.

The colour of the living colony is brownish, with a green oral disc in the specimen of the mud flat of St. Martin, and complete brown in the reef specimen.

Genus **Colpophyllia**

Colpophyllia natans (Muller)

(Pl. XXXIIIa–b)

VAN DER HORST 1927, p. 160 (sub *Maeandra areolata*); SMITH 1948, p. 86, pl. 18; ALMY & CARRIÓN-TORRES 1963, p. 153, pl. 12b; ROOS 1964, p. 11; ROOS 1969, p. 12. – HASS 1941, pl. p. 148 bottom; HASS 1947, pl. p. 257; HASS 1955, p. 114.

Meandroid colonies, septa with paliform lobes, abt. 10 per cm, often less, but sometimes more. Linkage lamellar. Walls invariably grooved.

CURAÇAO. Westpuntbaai: ZMA 223, 276. St. Martabaai: ZMA 219, 220. St. Michielsbaai: ZMA 222. Spaanse Water: ZMA 732, 734, 735. Curaçao: ZMA 725, 739; ZMU 4; RMNH 308–310, 314, 317.
BONAIRE. Slagbaai: HLM X1–52–2, X1–53–5.
PUERTO RICO: ZMA 853.

Distribution, see Fig. 34.

Generally present at a depth of less than 35 m. Also in inner bays. Scattered on open bottom attached to pieces of dead coral, or abundant on the reef.

When attached to coral shingle, the colony mostly spreads from the point of attachment, often with a short central stalk. When abundant on the reef, the colonies are often large spherical boulders, with a diameter of 1 m or more.

The colour of the living colonies varies between yellow and brown or olive, sometimes with bright green valleys.

Family RHIZANGIIDAE

KEY TO GENERA OF RHIZANGIIDAE IN THE NETHERLANDS ANTILLES

1a. Corallites are cylindrical tubes of less than 0.5 cm in diameter, and about 6 mm high. Corallites mostly crowded, and connected at their bases . . . . . *Astrangia*

1b. Cylindrical corallites up to 1 cm across, and 5 mm or more high. Corallites not very crowded, but mostly interconnected . . . . . *Phyllangia*

Genus **Astrangia**

Astrangia solitaria (Lesueur)

(Pl. XXXIVa–b)

VAN DER HORST 1927, p. 159; SMITH 1948, p. 91; ALMY & CARRIÓN-TORRES 1963, p. 155, pl. 15a.

Corallites cylindrical, up to 0.5 cm in diameter and abt. 6 mm high. Four cycles of septa with small teeth, the first two cycles reaching the columella. Low but distinct costae present. Corallites often crowded and connected at their bases.

CURAÇAO. Spaanse Water: ZMA 562, 172, 174–179.
BONAIRE. Palu Lechi: PWH 1056Ba, 1056C.

From the Netherlands Antilles only the above mentioned museum specimens are known to the author.

The corallites are attached to rock or dead parts of other corals.

Phyllangia americana Milne-Edwards & Haime

(Pl. XXXVIa–b)

VAN DER HORST 1927, p. 159; ALMY & CARRIÓN-TORRES 1963, p. 156, pl. 15b.

Corallites cylindrical, up to 1 cm in diameter and somewhat more in height.

CURAÇAO. Spaanse Water: ZMA 951–954, 1091, 1092.
BONAIRE. Slagbaai: HLM X1–47–4.

From the Netherlands Antilles only the above cited museum specimens are known to the author.

The corallites are attached to hard surfaces.

Family OCULINIDAE

Genus **Oculina**

Oculina valenciennesi Milne-Edwards & Haime

(Pl. XXXVII)

SMITH 1948, p. 91.

Loosely branched, straggling bushy colonies. Main branches up to 1 cm or more across. On older branches corallites more than 5 mm apart, abt. 4 mm in diameter and perpendicular to the surface of the colony. At the tips of the branches the corallites are more crowded and oblique. Peritheca with fine costal striae.

CURAÇAO. St. Michielsbaai: ZMA 3747.
BERMUDA: HLM EC137.

From the Netherlands Antilles only the colonies from St. Michielsbaai are known (Fig. 35).

These colonies grow at a depth of 6 m, on a flat rocky terrace with patches of sand.

The colour of the living colony is yellow.

Family TROCHOSMILIIDAE

KEY TO GENERA OF TROCHOSMILIIDAE IN THE NETHERLANDS ANTILLES

1a. Corallites mono- to tricentric, round or elongated but never branched valleys . . . . . *Dichocoenia*
1b. Corallites mono- to polycentric, meandroid. 2

2a. Valleys discontinuous, mono- to polycentric and up to 0.5 cm wide. Walls flattened with shallow groove. Colony encrusting when young, older colonies form thick and high columns . . . . . *Dendrogyra*
2b. Valleys often continuous, polycentric and up to 1 cm wide. Walls not flattened, but sometimes with distinct groove. Colonies encrusting, discoid or hemispherical boulders . *Meandrina*

Genus **Meandrina**

Meandrina meandrites (Linnaeus)

(Pl. XLa–b)

VAN DER HORST 1927, p. 160; SMITH 1948, p. 92, pl. 29; ALMY & CARRIÓN-TORRES 1963, p. 156, pl. 16b; ROOS 1964, p. 12, fig. 2, pl. 10; ROOS 1969, p. 12.

Meandroid colonies, with smooth septal margins and without paliform lobes. Width of the valleys abt. 1 cm. Larger and smaller septa alternate, the smaller ones may be absent. Abt. 7 larger septa per cm. Walls rarely with distinct groove.

ARUBA. Malmok: PWH s.n.
CURAÇAO. Westpuntbaai: ZMA 759, 760, 864. Kaap Malmeeuw: ZMA 801. Piscaderabaai: ZMA 809, 865. Curaçao: ZMA 762, 948; ZMU 1.
BONAIRE. Slagbaai: HLM X1–30–1, X1–31–3, X1–54–8, X1–55–7, X1–156–17, X1–156–18.
MARTINIQUE: PWH 1439.
SAN BLAS: HLM X1–121–15.

Distribution, see Fig. 36.

Not rare at the leeside of the islands. Not occurring in landlocked bays. Lower depth limit abt. 25 m. The apparent absence of this coral in Saba and St. Eustatius is peculiar.

Near its lower depth limit the colonies are discoid in a horizontal direction, in submarine caves (e.g. Lagún at Curaçao) it is slanting discoid. Colonies mostly spherical or hemispherical.

Colour of the living colony yellow or brown, white tentacles expanded at night.

Genus **Dendrogyra**

Dendrogyra cylindrus Ehrenberg

(Pl. XXXVIII–XXXIX)

SMITH 1948, p. 94, pl. 32–33; ALMY & CARRIÓN-TORRES 1963, p. 157, pl. 17b; ROOS 1964, p. 13. – HASS 1941, pl. p. 53, 96 bottom, 132 bottom; HASS 1947, pl. p. 240; HASS 1954, pl. p. 112 bottom; HASS 1955, p. 93.

Meandroid colonies with smooth septa. No paliform lobes. Larger septa inclining to lamellar columella. Lamellae of columella often short, looking like mere loose trabeculae. 7 to 10 septa per cm. Walls flattened with shallow and narrow groove. Distance between walls abt. 5 mm.

CURAÇAO. St. Michielsbaai: ZMA 247. Piscaderabaai: ZMA 246. Curaçao: ZMU s.n.; RMNH 404.
BAHAMAS: RMNH 557.

Distribution, see Fig. 37.

Common at the leeside of the leeward islands. Not occurring in landlocked bays, or directly in front of their mouths. Not deeper than abt. 10 metres.

The young colonies are encrusting, but the older ones develop heavy vertical columns, which may attain a height of 2 m or more. This is the only Antillean coral known to the author which expands its tentacles in daytime too.

Colour of the living colony dark brown. The outstanding tentacles give the colony a hairy appearance.

Genus **Dichocoenia**

Dichocoenia stokesii Milne-Edwards & Haime

(Pl. XLI, XLII, XLIII)

VAN DER HORST 1927, p. 159 (sub *D. porcata*); SMITH 1948, p. 93, pl. 31; SQUIRES 1958, p. 257, pl. 34 fig. 4; ALMY & CARRIÓN-TORRES 1963, p. 157, pl. 17a; ROOS 1964, p. 13; ROOS 1969, p. 12.

Massive colonies, corallites mono- to tricentric. Monocentric corallites round, other ones elongated, up to 5 cm long and 5 mm wide. Generally not longer than 1.5 cm. Tricentric corallites sometimes triangular or Y-shaped. Corallites exsert and costate, separated by granulated or vesiculate peritheca.

CURAÇAO. Westpuntbaai: ZMA 252. Plaja Hulu: PWH 1023A. St. Martabaai: ZMA 253. Piscaderabaai: ZMA 248–251, 592; RMNH s.n. Caracasbaai: ZMA 257. Fuikbaai: PWH 1038, 1039.
KLEIN BONAIRE: PWH 1049A.
BAHAMAS: RMNH 239.

Distribution, see Fig. 38.

To be found in various localities, from the mangroves of landlocked bays, to the reef in open sea. Common at depths less than 25 m. Horizontally discoid between a depth of 25 and 30 m.

Generally in hemispherical colonies of abt. 10 cm across, but, especially on the outer reef, also in boulders with a diameter up to half a metre. Often these large boulders have long corallites (several cm) at their sides.

Colour of the living colony yellow, or brown with yellow polyps.

Family MUSSIDAE

KEY TO GENERA OF MUSSIDAE IN THE NETHERLANDS ANTILLES

1a. Corals solitary . . . . . *Scolymia*
1b. Corals colonial 2

2a. Branched, phaceloid colonies . . . . . *Mussa*
2b. Colonies not branched 3

3a. Colonies cerioid; when dicentric linkage of loose trabeculae . . . . . *Isophyllastrea*
3b. Colonies meandroid 4

4a. Linkage trabecular. Walls enclosing series of corallites . . . . . *Isophyllia*
4b. Linkage lamellar. Walls discontinuous . . . . *Mycetophyllia*

Genus **Scolymia**

Scolymia lacera (Pallas)

(Pl. XLIVa–b)

VAN DER HORST 1927, p. 159, 160 (sub *Mussa lacera* + *Mussa* spec.); SMITH 1948, p. 96, pl. 23 (sub *Mussa angulosa*); WELLS 1964, p. 381, pl. 22 fig. 5–6; ROOS 1964, p. 13 pl. 7 (sub *Mussa lacera*); ROOS 1969, p. 12.

Center trabecular, lateral septal granulations sparse. Calices large, more than 4 cm, septa wholly dentate on margins.

CURAÇAO. Piscaderabaai: ZMA 866, 1459, 1463. Spaanse Water: ZMA 834, 835, 1100, 1399, 1458, 1461, 1462, 1464–1466. Curaçao: ZMU 11.
BONAIRE. Slagbaai: HLM X1–48–2, X1–53–8, X1–53–10, X1–56–16, X1–156–21.
CUBA: ZMA 823.
HISPANIOLA: Haiti, HLM EC118.
PUERTO RICO: ZMA 856.
LOS ROQUES: HLM X1–11–18.
West Indies: ZMA 820, 821. American Sea: ZMA 824.

In shallow water only found in the Spaanse Water in Curaçao. In deeper water, e.g. deeper than abt. 10 m, common along the coast of Curaçao, and probably also along the coasts of the other islands, at least those of the Leeward Group (cf. Fig. 39).

Generally occurring in the reef between 15 and 60 m deep. In Spaanse Water, a landlocked bay, it occurs at a depth of abt. only one metre. Comparison of this turbid water locality, and the localities in the open sea, shows that the integral amount of light in both localities is about the same, e.g. less than 60% of the light incident at the sea surface.

This is the only solitary Mussid coral in the Caribbean. Diameter of the coral up to 10 cm, usually about 6 cm. The specimens from Spaanse Water are less regular in circumference than those from the open sea.

The corals in the open sea are brightly coloured: often green, sometimes brown or red, and mostly with dark patches or concentric rings. The Spaanse Water specimens are dull brown.

Genus **Mussa**

Mussa angulosa (Pallas)

(Pl. XLV, XLVI)

SMITH 1948, p. 96, pl. 35 (in part); ALMY & CARRIÓN-TORRES 1963, p. 158, pl. 18a ROOS 1964, p. 13, pl. 8.

Large phaceloid colonies. Branches up to 5 cm across. Corallites mono- to tricentric, linkage trabecular. Septa with coarse teeth like

the costae, which run down the branches. Diameter of monocentric corallite up to 3 cm. Other corallites triangular, elongated or Y-shaped.

CURAÇAO. Piscaderabaai: ZMA 817, 867, 1456, 1457, 1461. Curaçao: ZMU8; RMNH 428.
BONAIRE. Slagbaai: HLM X1–39–1, X1–26–31.
MARTINIQUE. PWH 1439; ZMA 818.
America: RMNH 426, 427, 429.

In Curaçao it generally occurs at depths between 10 and 25 m. Probably this applies also to the other islands, at least those of the Leeward Group (cf. Fig. 40).

Between depths of 10 and 25 m on the reef in the open sea. It seems to be restricted to localities with abundant coral-growth. As the older branches are infested and eroded by boring organisms, this coral probably needs other corals as a support.

The living colony is completely covered by the fleshy polyps, adjacent ones touching each other.

The colour is pink, purple or brown.

Genus **Isophyllastrea**

Isophyllastrea rigida (Dana)

(Pl. XLVIIa–b)

SMITH 1948, p. 96, pl. 36; SQUIRES 1958, p. 258, pl. 41 fig. 3; ALMY & CARRIÓN-TORRES 1963, p. 158, pl. 18b; ROOS 1964, p. 16.

Colony cerioid. Corallites mono- or dicentric with linkage of loose trabeculae. Thin septa with coarse teeth.

CURAÇAO. Plaja Lagún: ZMA 333.
KLEIN BONAIRE: HLM X1–155–8.
SAN BLAS: HLM X1–121–17, X1–121–18.

Relatively rare in Aruba and Curaçao, more common in Bonaire and the Windward Group (cf. Fig. 41).

Scattered on not too densely populated reefs.

Mostly flat colonies, sometimes hemispherical boulders up to 15 cm across. The fleshy margins of the living polyps are pressed together, resulting in a polygonal appearance of the polyps.

Colour of the living colony pink or purple, with white oral discs.

Genus **Isophyllia**

Isophyllia sinuosa (Ellis & Solander)

(Pl. XLVIII, L)

SMITH 1948, p. 98, pl. 39; SQUIRES 1958, p. 257, pl. 40 fig. 4; ALMY & CARRIÓN-TORRES 1963, p. 159, pl. 20; ROOS 1964, p. 17.

Meandroid colonies, polycentric. Series of corallites completely enclosed by narrow walls. Septa with coarse teeth. Radial arrangement of corallites in young colonies. Trabecular linkage.

CURAÇAO. Westpuntbaai: ZMA 443.
KLEIN BONAIRE: HLM X1–155–4.
ST. MARTIN. Great Bay: PWH 1128A; ZMA 3736, 3737.
BERMUDA: HLM EC126, EC136, EC332–EC334.
FLORIDA: HLM EC117.
PUERTO RICO: ZMA 620, 684.
West Indies: ZMA 619.

Relatively rare in Aruba and Curaçao, common in Bonaire, very common and in some localities abundant, in the islands of the Windward Group (cf. Fig. 42).

Grows in shallow water, scattered among other corals, or scattered on the bottom without other corals, but never crowded.

Low, hemispherical colonies, up to 20 cm in diameter and 10 cm high.

Colour variable, in the Netherlands Antilles generally bluish-grey, with lighter oral discs.

Genus **Mycetophyllia**

Mycetophyllia lamarckana (Milne-Edwards & Haime)

(Pl. XLIX, LI)

SMITH 1948, p. 97, pl. 37–38; ALMY & CARRIÓN-TORRES 1963, p. 158, pl. 19a; ROOS 1964, p. 17; ROOS 1969, p. 13.

Meandroid colonies with lamellar linkage. Walls discontinuous. Low septa with coarse teeth.

CURAÇAO. Kaap Malmeeuw: ZMA 293. Piscaderabaai: ZMA 796, 799, 800. Curaçao: RMNH 408.
BONAIRE. Slagbaai: HLM X1–43–18, X1–40–6, X1–54–6, X1–54–7, X1–156–20.
SAN BLAS: HLM X1–123–14.

Distribution, see Fig. 43. Common along the islands of the Leeward Group, rare or absent in the Windward Group.

As a rule restricted to depths below 10 m. Lower depth limit abt. 30 m. In this zone very common, with flat colonies, which may be stalked or attached at one side to steep rocks or old parts of other corals. The flat colonies attain diameters to over 50 cm. Occasionally this species grows in water less than 10 m deep. Then the colony is hemispherical, with a diameter up to 50 cm.

The colour of the living coral in older colonies is blue or purplish, in young colonies also green or brown.

Family CARIOPHYLLIIDAE

Several species of this family occur in deeper water, or at the underside of other corals. These are mostly small and solitary species. On the reef there is only one conspicuous species of this family, which will be discussed below.

Genus **Eusmilia**

Eusmilia fastigiata (Pallas)

(Pl. LIIa–b)

VAN DER HORST 1927, p. 159; SMITH 1948, p. 99, pl. 41; ALMY & CARRIÓN-TORRES 1963, p. 160, pl. 21a; ROOS 1964, p. 17; VROMAN 1968, p. 53, 56, 60. – HASS 1941, pl. p. 148 bottom; HASS 1947, pl. p. 257 bottom; VENLO 1950, p. 30; HASS 1955, p. 128.

Phaceloid colonies with mono- to tricentric corallites. Diameter of monocentric, round corallites abt. 1.5 cm. Tricentric corallites triangular or Y-shaped. Septal margins smooth, costae running down the branches for several cm with fine and irregular teeth. Corallites in one, mostly hemispherical plane.

CURAÇAO. Westpuntbaai: ZMA 299, 306. St. Michielsbaai: ZMA 303. Kaap Malmeeuw: ZMA 297, 301. Piscaderabaai: ZMA 298, 300, 868. Punta Caballero: ZMA 324. Spaanse Water: ZMA 304. Curaçao: ZMU 10; RMNH 325, 328.
BONAIRE. Slagbaai: HLM X1–25–35, X1–26–2, X1–40–5, X1–52–1, X1–53–12, X1–156–13.
BERMUDA: RMNH s.n.
MARTINIQUE: PWH 1439.
Los ROQUES: HLM X1–11–14.
SAN BLAS: HLM X1–123–10.
American Sea: ZMA 294, 295.

Distribution, see Fig. 44.

Generally occurring on reefs at the leeside of the islands, common at a depth of abt. 10 m. Lower depth limit 35 m. Not in exposed localities. Present, but relatively rare, in landlocked bays, even among mangrove roots.

Colonies scattered among other corals. Diameter of the colonies up to 30 cm.

Colour of the living colony mostly bright yellow, but sometimes brown. Tentacles white.

Family DENDROPHYLLIIDAE

Genus **Tubastraea**

Tubastraea tenuilamellosa (Milne-Edwards & Haime)

(Pl. LIII)

BOSCHMA 1953, pl. 9–11 (sub *Tubastraea tenuilamellosa*); ALMY & CARRIÓN-TORRES 1963, p. 161, pl. 21b (sub *Tubastrea aurea*); ROOS 1964, p. 17.

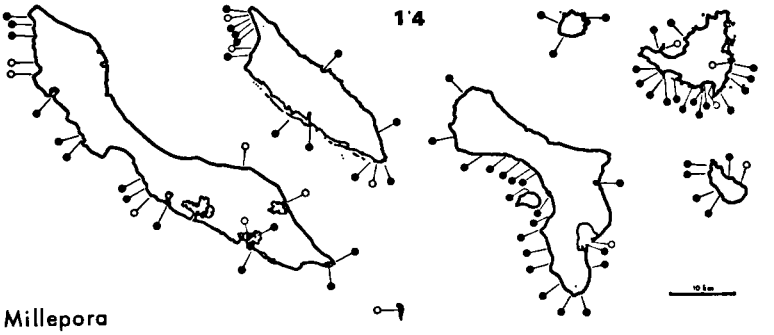
Corallum porous and fenestrate. Corallites generally protruding except sometimes in young colonies. Diameter of most corallites abt. 1 cm, sometimes more. Generally three cycles of septa reaching columella, which lies very deep as a rule. In large corallites four cycles of septa reaching columella.

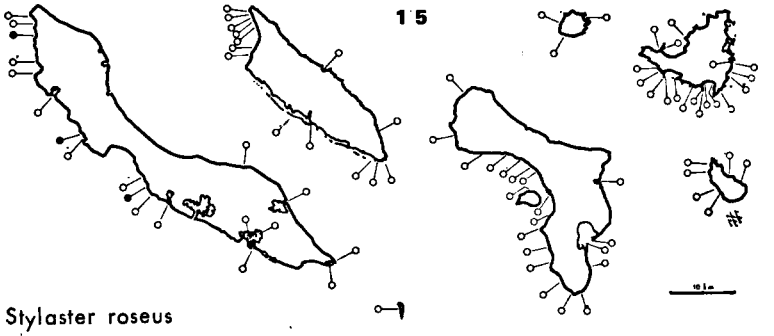
ARUBA. Eagle wharf: a great number of colonies in the RMNH collection, PWH 1302 (figured in *Stud. fauna Cur. 12*, pl. 12).
CURAÇAO. St. Martabaai: PWH s.n. St. Michielsbaai: ZMA 1111a. Piscaderabaai: ZMA 1111b. Caracasbaai: PWH 1334.
BONAIRE. Slagbaai: PWH 1380.
KLEIN BONAIRE: PWH 1369; HLM X1–137–3, X1–155-3.

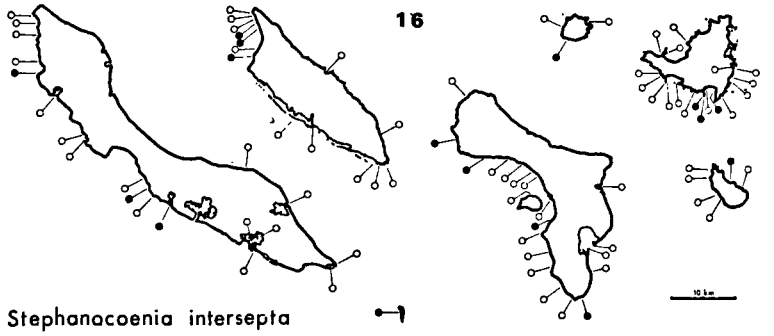
Distribution, see Fig. 45. In the Windward Islands only a few young colonies were found in Saba.

During the last years, this coral seems to lose its preference for shady localities. It is often abundant at steep rocky slopes, just below the waterline, in the shadow of a cliff. However, it may be found on boulders in the sun too.

This striking orange and red coral abounds in the Leeward Islands of the Netherlands Antilles, but up till now, there have been few observations from other Caribbean islands. It has been mentioned from Jamaica (GOREAU 1959), Puerto Rico (ALMY & CARRIÓN-TORRES 1963), Saba, Barbados (LEWIS 1960), Bonaire, Curaçao and Aruba. It seems to be abundant in the last three islands only. The first record of this coral for the Caribbean region, is from 1943, Puerto Rico (see BOSCHMA 1953). The abundance in Curaçao has markedly increased during the last years. It is interesting in this respect that in 1959 GOREAU reported this coral from Jamaica as sometimes found in restricted localities, but that GOREAU & WELLS (1967) mention it from the same island as common, patchy.







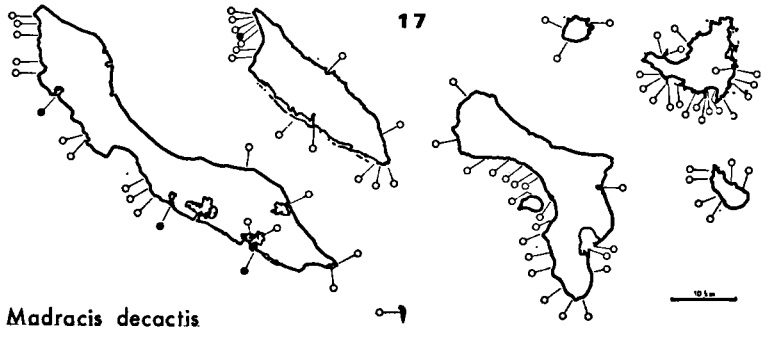


Fig. 14–17. Distribution of *Millepora, Stylaster roseus, Stephanocoenia intersepta* and *Madracis decactis*.

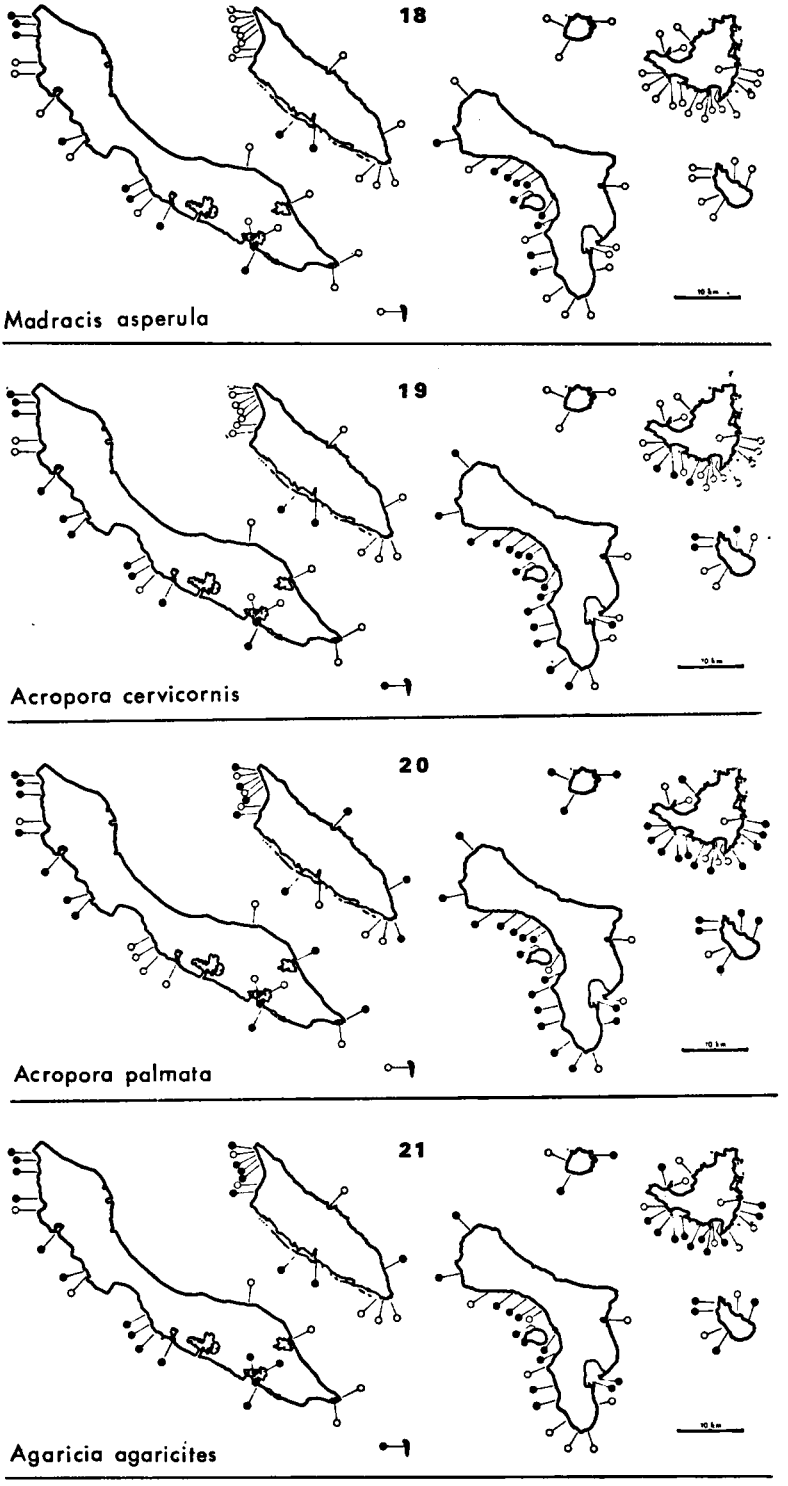
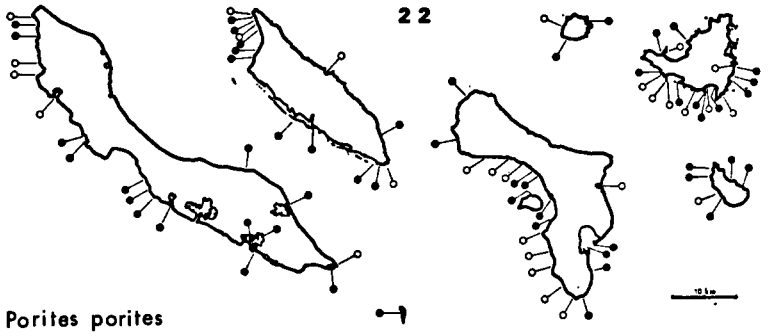
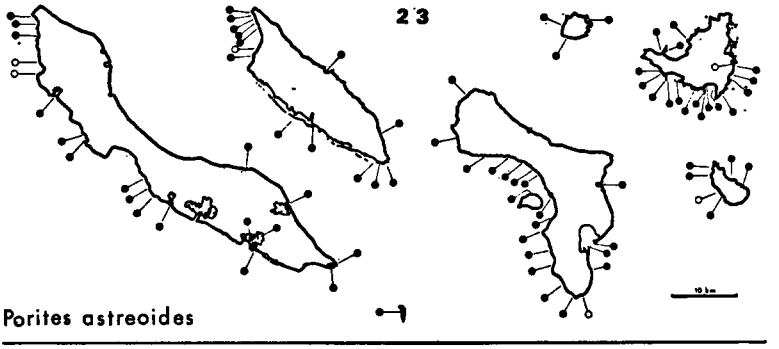
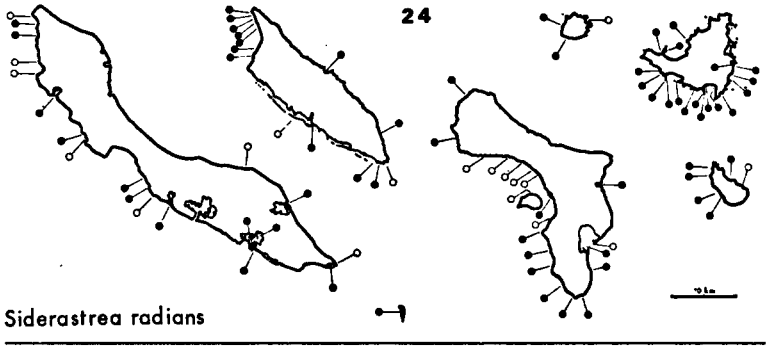


Fig. 18–21. Distribution of *Madracis asperula, Acropora cervicornis, Acropora palmata* and *Agaricia agaricites*.







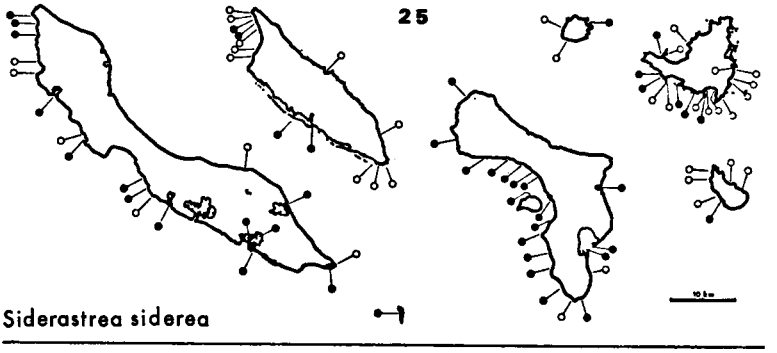
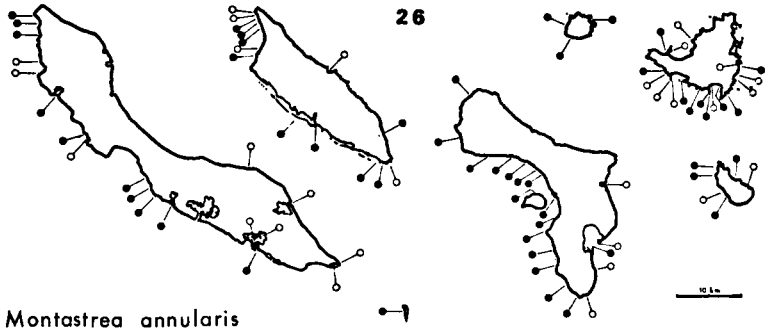
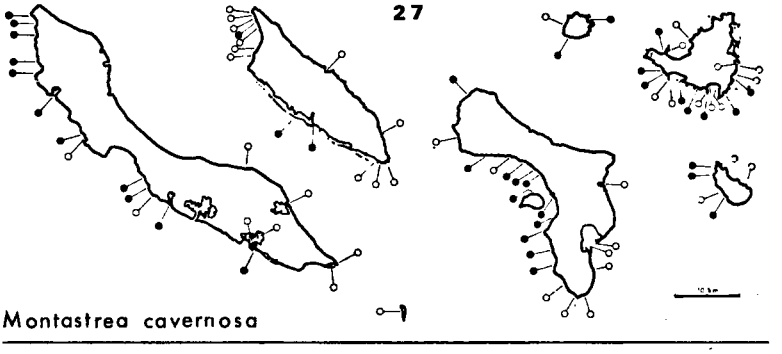
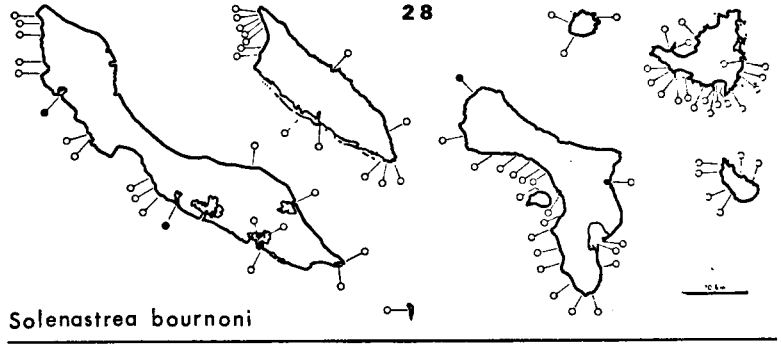


Fig. 22–25. Distribution of *Porites porites, Porites astreoides, Siderastrea radians* and *Siderastrea siderea.*







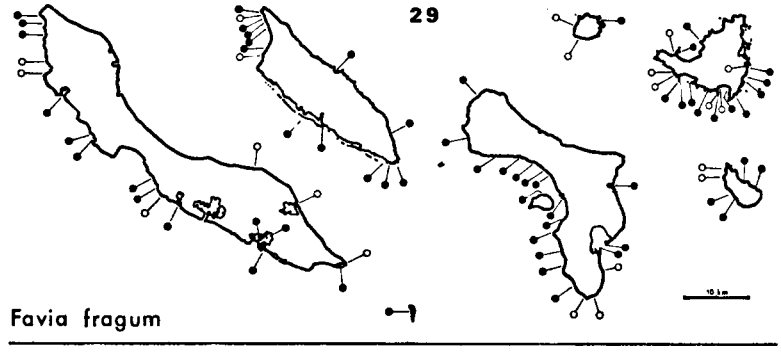


Fig. 26–29. Distribution of *Montastrea annularis, Montastrea cavernosa, Solenastrea bournoni* and *Favia fragum.*

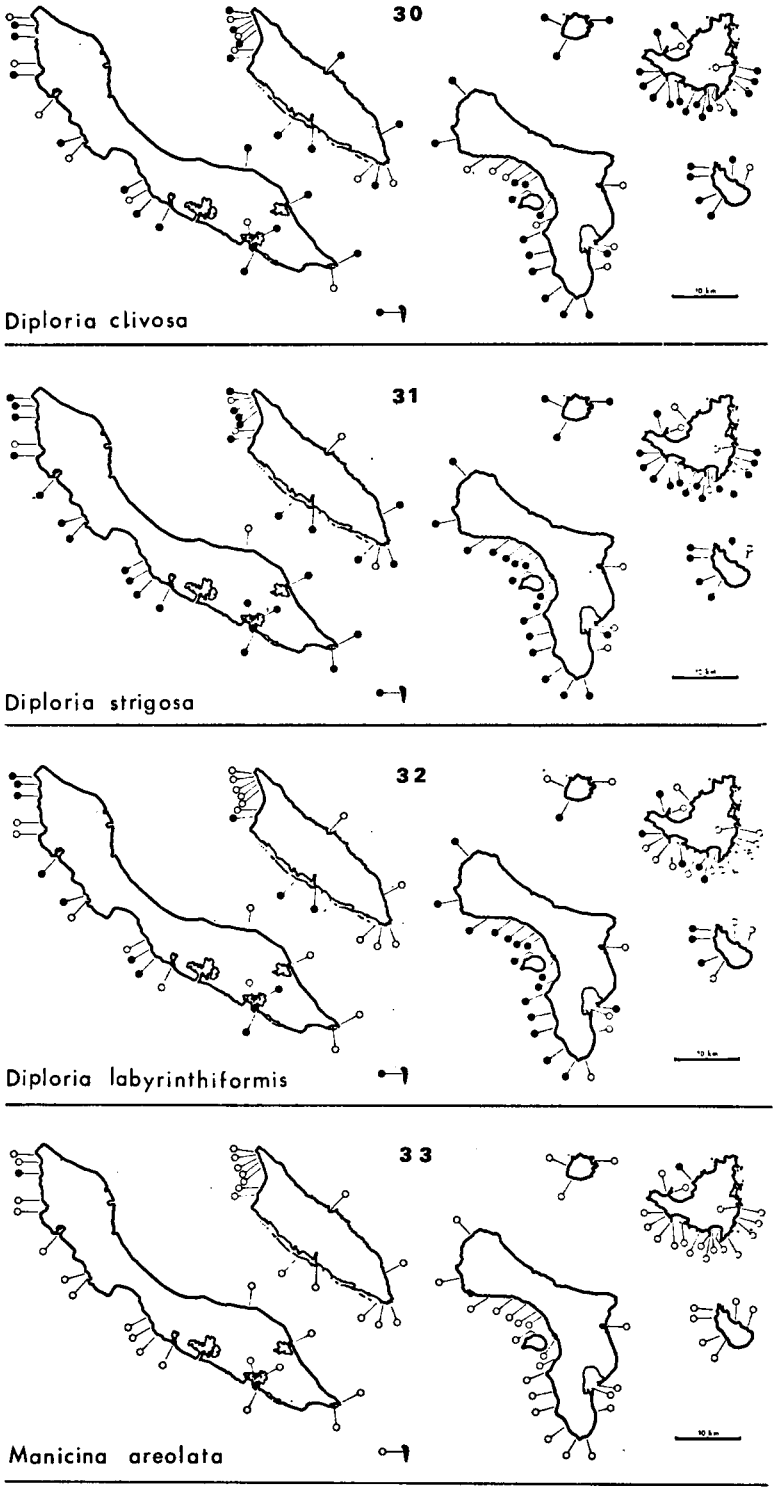
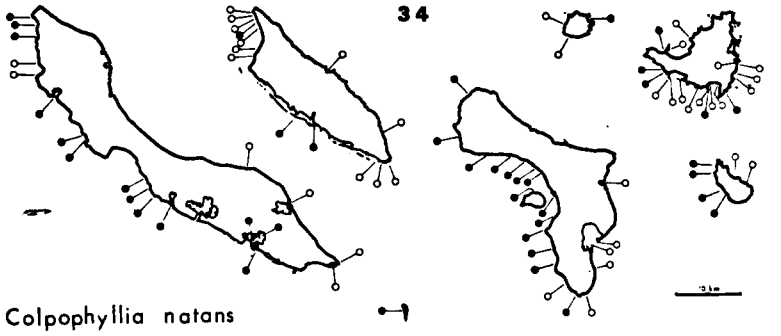
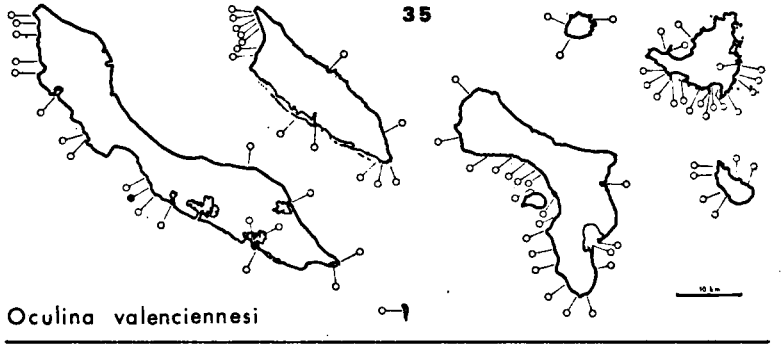
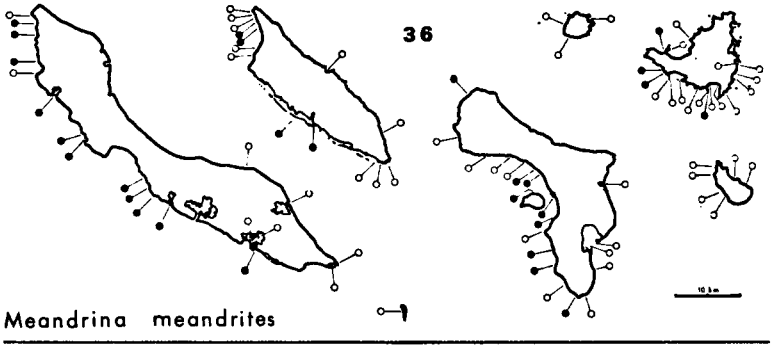


Fig. 30–33. Distribution of *Diploria clivosa, Diploria strigosa, Diploria labyrinthiformis* and *Manicina areolata.*







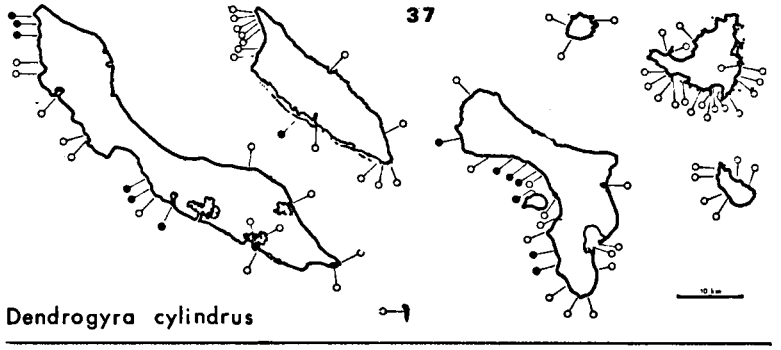
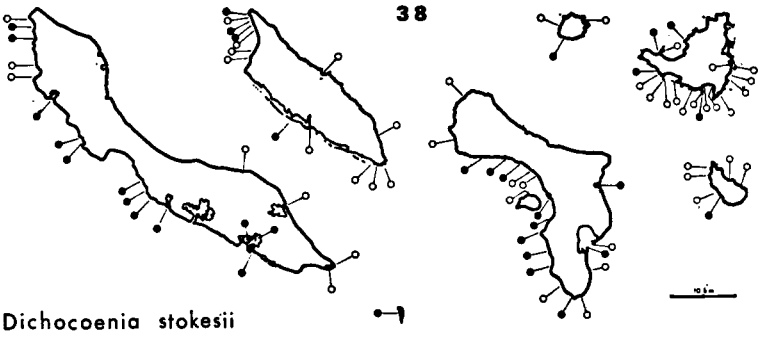
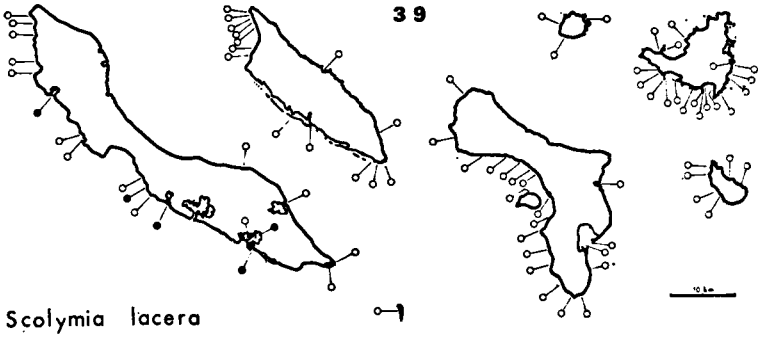
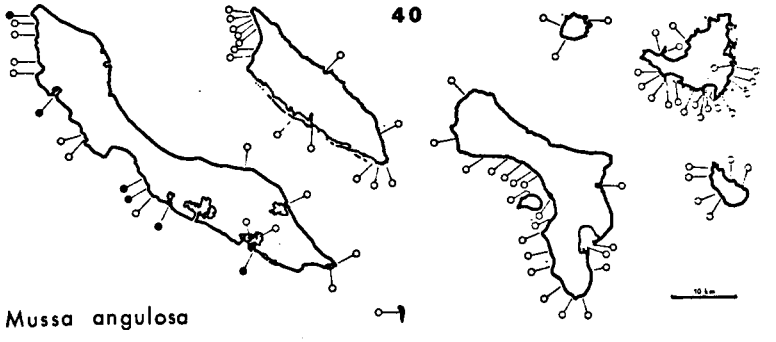


Fig. 34–37. Distribution of *Colpophyllia natans, Oculina valenciennesi, Meandrina meandrites* and *Dendrogyra cylindrus.*







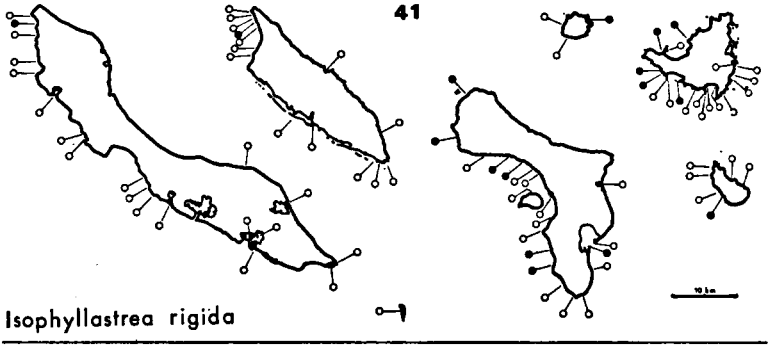


Fig. 38–41. Distribution of *Dichocoenia stokesii, Scolymia lacera, Mussa angulosa* and *Isophyllastrea rigida.*

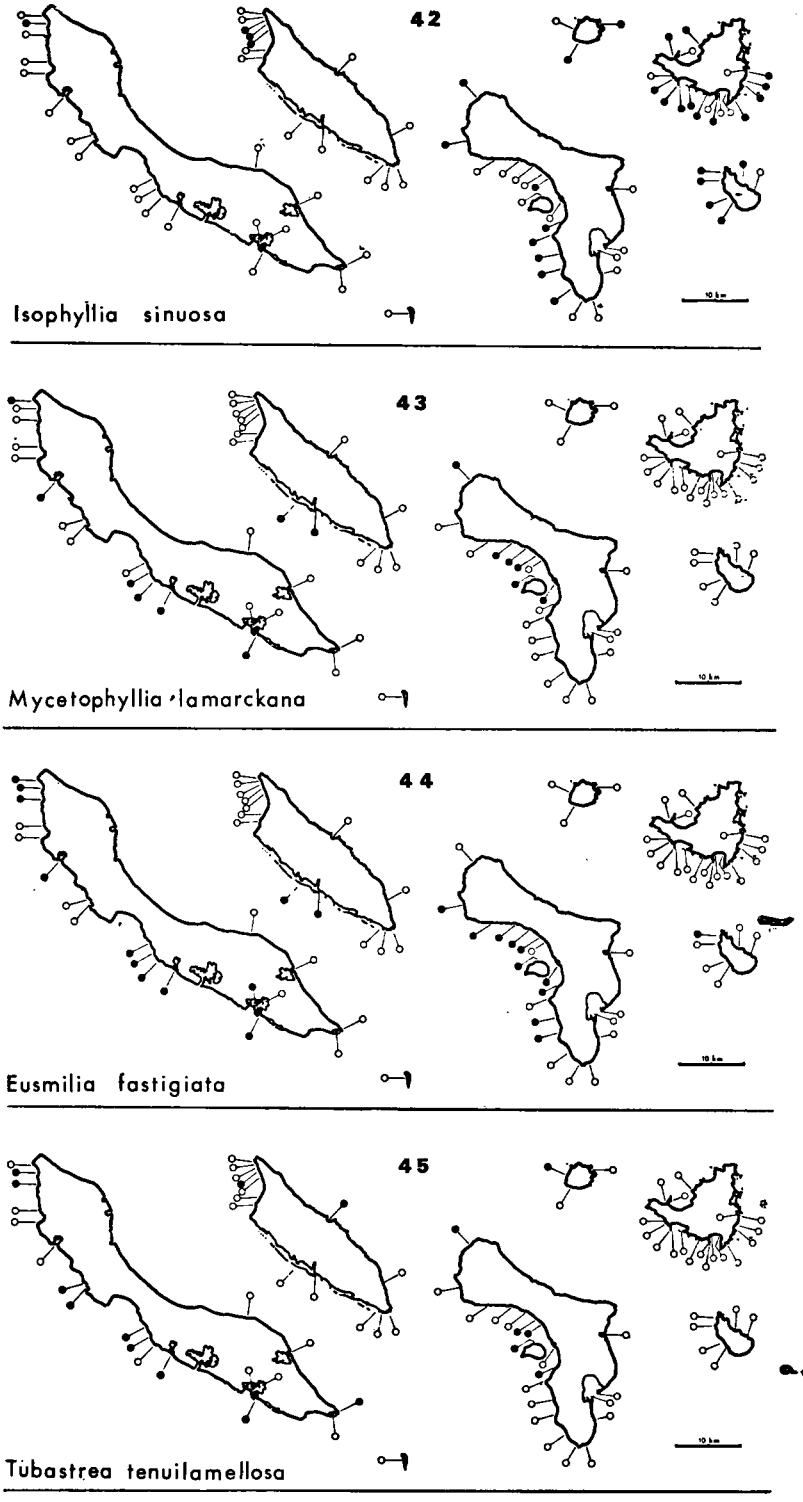


Fig. 42–45. Distribution of *Isophyllia sinuosa, Mycetophyllia lamarckana, Eusmilia fastigiata* and *Tubastrea tenuilamellosa.*

NOTES ON REEF CORAL ECOLOGY IN THE NETHERLANDS ANTILLES

In this chapter some aspects of general reef coral ecology will be dealt with, as far as they are not discussed as items of special interest in the description of localities or in the systematic description.

Localities are referred to by numbers by which they are indicated in the chapter dealing with the "Description of Localities."

In coral ecology environmental factors may affect the zonation or distribution of certain species, and may also affect the shape of a colony of certain individual corals. This double effect is most striking in factors with a directional effect such as light or water movement.

Light

The influence of light on the distribution of hermatypic scleractinian corals is well known. It restricts reefs of these corals to clear waters and to the uppermost parts of the seas and oceans.

As a decrease in light intensity is generally caused by an increasing turbidity, the influence of decreasing light-intensity is parallel to the influence of increasing silt content of the water. The silt not only causes a decrease of light intensity, it also has a disadvantageous effect in itself. Both factors, turbidity and silt, are responsible for the relative scarcity of corals and coral species in the inner bays and lagoons of Klein Lagoen (A 11), Piscadera inner bay (C 12), inner part of Spaanse Water (C 14), Awa di Oostpunt (C 16), Lac (B 18) and Oyster Pond (M 18).

If a coral is more restricted in its distribution by rate of light intensity than by presence of mud or silt, this coral when growing in deeper water in the clear open sea, may occur at shallow places in turbid water. This is illustrated by the distribution of the Mussid coral *Scolymia lacera*. This solitary coral is found along the entire open coast of Curaçao, from a depth of 10 metres to the lower limit of the reef near 50 metres. In Spaanse Water (C 14, 15), however, it may be found at depths from 1 to 2 metres. The light intensities in those quite different localities are about the same (Roos, 1964).

Only this coral appears to demonstrate the influence of light on zonation so well. It is the most sturdy coral of the region, solitary and most capable of ridding itself of silt (cf. ORR 1931).

However, also a number of other corals is markedly influenced by the intensity of light. According to GOREAU (1959), ROOS (1964) and the present study the massive corals *Montastrea annularis*, *Meandrina meandrites*, *Dichocoenia stokesii*, *Porites astreoides* and *Colpophyllia natans* shows a flattening of the colony in deeper water. Under optimal light conditions these corals attain a more or less hemispherical shape, but near their lower depth limit, and also near the surface in the shadow of rocks or other corals, as well as in niches or caves, these corals are flat. The living part of the colony is always directed to the light maximum. As ROOS (1967) demonstrated for *Porites astreoides*, in this case the shape of the colony only depends on the submarine radiance distribution. In the field this is clearly demonstrated around the smaller islands in Spaanse Water (C 14), where *P. astreoides* occurs in niches and on the shallow flat rocky

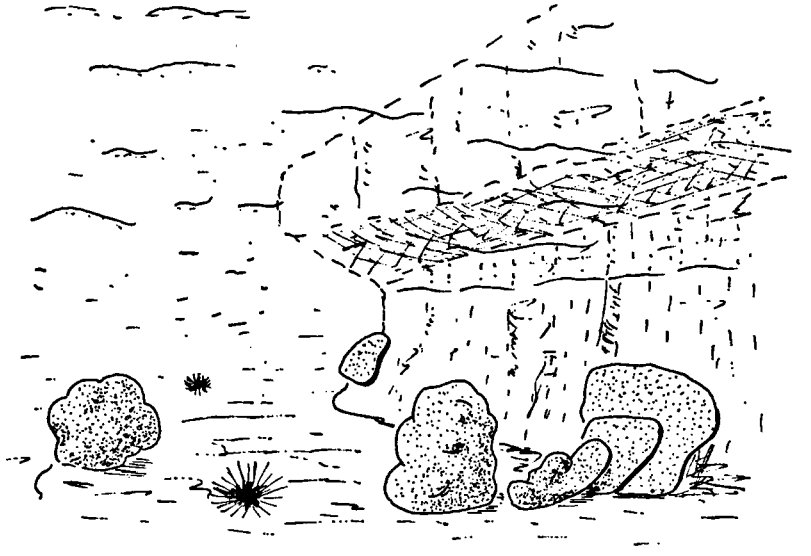


Fig. 46. Colonies of *Porites astreoides* in and near a niche (surf notch) at an island in Spaanse Water, CURAÇAO, showing influence of light distribution on shape of colony.

bottom in front. There the transition from spherical colonies to flat plates is visible over a distance of about half a metre (Fig. 46).

In Curaçao *Mycetophyllia lamarckana* occurs mainly between depths of of 40 to 10 metres, where it is very common. Sometimes it also may be found in less deep water, in the open sea (A 9, C 10, B 4, 5, 6). In the deep zone this coral is invariably flat, but at a depth of less than 10 m it is hemispherical. Here also there is a correlation between submarine radiance distribution and shape of the colony.

The growth forms of *Agaricia agaricites* must be mentioned too, which gradually merge into each other (Roos 1964). Small roundish colonies occur in very shallow water. At a depth of 10 metres the colonies are leaf shaped, with polyps at both sides of the colony. In deeper water they consist of large vertical scales, sometimes very thin, with polyps at one side of the colony only. This flattening is not comparable to that of the other corals. It is remarkable that these vertical colonies extend to greater depths (over 50 metres) than do the horizontally flattened colonies.

Water movement

Just like radiance distribution, water movement has two effects on coral growth. Firstly a general limiting effect and secondly an effect on the shape of colonies of certain species.

Generally encrusting, low or heavy branched forms are found in exposed localities on surf swept coasts (A 13, 14, C 17, 19, B 20, S 3, E 6). At unexposed localities or along the leeside of the islands also more fragile and delicately branched colonies occur. However, there too massive and heavy colonies are the most important reef builders.

Most adapted to surf conditions are encrusting colonies of *Diploria clivosa* and *Porites astreoides*. Also encrusting or low and heavy *Acropora palmata* is generally present in exposed localities. At the islands of the Windward Group also *Isophyllia sinuosa* occurs in somewhat sheltered places. Crevices in the bottom may contain blunt *Porites porites*.

The directional effect of water movement on colony shape is clearly demonstrated by *Acropora palmata*. This extremely variable species occurs in the breakers as well as in sheltered areas at the

leeside. In quiet water this *Acropora* develops into a tree-like colony, with a short broad stem and flat branches spreading in all directions. There is some variation in the mode of branching. Sometimes the branches are located in one plane, more or less grown together to nearly circular or lobated colonies, sometimes the branches are more upright and separated. In very shallow water, or in extremely rough conditions this coral remains encrusting.

In the narrow connection between the St. Jorisbaai (C 18) and the sea at the north coast of Curaçao, extremely streamlined colonies are found. In this bottle-neck formed mouth the alternating tidal currents cause *Acropora* to grow in elongated forms, parallel to the narrow entrance. The colonies are symmetrical, with a supporting stem in the middle. At the same coast, but in exposed embayments (C 19) the turbulence of the water causes *Acropora palmata* to grow into a flat screwlike shape (Roos 1964). Also in places somewhat deeper than a normal reef, but surrounded by it, screw-shaped colonies are to be found.

At the N.E. coast of St. Eustatius (E 6) heavy breakers roll out on a flat sandy beach. There *Acropora palmata* occurs in a shape resembling some trees which acquire a similar form under influences of the tradewind. They are scattered, heavy colonies on an inclining stem, with thick branches, all pointing to the coast. Similar forms were described by Shinn (1964) from the Florida Keys, where they form the bulk of the outer *Acropora* reefs in at least two localities. The colonies of *Acropora palmata* do not show any mechanical damage. It is therefore not likely that the mechanical force of the water is directly responsible for the streamlining. Probably the growth conditions are more favourable at the lee-side of the colony. As the transport-capacity of the water is proportional to its speed, prey catching is easier at the lee-side of the colony, which is also the case for diffusion of metabolites. This explanation also holds good for short and blunt colonies or colonies in holes and crevices along coasts where rollers and breakers come in. Lee-side localities, where water transport is at a minimum, also are most favourable for the settling of the planula larvae.

Under constant ecological conditions coral growth is adapted to the special conditions of the localities. Encrusting or heavy corals

occur predominantly at the windward sides of the islands, more fragile species flourish at the leeward sides. The conditions are very constant indeed, especially in the islands of the Leeward Group. The islands of the Windward Group are from time to time subjected to hurricanes passing at smaller or greater distance. Therefore fragile reefs of some extent do not occur here. But even here *Acropora palmata* may be found, dead and overturned by wave action, sometimes proliferating from their original underside (M 17). Similar overthrowing and overturning is reported from the Alacran Reef, Gulf of Mexico (KORNICKER & BOYD 1962) and from Jamaica (GOREAU 1959).

When, as rarely happens, a hurricane passes North of the islands of the Leeward Group, the consequences are worse. Typical for the lee-sides of these islands are large reefs of the fragile *Acropora cervicornis*. The passage of a hurricane causes the wind to turn to an opposite direction. Especially the *Acropora* reefs suffer and are broken down by the surf on the south and east coasts of the islands. Sometimes they recover (C 6), sometimes they do not (A 9, B 2).

SUCCESSION

The broken *Acropora* reefs are probably killed by severe pollution with mud, driven into the sea from inner bays by heavy rains accompanying the hurricane. Lowering of the osmotic pressure through the rain alone does not kill the corals (GOREAU 1964).

As is shown at Plaja Frans (B 2) and to some extent also at Mangel Altu (A 9) the dead branches of *Acropora* offer a substrate for massive corals that suffered less from the disaster which killed the branched corals. The area was recolonized by several species of which *Montastrea annularis* is the most important. In Jamaica recolonization takes place especially by *Diploria strigosa* (GOREAU 1959). The locality which is no longer suited for the development of great reefs of *Acropora*, favours the growth of massive Scleractinians and hydrocorals of the genus *Millepora*.

It appeared to be impossible to estimate the amount of time needed for recolonization. Reefs described from Bonaire (B 2) and Aruba (A 9) may have been killed on the same occasion. Recoloni-

zation in Bonaire, however, has proceeded much farther than in Aruba. This may be explained by the greater pollution in Aruba with its refinery and more intensive shipping-traffic. It is clear, however, that stony and rocky bottoms are colonized more easily by massive corals like *Montastrea* and *Diploria* than by *Acropora*. The latter seems to flourish on a sandy bottom, where it grows on patches of hard rock or limestone, partly covered by sand.

Along the coasts of the islands of the Leeward Group there is a distinct zonation of Acropora. The upper zone is always occupied by *Acropora palmata*. The uppermost colonies are often crowded and dead. They are cemented together by calcareous algae and *Millepora*. As indicated in Fig. 10 (B 5) there is a succession in the overgrowing of the *Acropora* colonies reaching the water surface. According to SHINN (1964) *Acropora* at the Florida reefs dies from crowding. This is apparently not the main reason in Bonaire. Only the *Acropora* colonies growing in very shallow water and reaching the sea surface are killed and overgrown. Colonies in deeper water, as crowded as the others, but not reaching the surface, are apparently healthy. However, the *Acropora palmata* reef at the entrance of the Spaanse Water in Curaçao (C 13, Fig. 9) which does reach the surface but stands in a few metres of water is healthy. Apparently constant pollution with upwhirling sediment in shallow water kills the colony.

Crowding may play a part in accumulating loose sediment between the colonies, as crowding greatly decreases water circulation around and between the colonies. The crowded and apparently unhealthy *Acropora* colonies are overgrown just below the water surface by *Zoanthus* and *Palythoa* (cf. GOREAU 1959). When they reach the surface these zoantharian sea anemones are replaced by *Millepora* and calcareous algae cementing the upper branches of the *Acropora* colonies together, thus forming a platform just at or above the water surface.

GROWTH RATE

Artificial submarine objects offer the possibility to learn something about growth rates of young colonies. The time of submersion has to be known, there must be an indication that colonization took

place immediately after submersion and that coral growth has not been disturbed by factors like ageing or crowding.

At Palm Beach (A 6) and Oranjestadbaai (E 3) comparable iron objects are to be found on a sandy bottom. Five and a half years before the locality was visited, a diving-tower was erected at the Aruba Palm Beach Club (A 6). In St. Eustatius the motor vessel "Quo Vadis" (E 3) sunk 10 years before the present author studied the corals of the island. On the deck of the ship as well as on the diving-tower a number of massive corals are to be found. As the diameter of all the colonies on the tower is about 5½ cm, and on the ship 10 cm, it may be inferred, first, that both iron objects were colonized shortly after their submersion, and secondly, that the annual increase of diameter of the colony amounts to one centimetre. This does not agree with observations on the Alacran Reef (KORNICKER & BOYD 1962). There only older wrecks are covered by coral colonies which are of variable size.

Notes in the field station of the Natural Science Study Group of the Netherlands Antilles indicate that at Sta. Martabaai (C 6) tips of recovering *Acropora cervicornis* after storm-damage grow several centimetres per year.

DISTRIBUTION AND ZONATION

As pointed out, light distribution, turbidity and wave action are important with regard to coral growth and therefore to coral distribution.

As has been demonstrated for Curaçao (ROOS 1964) coral growth in deeper water, i.e. deeper than 10 m, does not show much variation. As those depths are beyond the scope of this paper, only the variation above that depth will be considered here.

Because of differences in the general topography, especially as regards the slope of the bottom around the islands, there are striking differences between Curaçao and Bonaire at one side and Aruba and the islands of the Windward Group at the other.

Curaçao and Bonaire are surrounded by a submarine terrace, sloping down to about 10 m. For the greater part this is covered with sand. At some places the underlying rock comes to the surface.

Here reef formation takes place. This is especially the case at the edge of the terrace and at the steep slopes, where sediment is absent. The same holds good for the foot of the cliffs which rise above sea level. Therefore at Curaçao and Bonaire the coast has two important zones of coral growth: the foot of the cliffs constituting the coast of the islands at a depth varying from sea level to 3 m, and the edge of the submarine terrace at 10 m. The latter locality is the richest, for there all shallow water species are to be found together with species which are confined to deeper water like the mussid corals *Scolymia lacera, Mussa angulosa* and *Mycetophyllia lamarckana.* Also species of *Madracis* are limited to that depth; obviously these corals are confined to lower light intensities. As already pointed out, only *Scolymia lacera* is able to live under the same light conditions in polluted water. At the foot of the cliffs these mussids are replaced by *Isophyllastrea rigida* and *Isophyllia sinuosa.* The latter species is abundant on the patchy reefs of the islands of the Windward Group. This is in striking contrast to the situation in the islands of the Leeward Group. This distribution is contrary to that of *Tubastrea tenuilamellosa* which occurs on all islands of the Leeward Group, commonly to abundantly, and is almost completely absent in the islands of the Windward Group. Other corals are common in the same degree at all eight islands.

The most important reef builders grow along the edge of the submarine terrace and at the outer reef in Aruba at the same depth: *Montastrea annularis,* and to a lesser extent *M. cavernosa.* On patchy reefs on a sandy bottom also *Diploria clivosa* and *D. labyrinthyformis* are important. In both localities *Diploria strigosa* or *Colpophyllia natans* may locally form the bulk of the reef.

In sandy areas in rather quiet water large reefs of *Acropora* occur. These are almost exclusive, with some undergrowth of smaller massive corals. Generally there is a reef of *Acropora cervicornis* at a depth of some metres, while the zone from the *cervicornis* reef to the surface of the water is occupied by *A. palmata.* Along the cliff at the lee-side more *Acropora palmata* than *A. cervicornis* is present.

From the above-mentioned corals only *Acropora palmata* and *Diploria clivosa* occur in exposed localities. Here *Acropora palmata* is often encrusting.

Large reefs of *Acropora cervicornis* which are characteristic for Curaçao and especially for Bonaire, are absent from the islands of the Windward Group. This is probably caused by the greater storm frequency as compared with the islands of the Leeward Group.

Aruba and the islands of the Windward Group correspond in depth and slope of the sea bottom and in not having a coast completely consisting of coral limestone and debris like Curaçao and Bonaire. Similar to all localities in the Windward Group, in Aruba corals may grow on scattered rock boulders (A 1, 3, 14). In other localities Aruba correlated with the other islands of the Leeward Group in having coral growth at the foot of a limestone cliff (A 4, 5, 7). In front of the sandy beaches at the west coast of Aruba there is some scattered coral growth amidst *Thalassia*.

Of the cliff localities especially Malmok is noteworthy (A 4). Despite the rather low number of colonies here, the number of species is considerably high. Coral growth is restricted to shallow water, at the steep sides and in holes and niches of a low cliff.

The most remarkable feature of Aruba is the presence of a well-developed barrier reef (A 8, 9) at a depth of about 10 m. It is somewhat comparable to the reefs along the edge of the steep slope at that depth in Curaçao and Bonaire. But there the heavy *Montastrea annularis* colonies are scattered, while in Aruba they are packed together over great distances. Scattered among the *Montastrea* colonies the other corals grow, as they do everywhere at that depth. The Aruba barrier reef is the only reef in the Netherlands Antilles where no sandy or rocky bottom is visible at all. At the NE side of Aruba (A 13) there is another barrier reef; it is, however, less developed and less conspicuous.

Comparable structures are absent in Curaçao, but in Bonaire the great lagoon of Lac is separated from the sea by a reef barrier (B 18). The base of this reef appears to be a continuation of the wall of coral debris surrounding the flat southern part of the island. Although the reef stretches like a barrier reef, it is only an accumulation of coral growth on the underlying rock of a drowned coast-line.

In the islands of the Windward Group reef development is relatively poor. Coral growth takes place at the foot of cliffs and on scattered boulders in front of it. Due to topographical and clima-

tological circumstances the localities on these islands show a more windward aspect than those on the other islands. Remains of a well-developed reef are found at the east side of St. Martin (M 16, 17). There old and bare *Montastrea annularis* colonies are present, corresponding to those described from Jamaica (GOREAU 1959) in the buttress zone. These colonies are 1–2 m high, somewhat rectangular, with canals in between, which are sometimes overroofed by the colonies. This buttress zone (GOREAU 1959, LEWIS 1960) or spur and groove formation (SHINN 1964), being rather common throughout the Caribbean, is nowhere present in recent coral formations in the Netherlands Antilles.

At Boca Bartól on Bonaire (B 1) great buttresses and canyons occur in one of the finest reefs of the Netherlands Antilles. Like the barrier of Lac the topography is not primarily due to coral formation, but to coral growth on a preexisting coastal shape. A number of parallel submarine limestone projections extend from the coast. The zonation on the steep slopes is remarkable. At the foot of the rock in deeper water a great number of colonies of *Mycetophyllia lamarckiana* is found, as flat as at the steep slopes of the submarine terrace surrounding the island. From the corals limited to deeper waters, in open sea *Mycetophyllia* occurs at the least deep limit of the living reef up to the water surface; here the zonation is not disturbed by pollution or turbidity accompanying a gradually sloping bottom. The abundance of so many species at this locality presents a distinct contrast to coral growth on a shallow bottom near the foot of a cliff, or in an inner bay or lagoon.

Only a few corals are able to grow in turbid water near the surface, like *Porites astreoides* and especially *Siderastrea radians*. The latter occurs near the low-water line at the muddy shore of the Curaçao inner bays (C 12, 15). Generally the colonies are attached to underlying stones or rock, but also loose lying *Siderastrea radians* colonies are to be found. Mostly they have the shape of a flat pancake. Sometimes they are round or globular, lying loose on the mud, without any sign of attachment and with living polyps at all sides. The slow turning over by wave action apparently does not prevent the polyps from cleaning themselves and keeping the colony alive.

VARIATION

As pointed out in the systematical part of this paper, there is a considerable variation in important characteristics like arrangement of septa and costae, number of pali and length of the series in a polycentric coral cf. *Agaricia agaricites, Porites astreoides, P. porites, Diploria clivosa* and *Dichocoenia stokesii*. There also is a great variation in growth form, cf. *Acropora cervicornis, A. palmata, Agaricia agaricites, Porites astreoides, P. porites* and *Mycetophyllia lamarckana*.

In contrast to the former, the latter type of variation is ecologically determined. The two types of variation together, which occur in *Agaricia, Porites* and *Acropora* make a distinction between species, variation and growth-form on purely morphological grounds obscure or even impossible. This gave rise to the old species problem in *Acropora* (cf. VERRILL 1902). The same problem in *Porites*, however, is no less confusing (cf. BERNARD 1906). Further development of underwater research will bring more and more different forms to light, thus increasing the systematical confusion. Therefore the great number of species of *Agaricia* in the "Revised list of Species... of the shallow water Scleractinia of Jamaica" (GOREAU & WELLS 1967) has to be interpreted with care. On the basis of observations made in different colonies of *Agaricia agaricites*, all present in the Amsterdam Zoological Museum, it is to be concluded that various parts of one and the same colony can easily be brought under various species names.

Flattening of colonies of *Porites astreoides* unsolvable by BERNARD (1906), is brought about by variation in submarine light distribution (ROOS 1967).

The different growth forms of *Porites porites* which are sometimes to distinguish the species, are also brought about by environmental circumstances (ROOS 1964), partly depending on depth of the water in the same way as pointed out for *Acropora cervicornis* by KORNICKER & BOYD (1962). They describe small bushy colonies which are limited to shallow water and normal *cervicornis* growing in deeper water, at about 5 feet.

The great problem in *Acropora*, however, is not the variation within the form easily distinguished as *Acropora cervicornis* or *Acro-*

pora prolifera, but the question as to whether the species really differ. Generally in the field there is no problem at all. Gross exploration of localities rich in *Acropora* (C 13, B 2, 4, 6, 7, 10, 13) shows a clear distinction between a lower reef of *Acropora cervicornis* and an upper reef of *Acropora palmata*. Closer observation, however, makes one feel less sure about the species distinction.

At the entrance of Spaanse Water (C 13) the outer colonies of the *Acropora palmata* reef have protuberances which are *cervicornis*-like. They exactly resemble the small bushy colonies growing in very shallow water in the same locality, and are indistinguishable from them when detached. Other *cervicornis*-like branches arise from *palmata* colonies at Goto (B 3). There is no disjunction in the skeleton nor in the living tissue. These parts of the *Acropora palmata* colonies are described as subvariety *surculo-palmata* (VERRILL 1902).

In Bonaire the lower *Acropora cervicornis* reef meets the upper *Acropora palmata* reef. In some places colonies of both species are inextricably entangled. There *Acropora cervicornis* colonies bear at the *palmata*-side thick, round branches, not distinguishable from round *palmata* branches at the lowerside of the *Acropora palmata* reef. Also normal round *cervicornis* branches arise from normal flat *palmata* branches.

At Plaja Frans (B 2) can be observed how neighbouring colonies may grow together. There a colony of *Acropora cervicornis* is found, with one branch ending abruptly. About 20 cm above this truncated

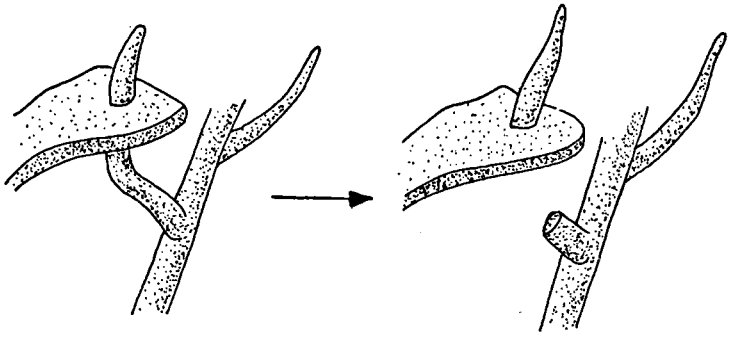


Fig. 47. Colonies of *Acropora palmata* and *Acropora cervicornis* at Plaja Frans, BONAIRE, showing growing together of branches.

end there is a normal flat branch of a neighbouring *Acropora palmata*. From this flat branch a normal round *Acropora cervicornis* branch arises in a direct line with the truncated branch of the *Acropora cervicornis* colony. Probably both branches met each other once, both continued growing further in the original direction and the *cervicornis*-part below the *palmata*-branch died from lack of light (Fig. 47). In none of the cases mentioned of growing together of apparently different *Acropora* colonies, disjunction in the living tissue was observed.

As BOSCHMA (1948) and YONGE (1963) pointed out, the ability of colonies to grow together offers a criterion for species limitation. As we see how these *Acropora* colonies fuse, the conclusion may be justified that speciation in *Acropora* has started in the direction of morphologically and ecologically different *Acropora cervicornis* and *Acropora palmata*, but that these species have hardly grown out of the subspecies level.

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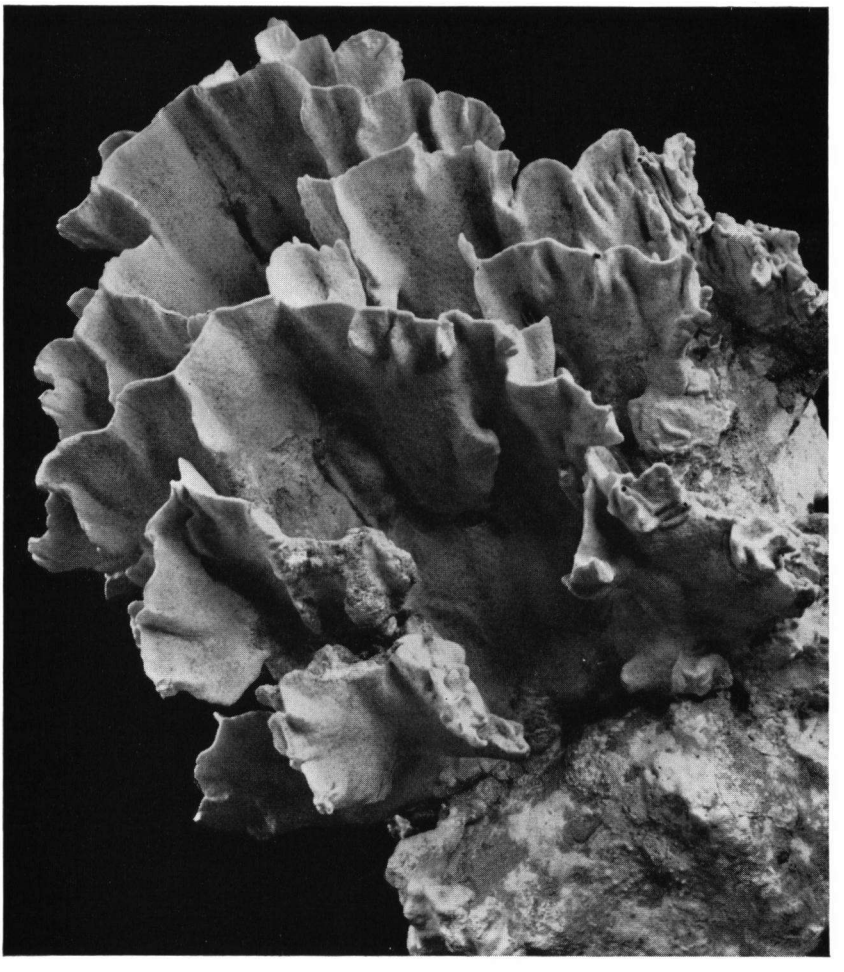
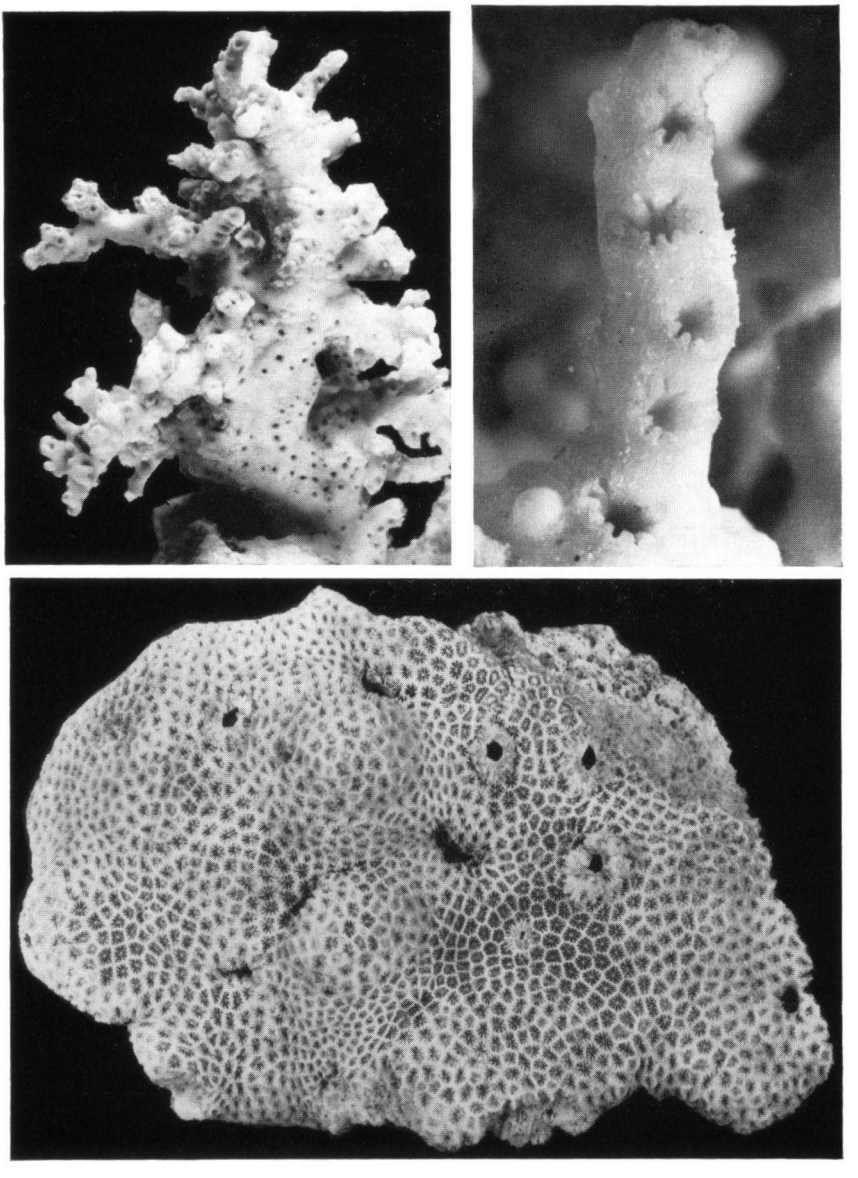


I. *Millepora squarrosa* Lamarck, CURAÇAO (ZLU, × 0.47).

II. *Millepora alcicornis* Linnaeus, WEST INDIES (ZMA, × 0.93).

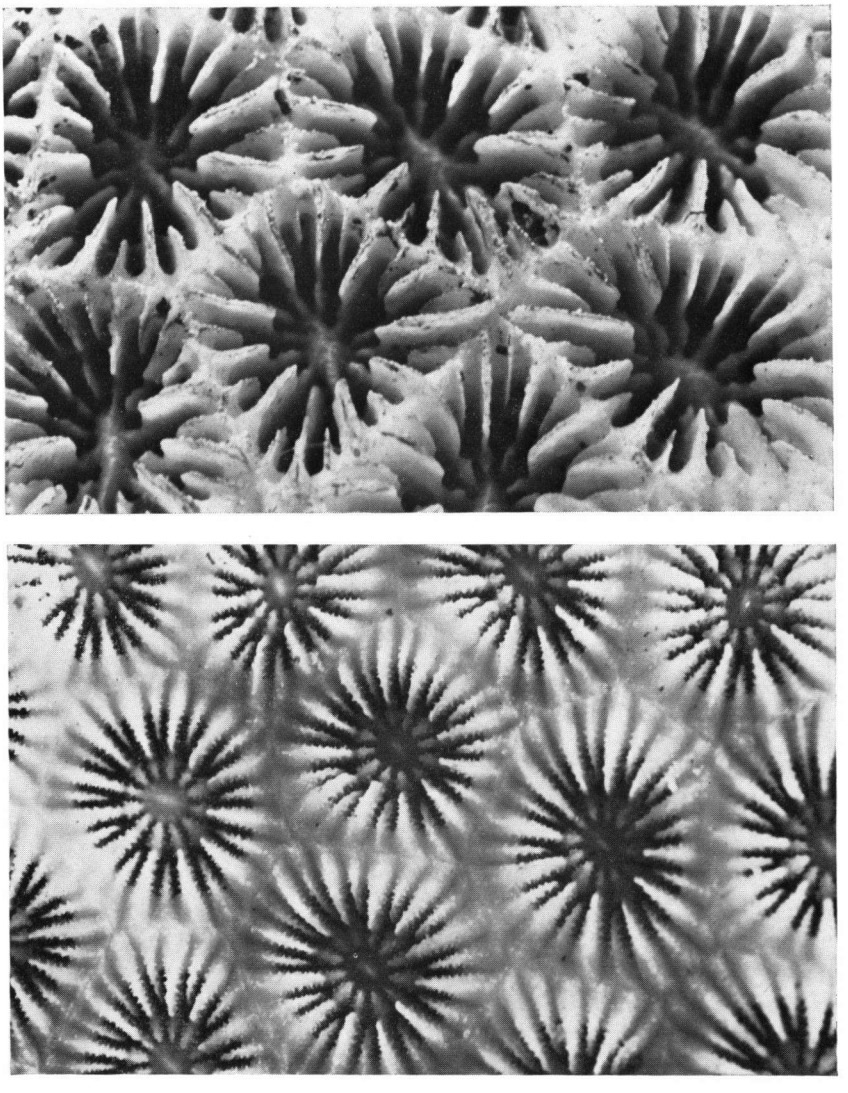
III. *Millepora complanata* Lamarck, CURAÇAO (ZLU, × 0.54).



IVa. *Stylaster roseus* (Pallas), CURAÇAO, St. Michielsbaai (ZMA 1107, × 1.9).

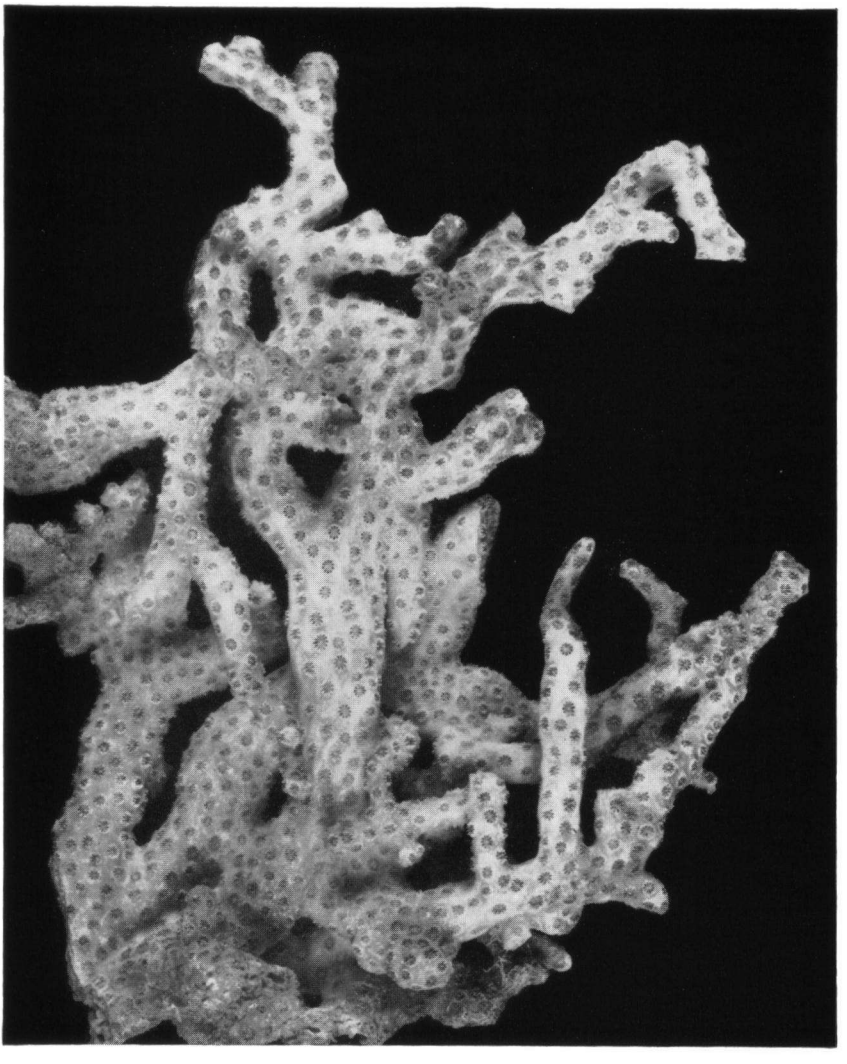
IVb. *Stylaster roseus* (Pallas), CURAÇAO, St. Michielsbaai (same specimen, × 14).

IVc. *Stephanocoenia intersepta* (Esper), CURAÇAO, Piscaderabaai, 0.5 m (ZMA 1104, × 1.0).

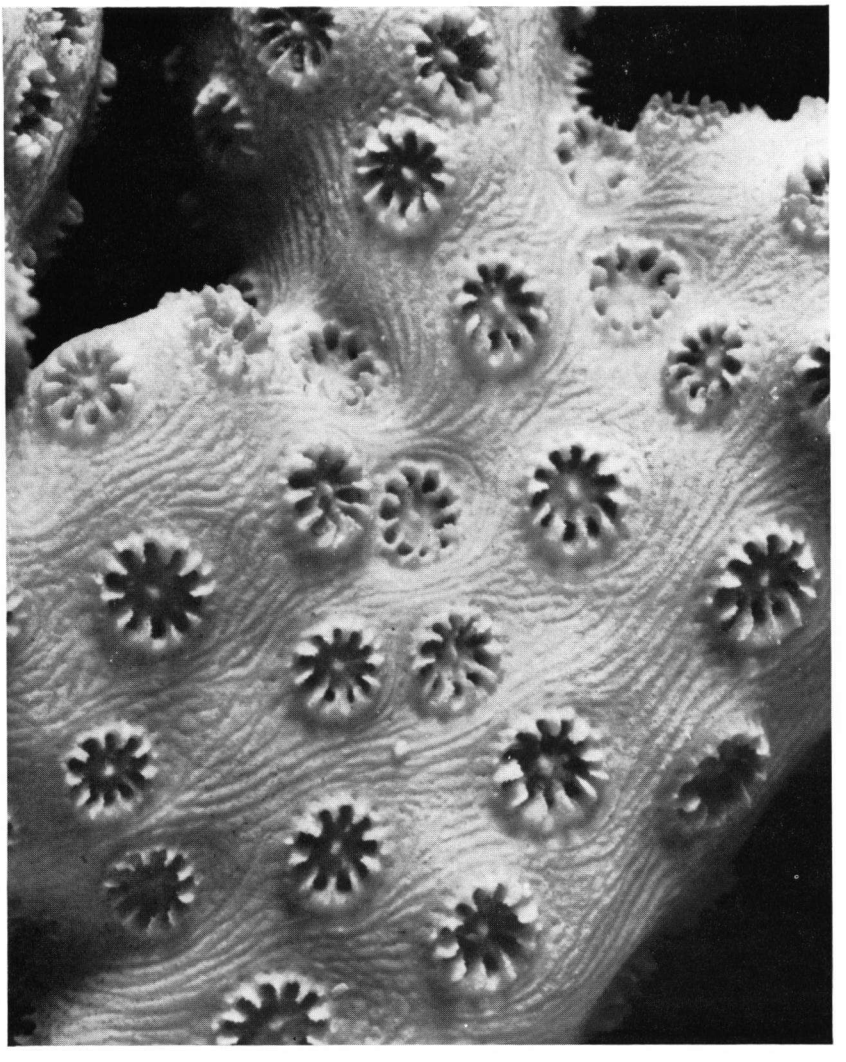


Va. *Stephanocoenia intersepta* (Esper), CURAÇAO, Piscaderabaai, 0.5 m (same specimen as IVc, × 12).

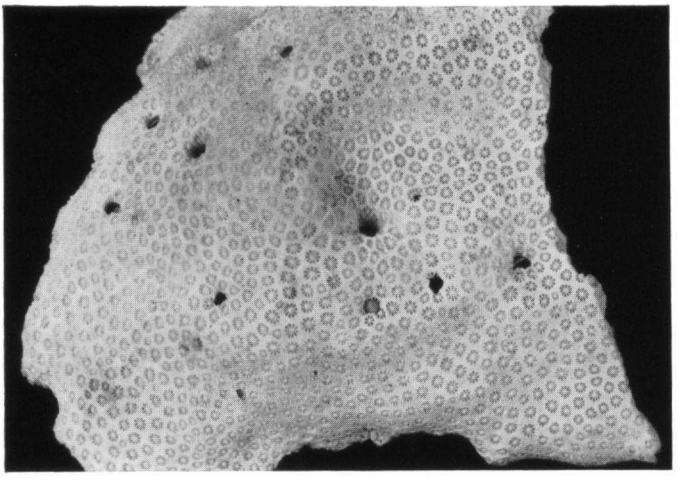
Vb. *Stephanocoenia intersepta* (Esper), CURAÇAO, Piscaderabaai, 40 m (ZMA 1105, × 18).

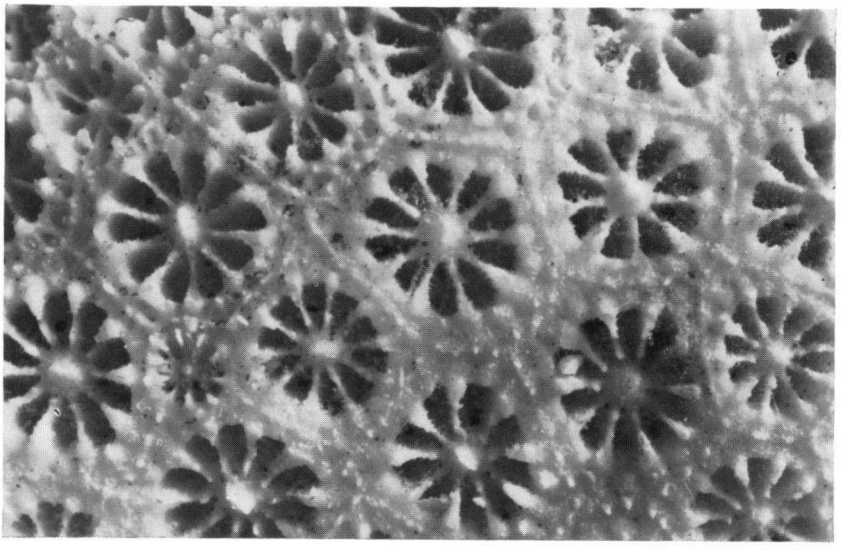


VI. *Axhelia myriaster* Milne-Edwards & Haime, ARUBA (RMNH 61, × 0.92).



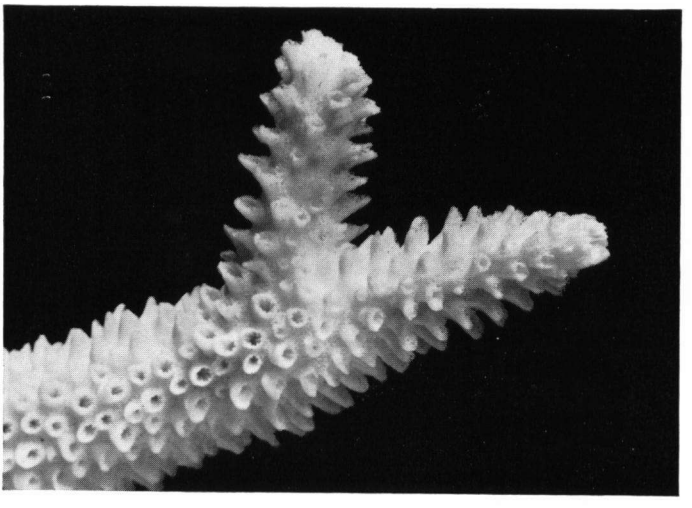
VII. *Axhelia myriaster* Milne-Edwards & Haime, ARUBA (same specimen as VI, × 12).

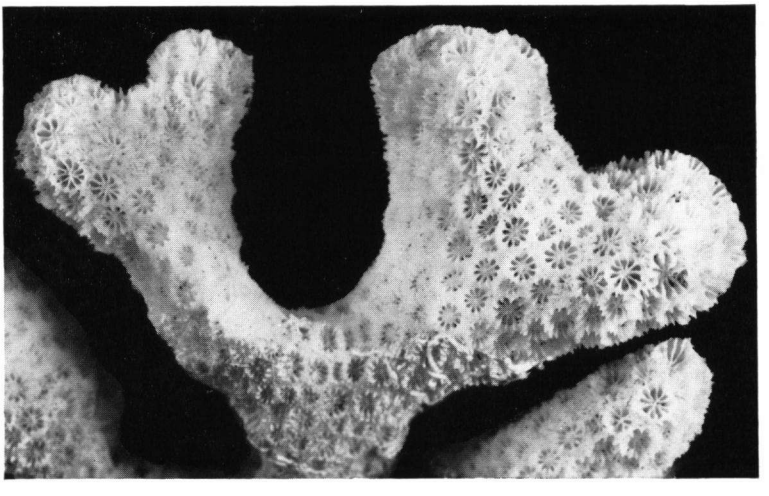




VIIIa. *Madracis decactis* (Lyman), CURAÇAO, Piscaderabaai (ZMA 623, × 1.3).

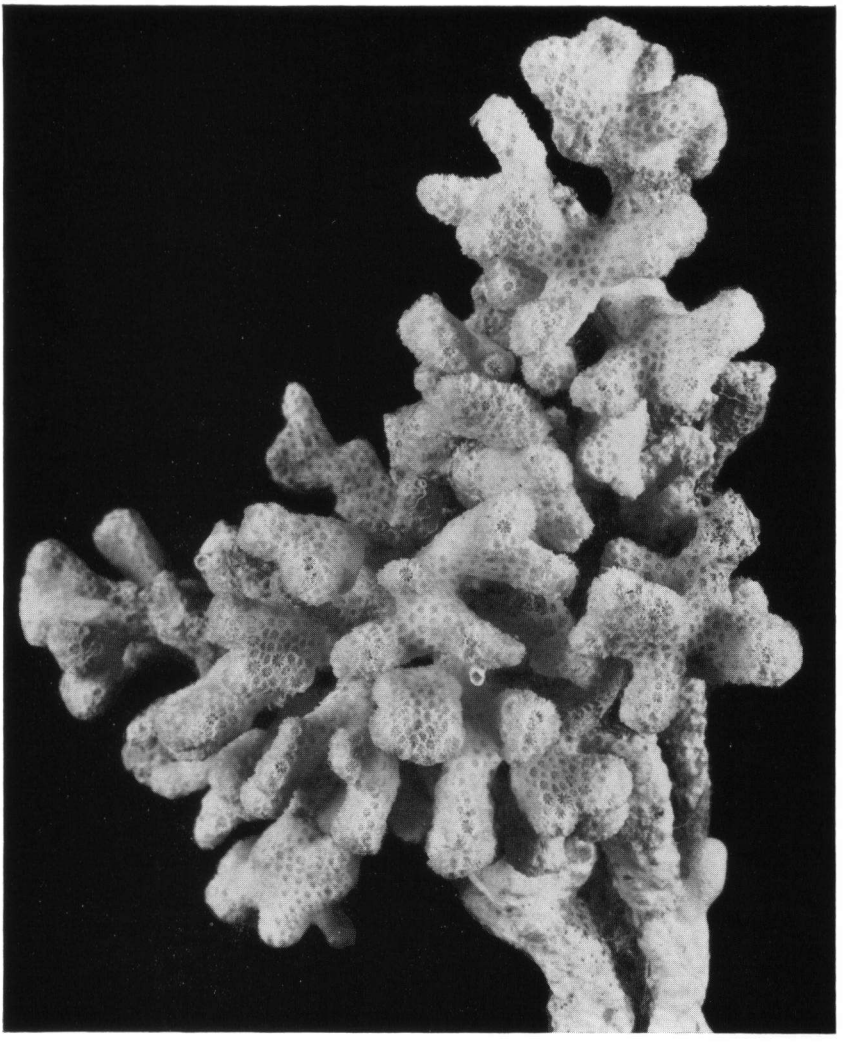
VIIIb. *Madracis decactis* (Lyman), CURAÇAO, Piscaderabaai (same specimen, × 18)



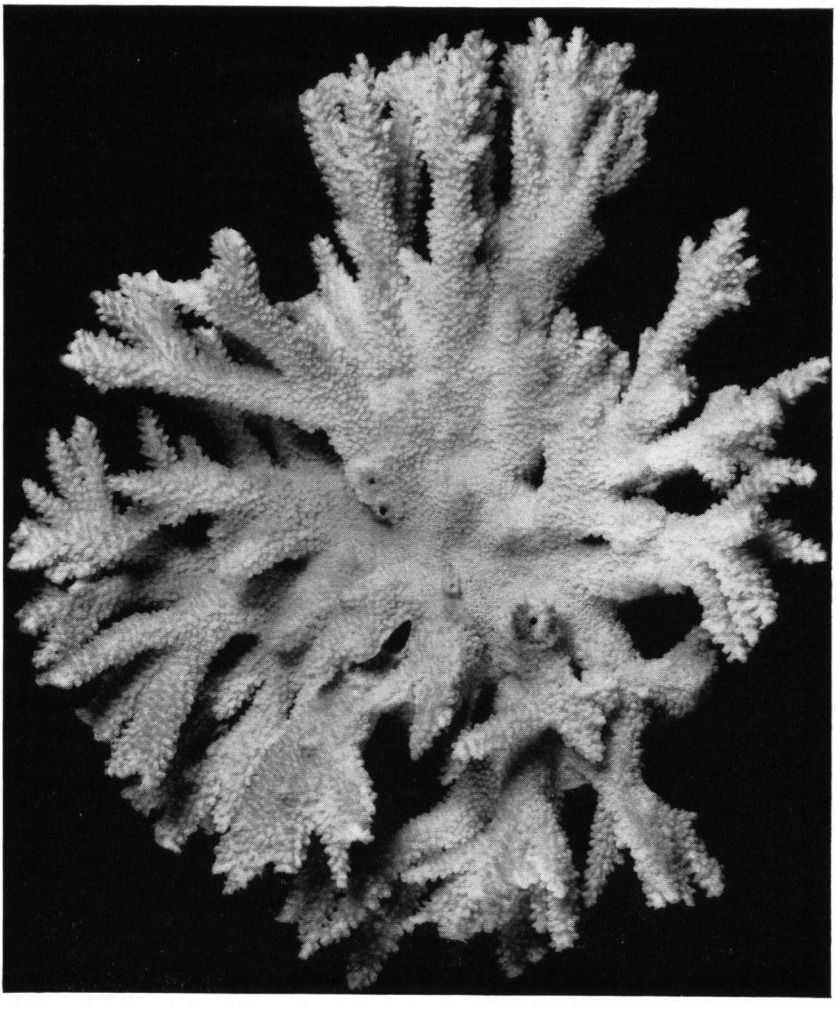


IXa. *Acropora cervicornis* (Lamarck), CURAÇAO (ZLU, × 1.7).

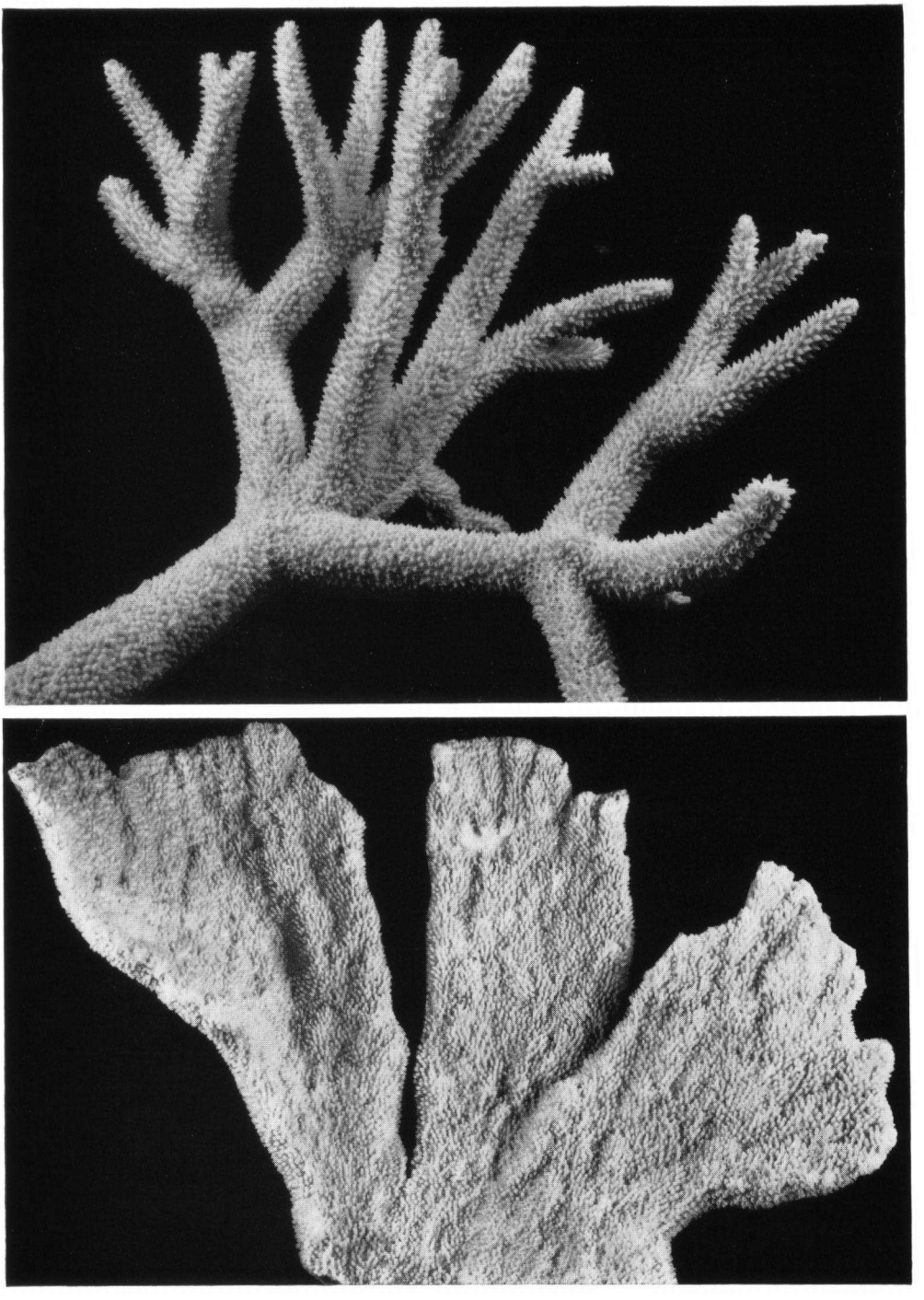
IXb. *Madracis asperula* Milne-Edwards & Haime, CURAÇAO, Piscaderabaai (ZMA 629, × 4.7).



X. *Madracis asperula* Milne-Edwards & Haime, CURAÇAO, Piscaderabaai (same specimen as IXb, × 0.94).

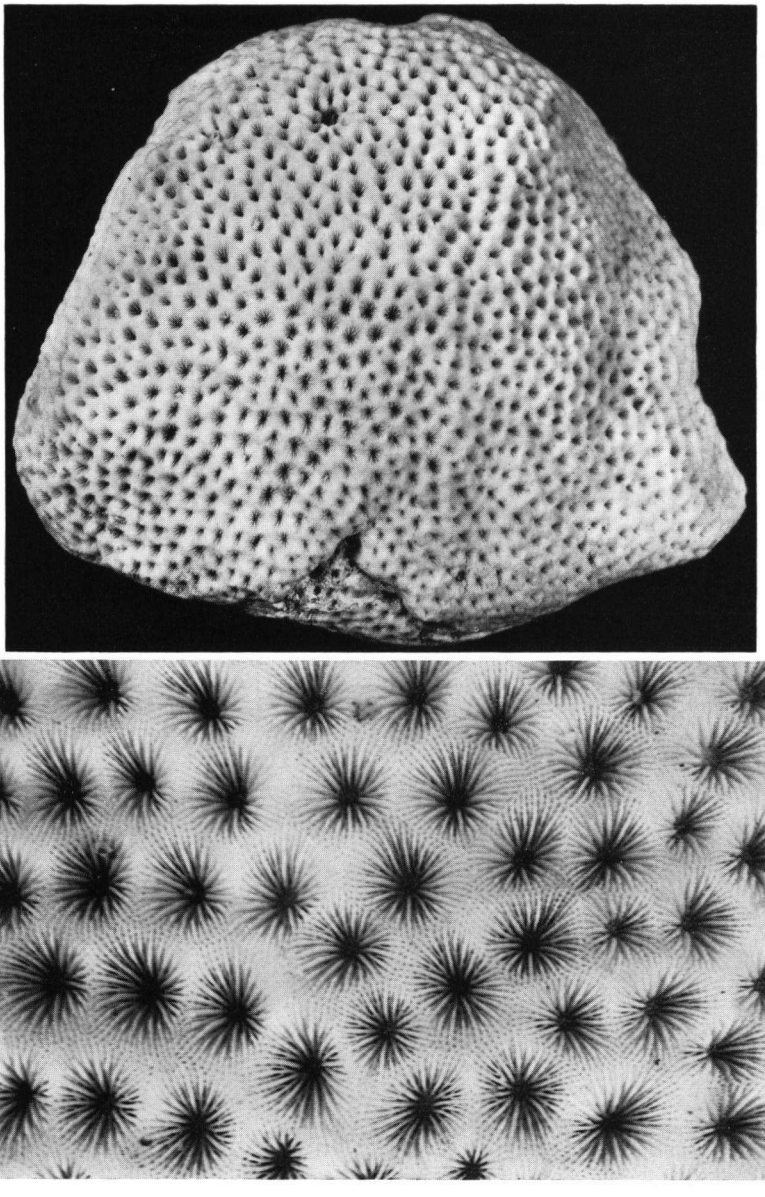


XI. *Acropora prolifera* (Lamarck), CURAÇAO, Caracasbaai (ZMA 182, × 0.55).



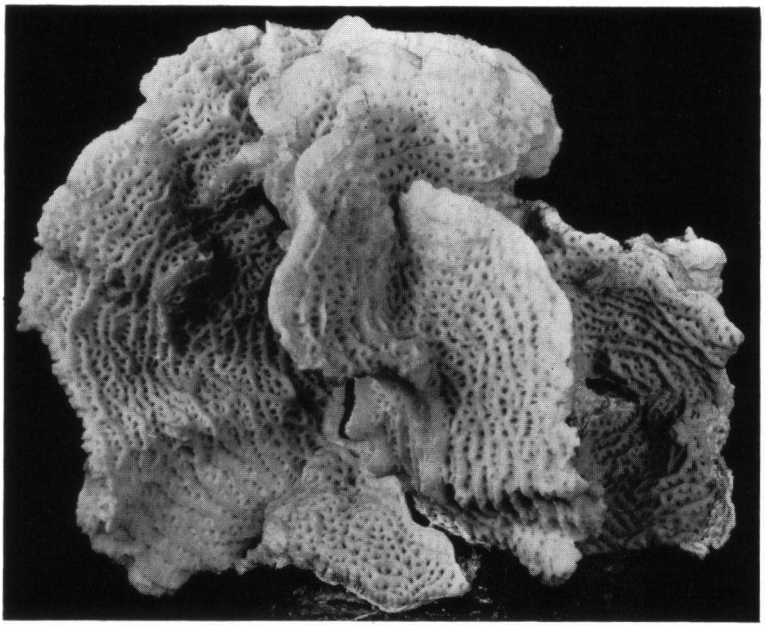
XIIa. *Acropora cervicornis* (Lamarck), CURAÇAO (same specimen as IXa, × 0.46).

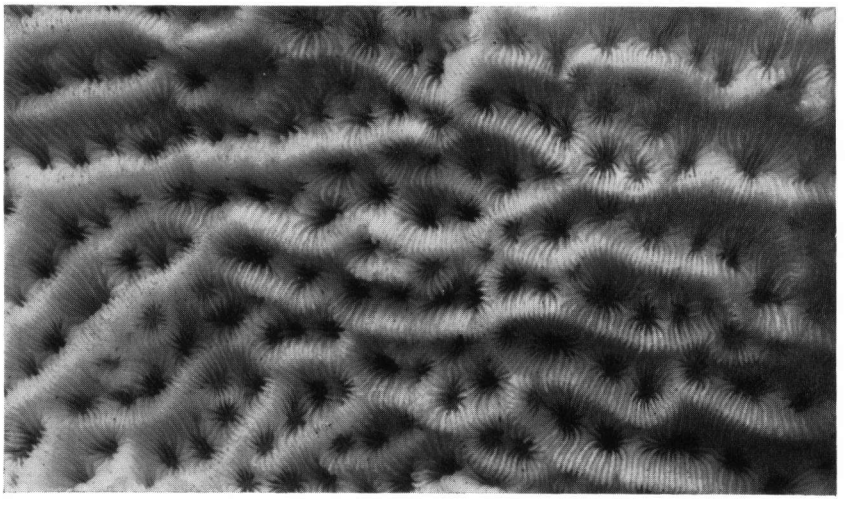
XIIb. *Acropora palmata* (Lamarck), CURAÇAO, Caracasbaai (ZMA 72, × 0.28).



XIIIa. *Siderastrea siderea* (Ellis & Solander), CURAÇAO, Spaanse Water (ZMA 1367, × 0.68).

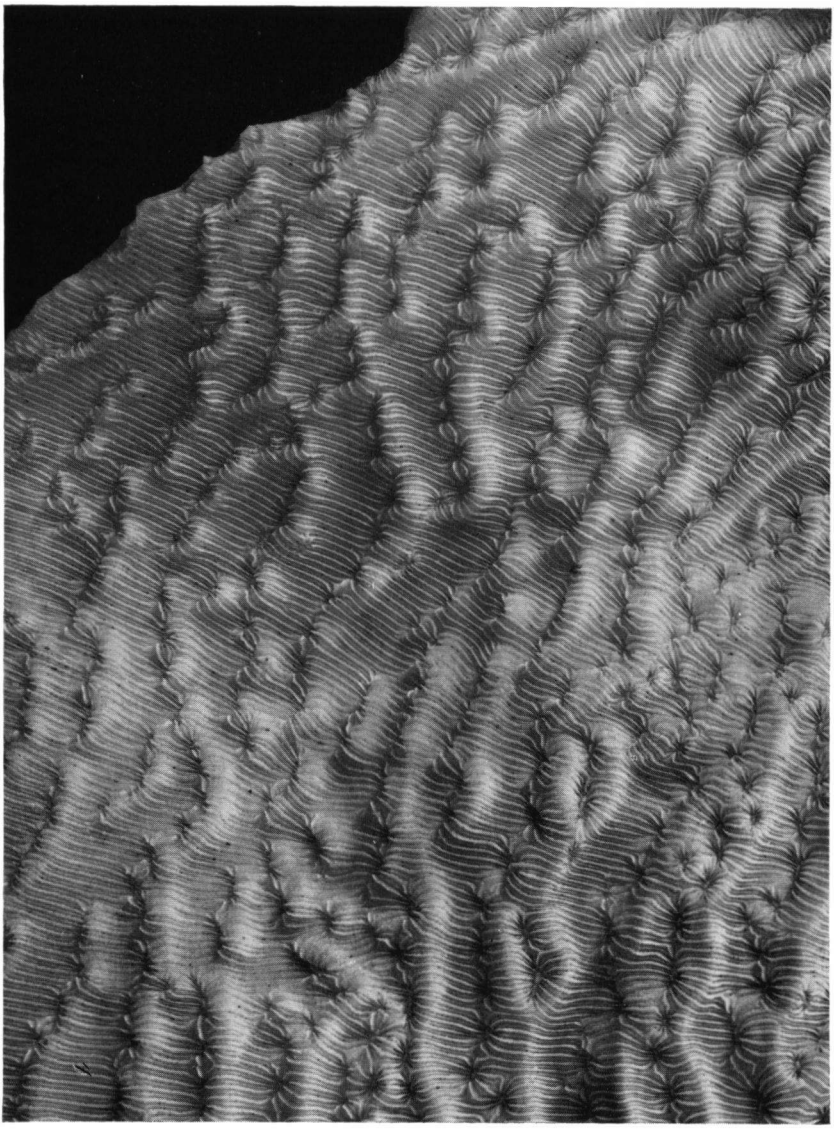
XIIIb. *Siderastrea siderea* (Ellis & Solander), CURAÇAO, Spaanse Water (same specimen, × 2.5).



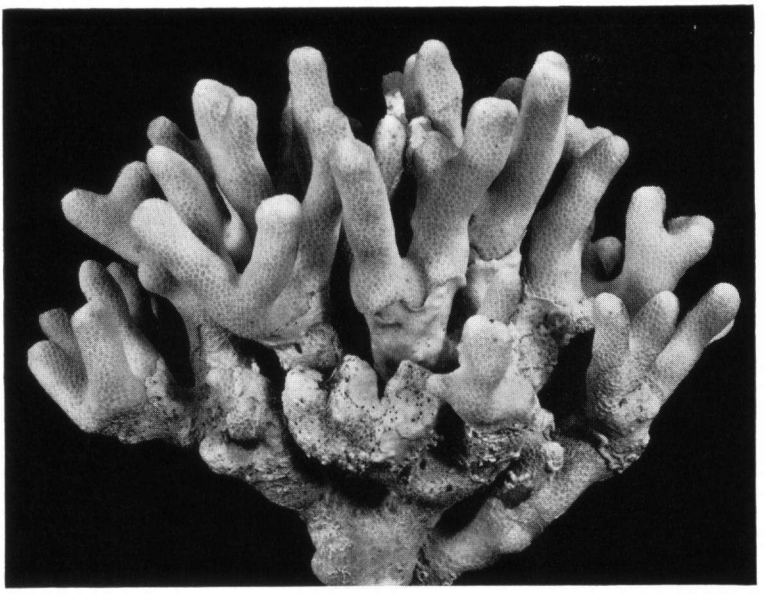


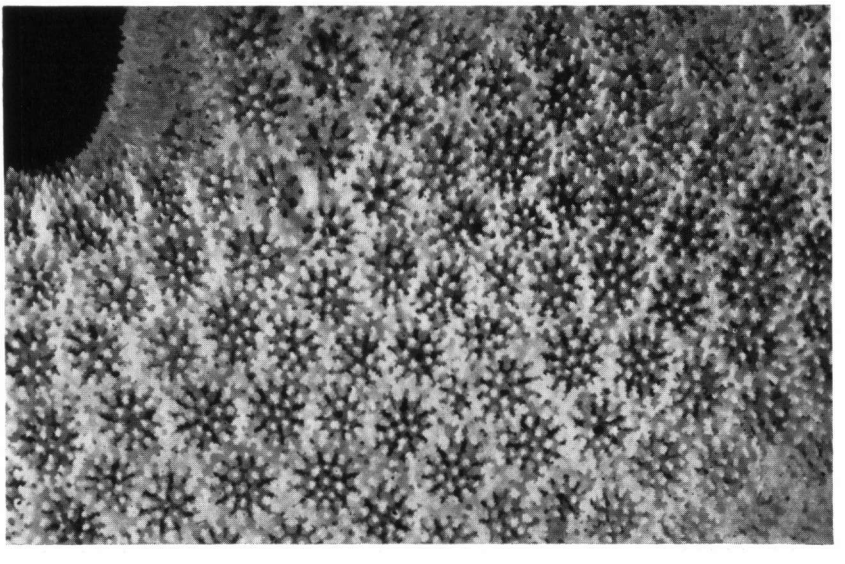
XIVa. *Agaricia agaricites* (Linnaeus), CURAÇAO (ZLU, × 0.67).

XIVb. *Agaricia agaricites* (Linnaeus), CURAÇAO (ZLU, same specimen, × 2.6).



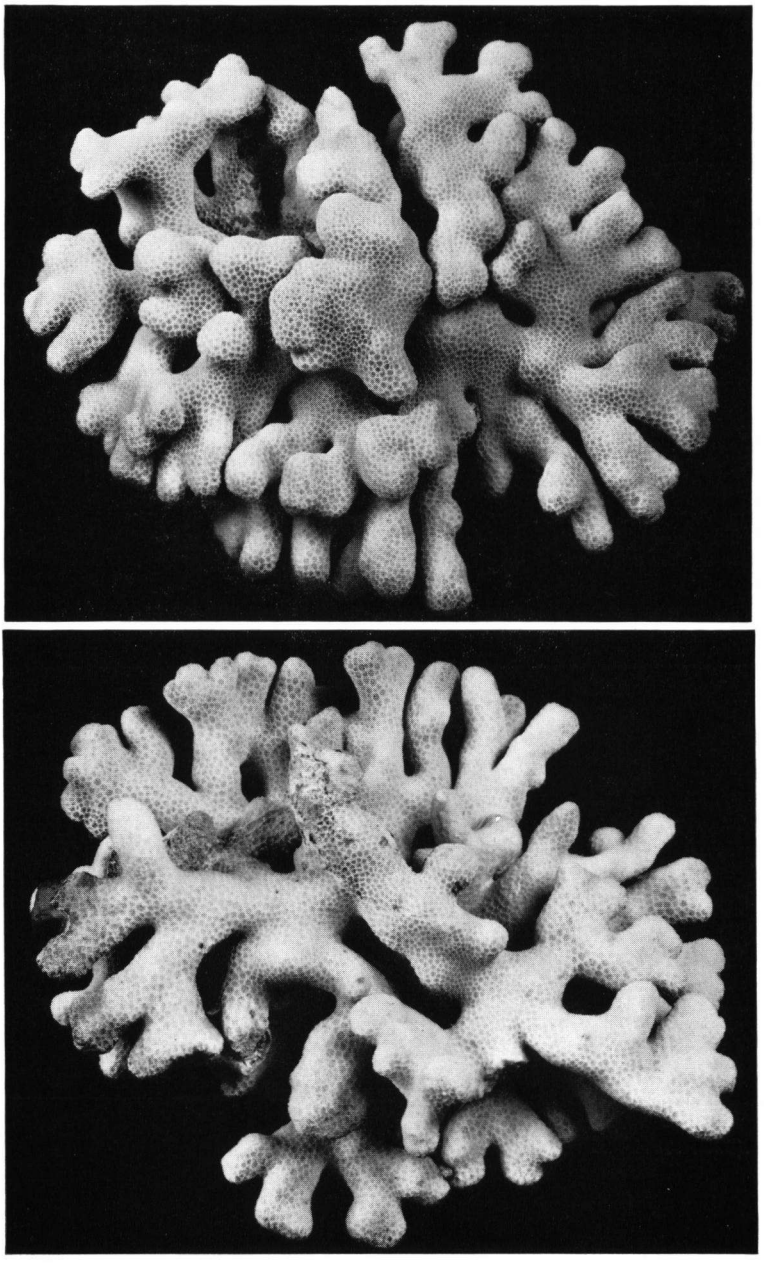
XV. *Agaricia agaricites* (Linnaeus), CURAÇAO, Piscaderabaai (ZMA 171, × 2.5).





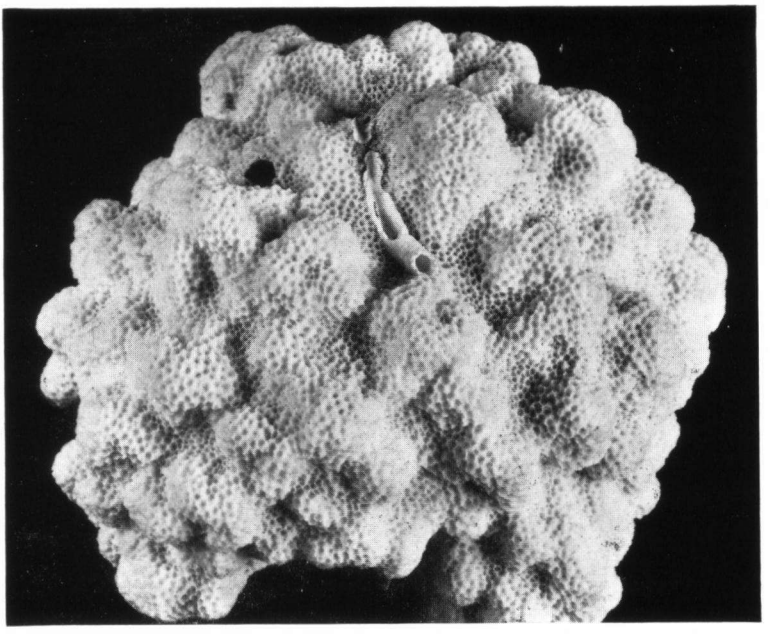
XVIa. *Porites porites* (Pallas), CURAÇAO, St. Michielsbaai (ZMA 887, × 0.49).

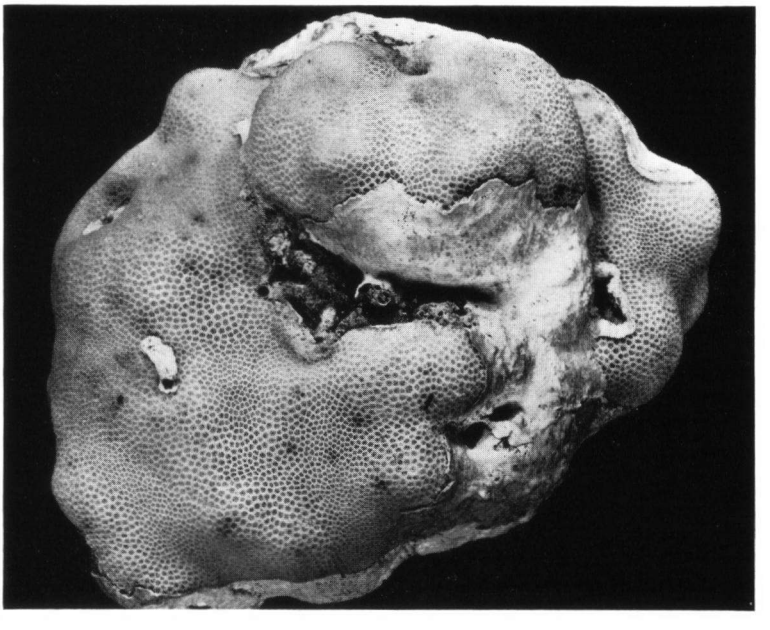
XVIb. *Porites porites* (Pallas), CURAÇAO, St. Michielsbaai (same specimen, × 6.4).



XVIIa. *Porites porites* (Pallas), CURAÇAO, Plaja Bartól (PWH, × 0.75), upper side.

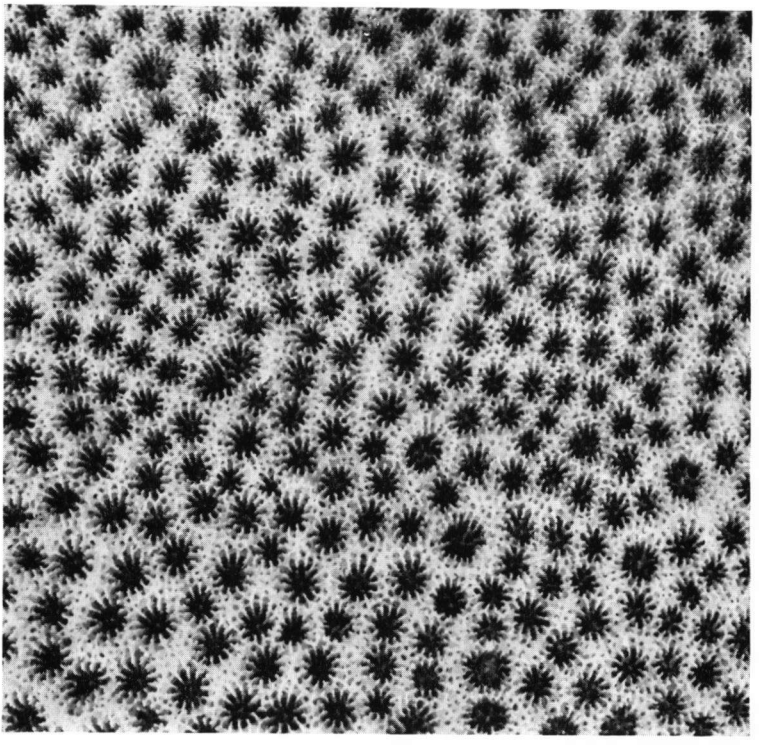
XVIIb. *Porites porites* (Pallas), CURAÇAO, Plaja Bartól (same specimen, × 0.71), under side.

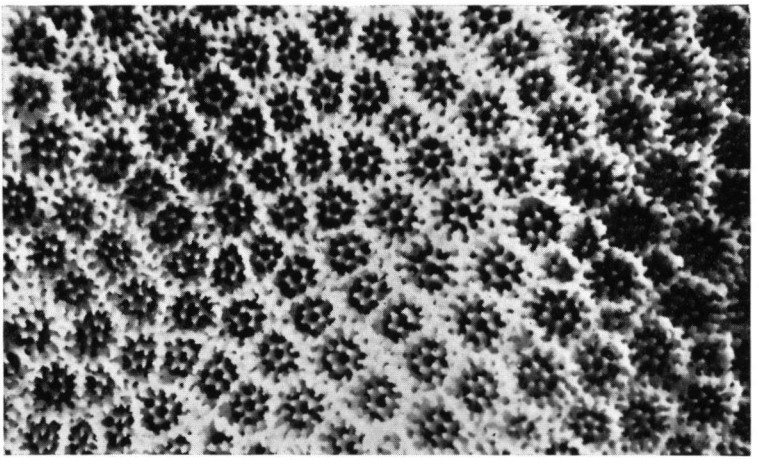




XVIIIa. *Porites astreoides* Lamarck, CURAÇAO, Piscaderabaai (PJR, × 0.97).

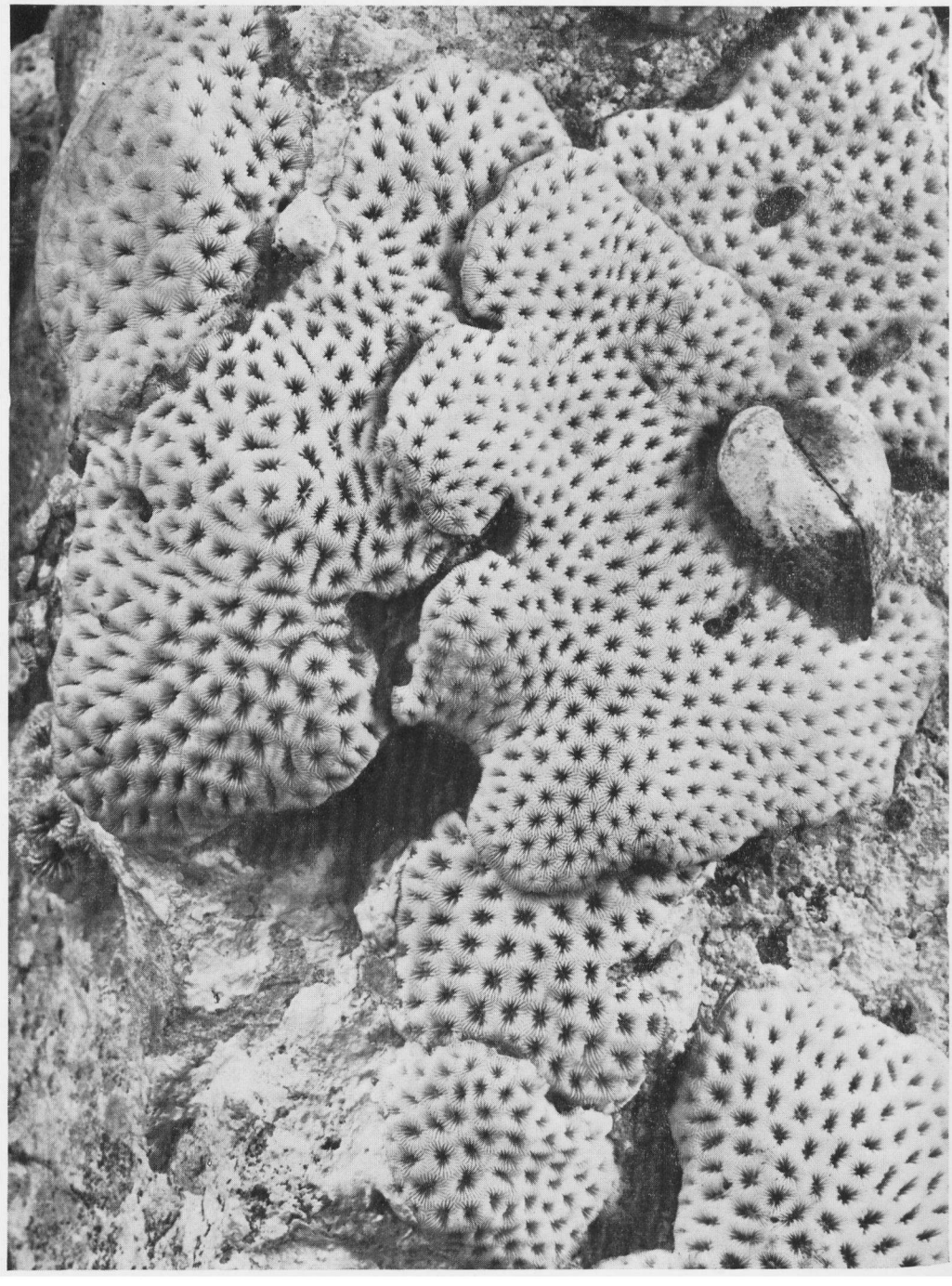
XVIIIb. *Porites branneri* Rathbun, CURAÇAO, Caracasbaai (ZMA 1023, × 0.80).



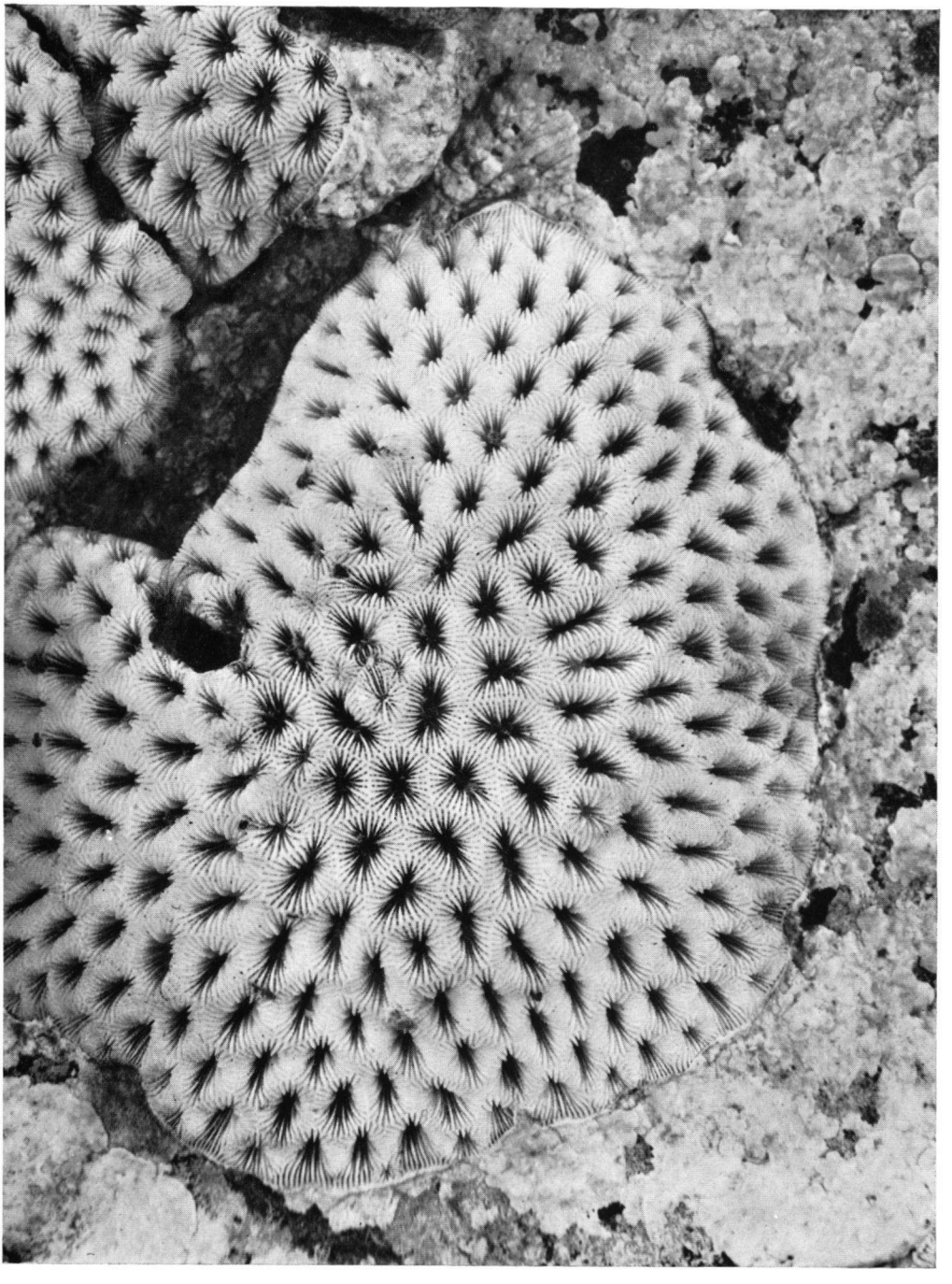


XIXa. *Porites astreoides* Lamarck, CURAÇAO, Spaanse Water (ZMA 3743, × 6.0).

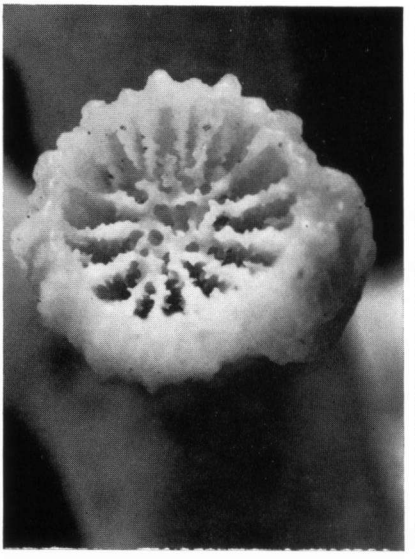
XIXb. *Porites branneri* Rathbun, CURAÇAO, Caracasbaai (same specimen as XVIIIb, × 9.4).

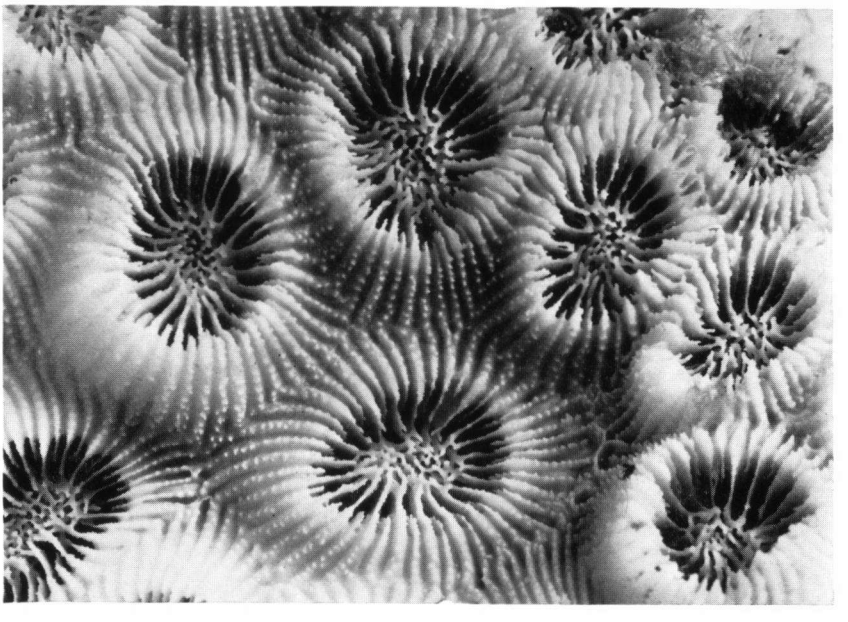


XX. *Siderastrea radians* (Pallas), CURAÇAO, Spaanse Water (PWH, × 1.6).



XXI. *Siderastrea radians* (Pallas), CURAÇAO, Spaanse Water (same specimen as XX, × 3.4).

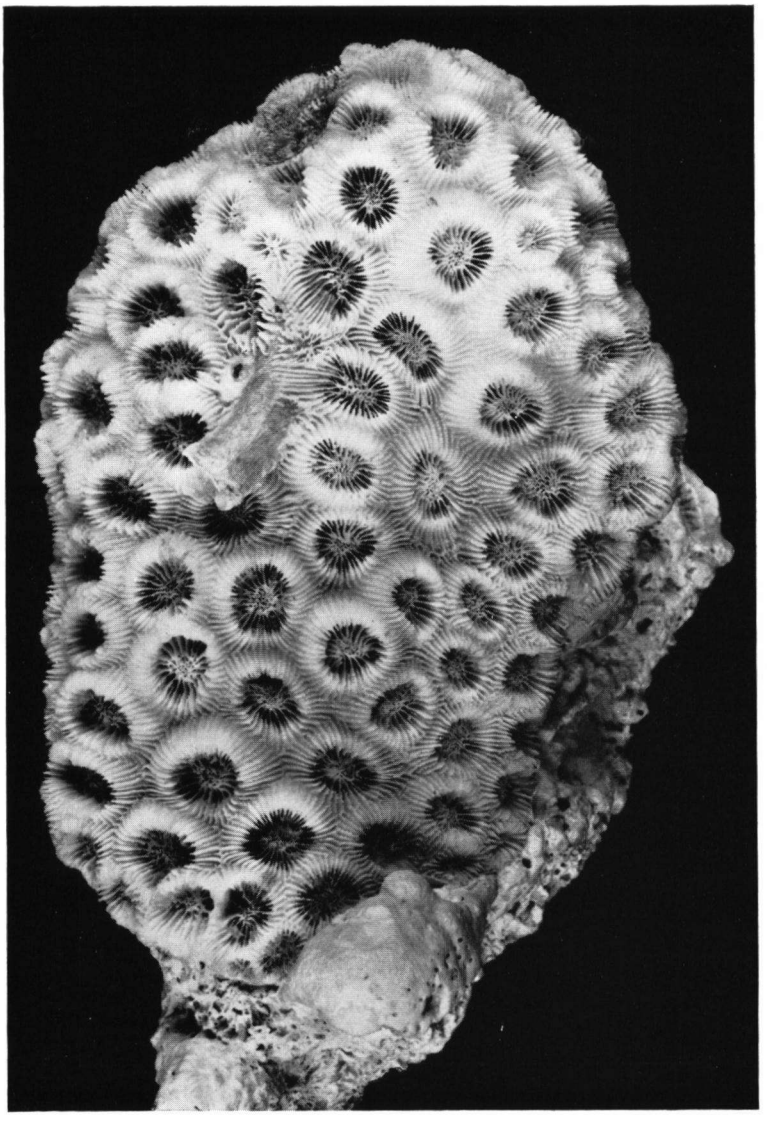




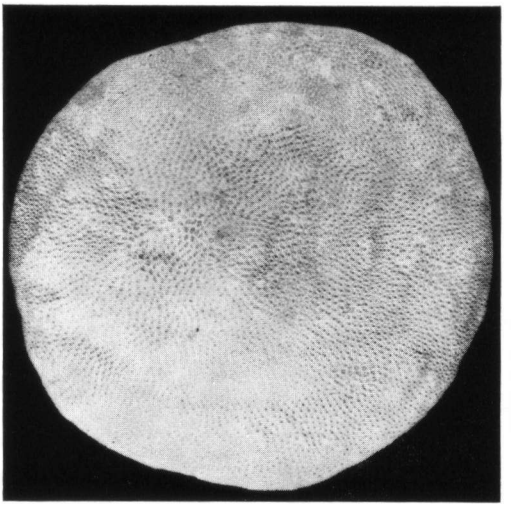
XXIIa. *Cladocora arbuscula* (Lesueur), ST. KITTS, Frigate Bay (PWH 20.VII.1955, × 12).

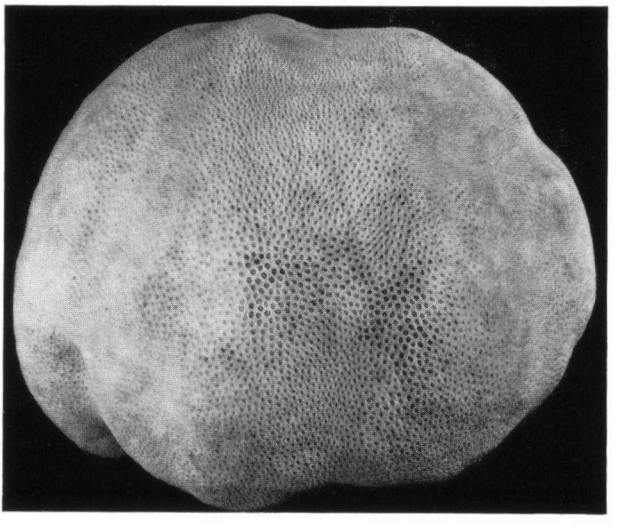
XXIIb. *Cladocora arbuscula* (Lesueur), ST. KITTS, Frigate Bay (same specimen, × 2.9).

XXIIc. *Montastrea cavernosa* (Linnaeus), CURAÇAO, Sta. Martabaai (ZMA 797, × 3.8).



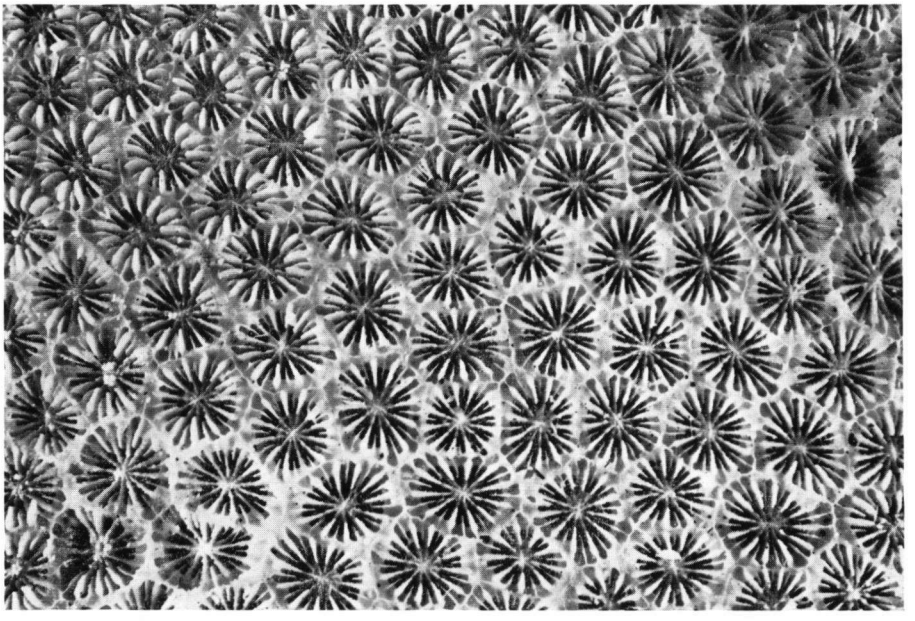
XXIII. *Montastrea cavernosa* (Linnaeus), CURAÇAO, Sta. Martabaai (same specimen as XXIIc, × 1.0).

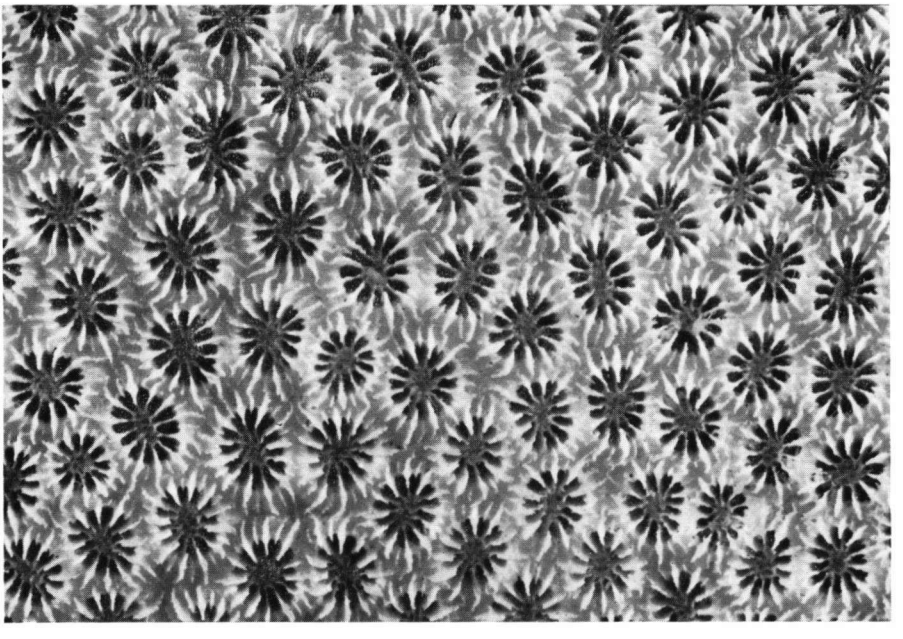




XXIVa. *Solenastrea bournoni* Milne-Edwards & Haime, CURAÇAO, Piscaderabaai (ZMA 1103, × 0.40).

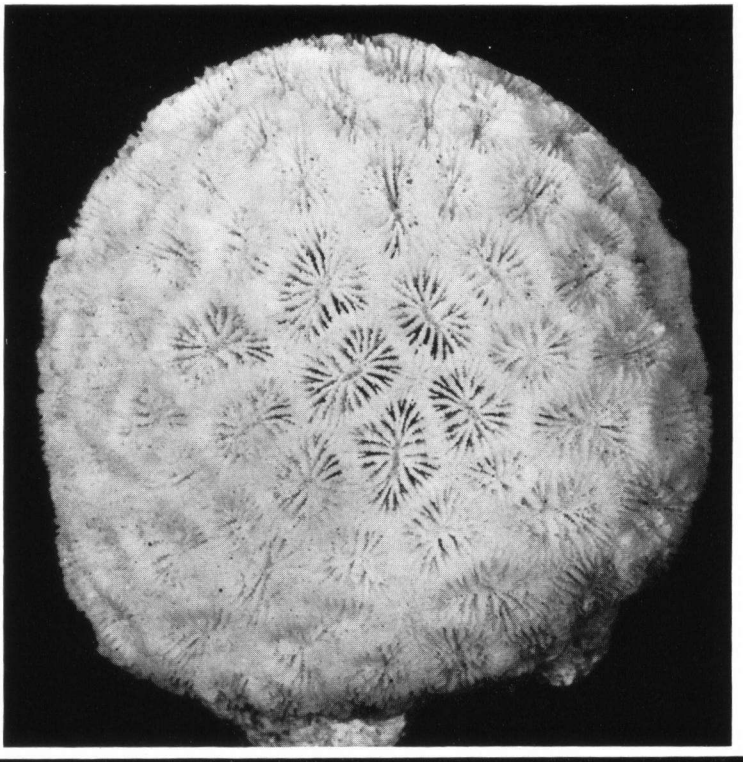
XXIVb. *Montastrea annularis* (Ellis & Solander), CURAÇAO, Caracasbaai (ZMA 852, × 0.32).

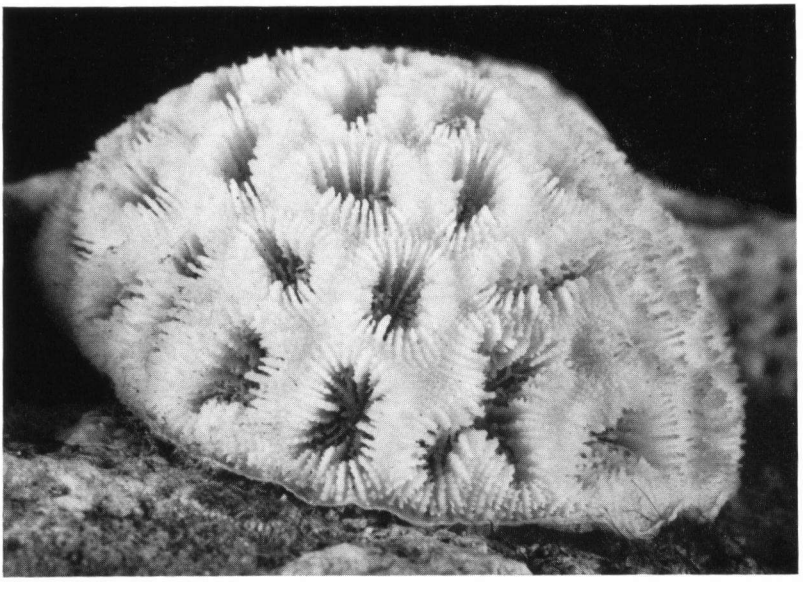




XXVa. *Solenastrea bournoni* Milne-Edwards & Haime, CURAÇAO, Piscaderabaai (same specimen as XXIVa, × 6.0).

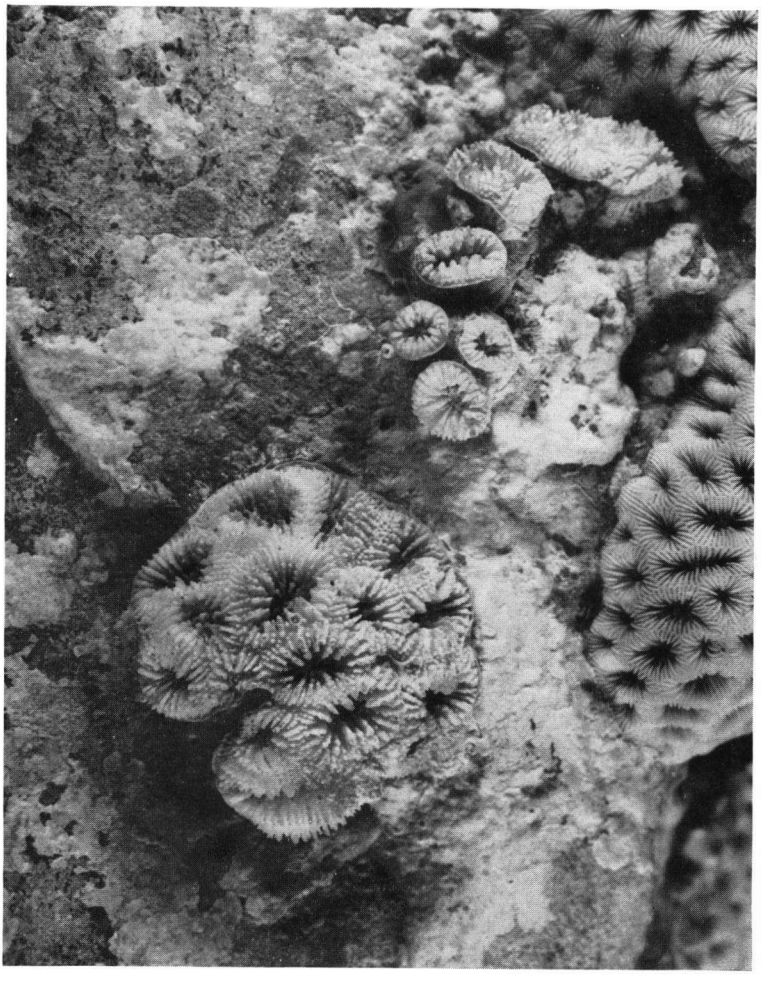
XXVb. *Montastrea annularis* (Ellis & Solander), CURAÇAO, Caracasbaai (same specimen as XXIVb, × 6.0).



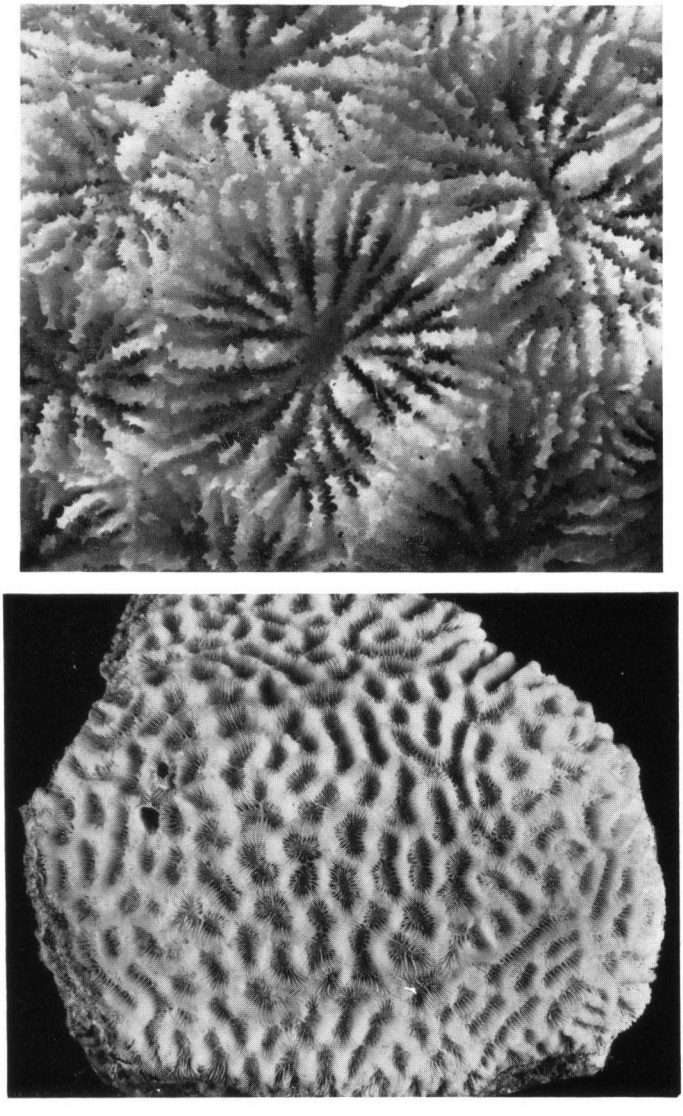


XXVIa. *Favia fragum* (Esper), CURAÇAO, Piscaderabaai (ZMA 330, × 2.3).

XXVIb. *Favia fragum* (Esper), CURAÇAO, Spaanse Water (PWH, × 3.1).

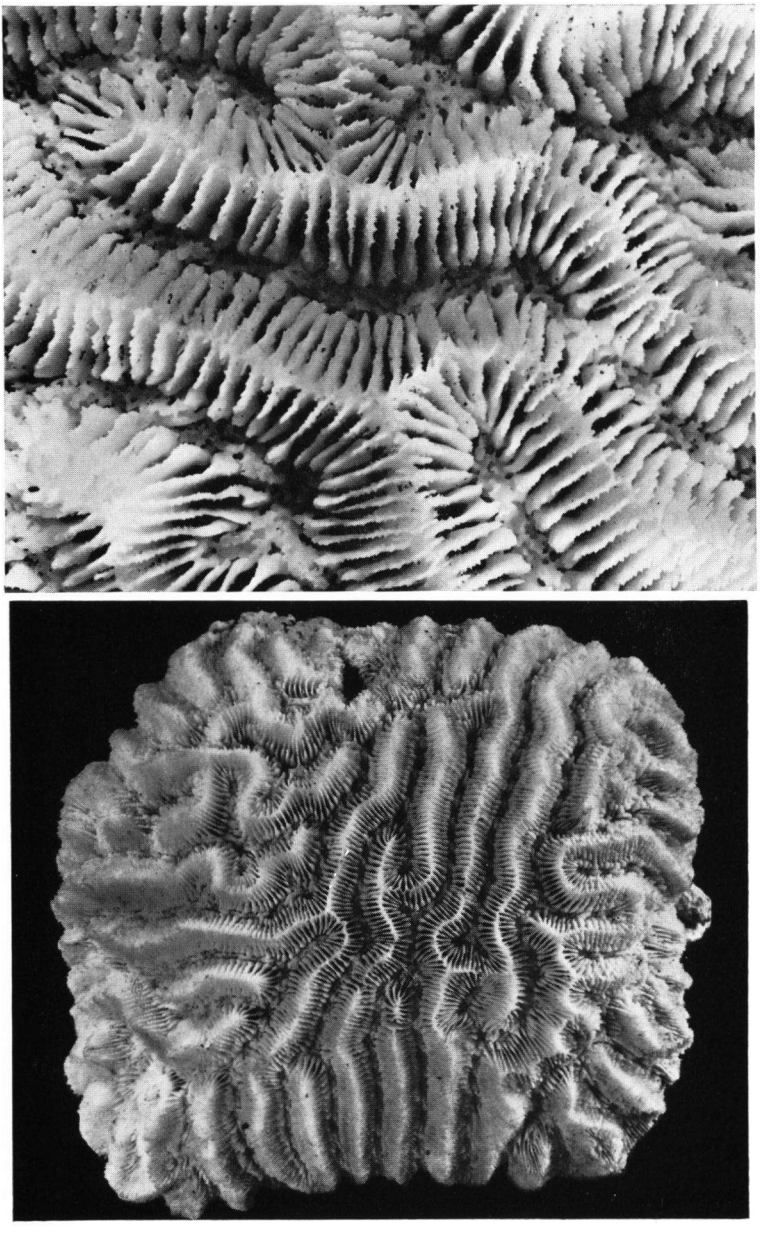


XXVII. *Favia fragum* (Esper), CURAÇAO, Spaanse Water (PWH, × 2.4).



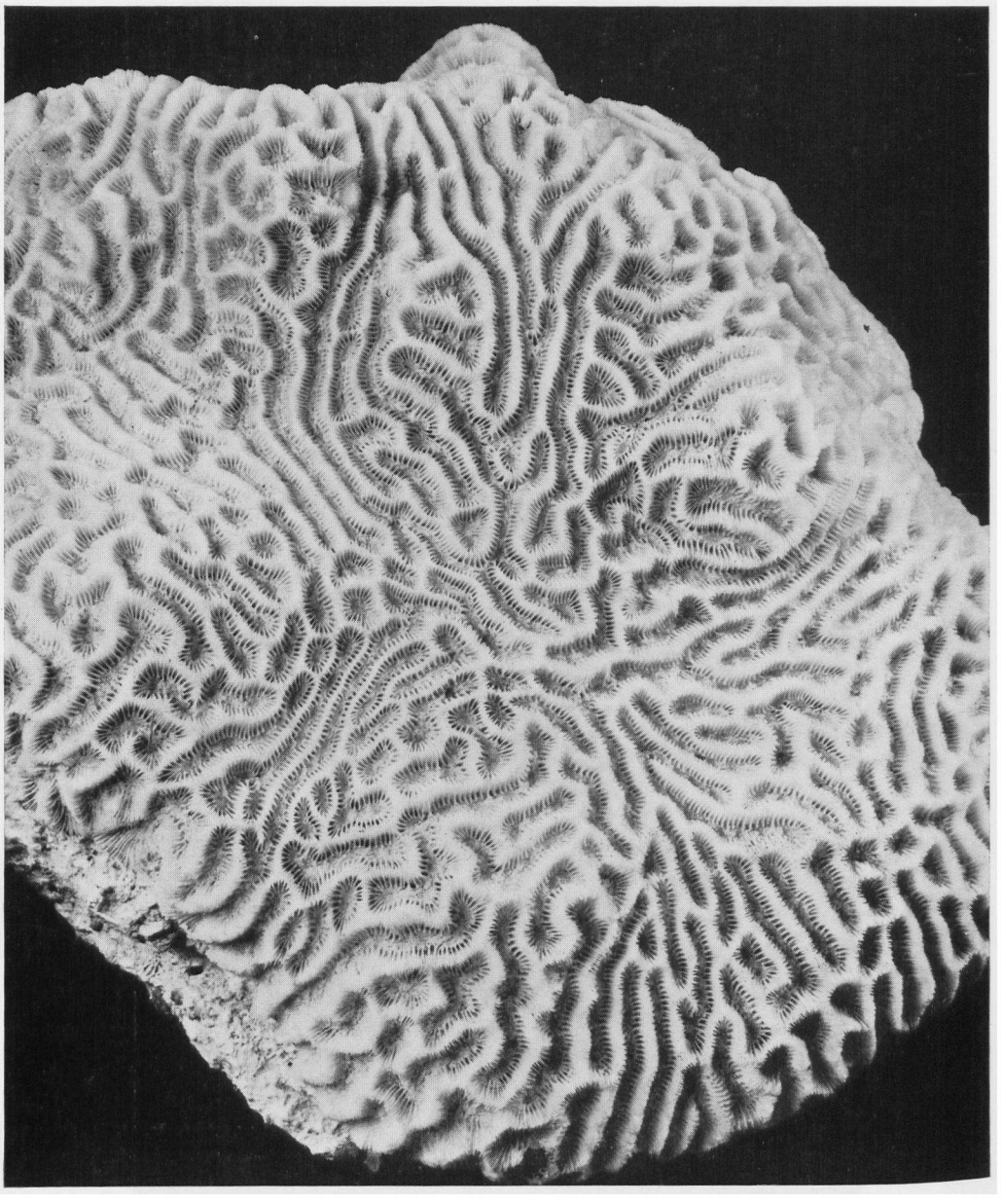
XXVIIIa. *Favia fragum* (Esper), CURAÇAO, Piscaderabaai (same specimen as XXVIa, × 9.0).

XXVIIIb. *Diploria clivosa* (Ellis & Solander), BONAIRE, Punt Vierkant (ZMA 3733, × 0.75).

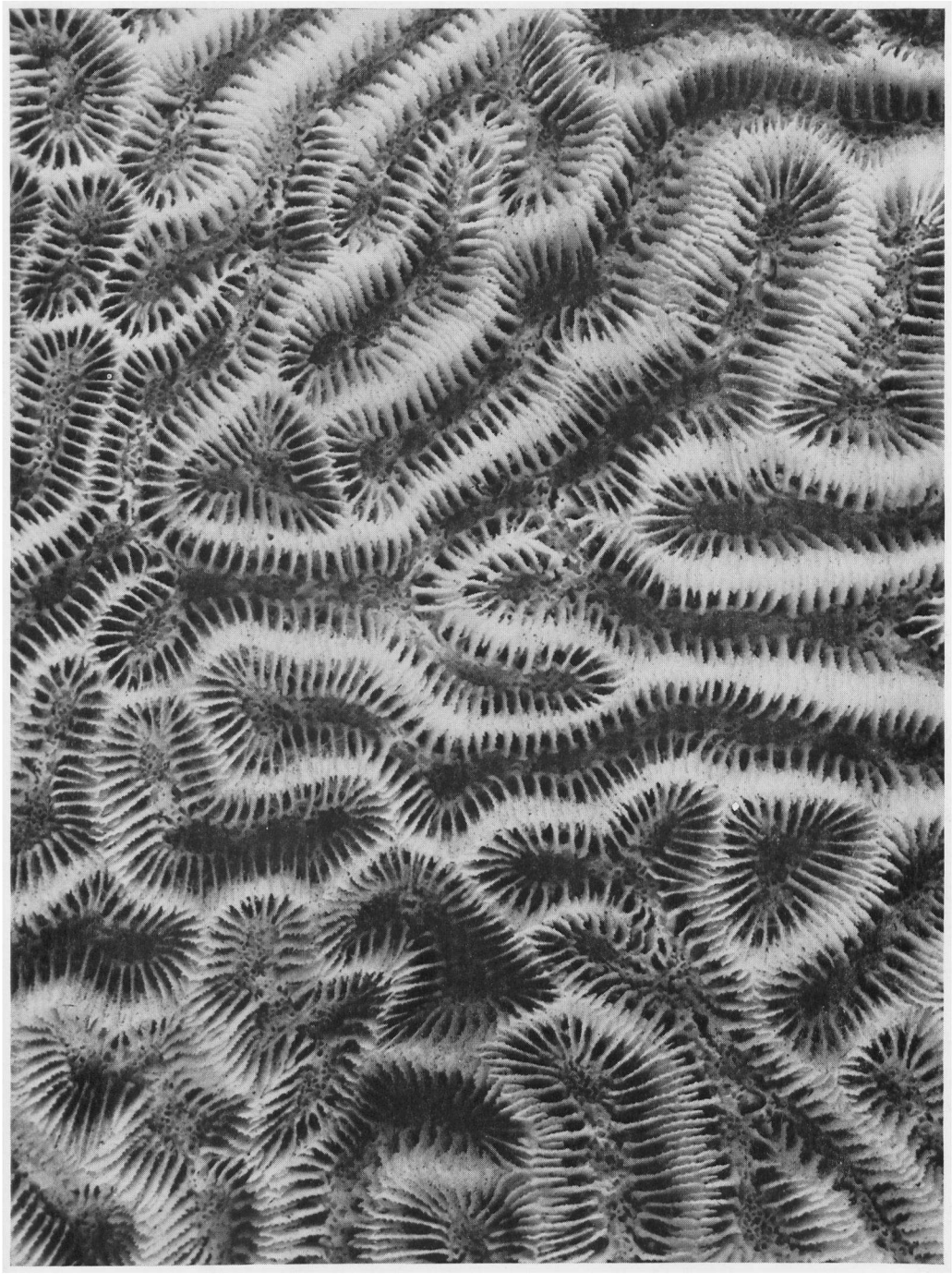


XXIXa. *Diploria strigosa* (Dana), CURAÇAO, St. Michielsbaai (ZMA 263, × 3.6).

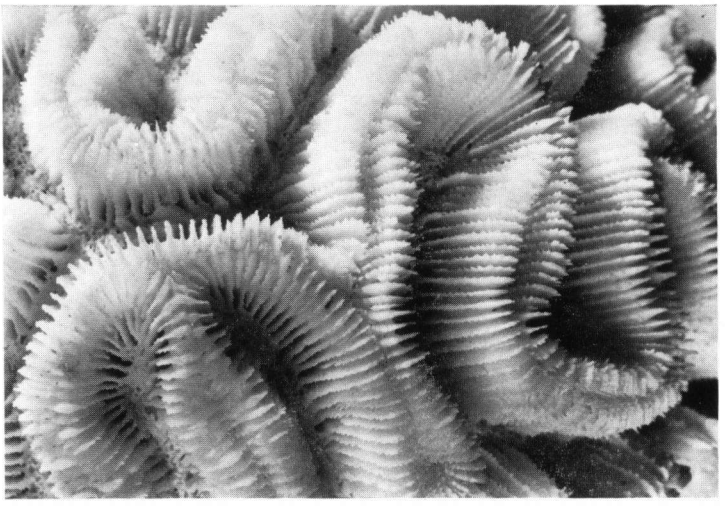
XXIXb. *Diploria strigosa* (Dana), CURAÇAO, St. Michielsbaai (same specimen, × 0.84).

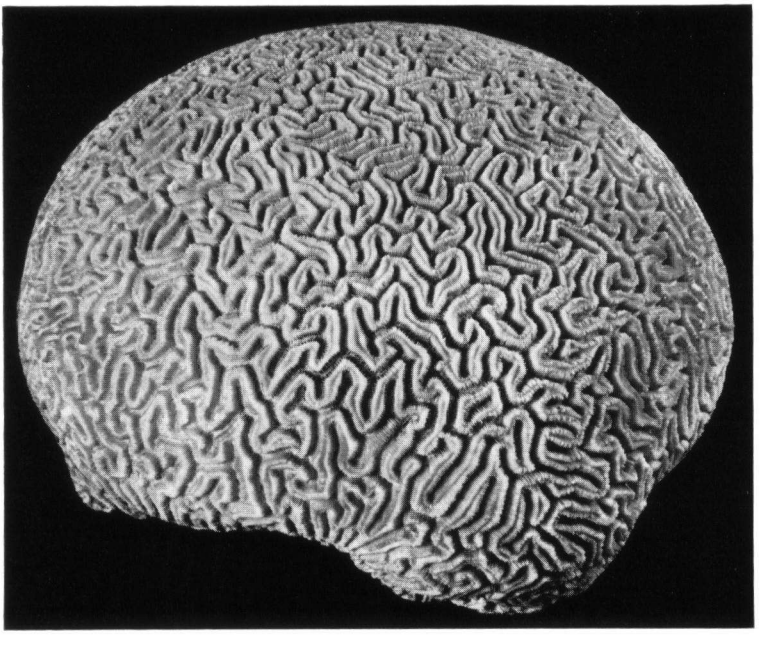


XXX. *Diploria clivosa* (Ellis & Solander), Curaçao (ZLU, × 0.80)



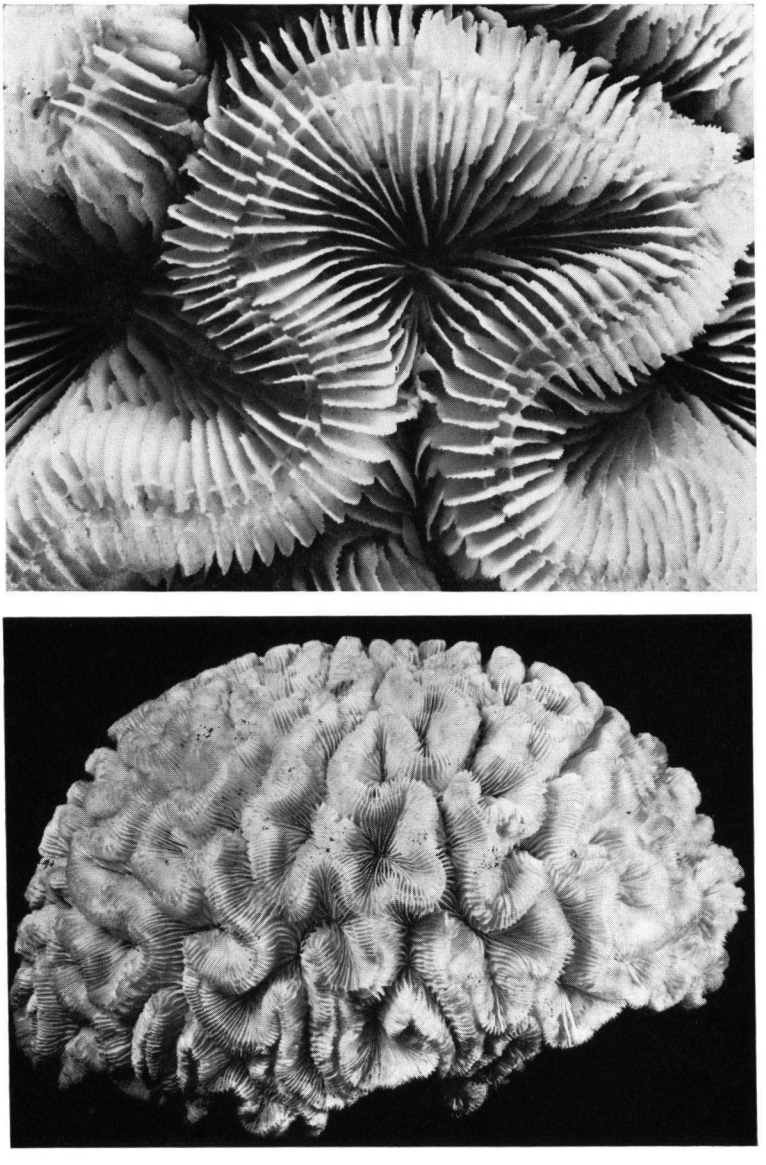
XXXI. *Diploria clivosa* (Ellis & Solander), CURAÇAO (same specimen as XXX, × 3.9).





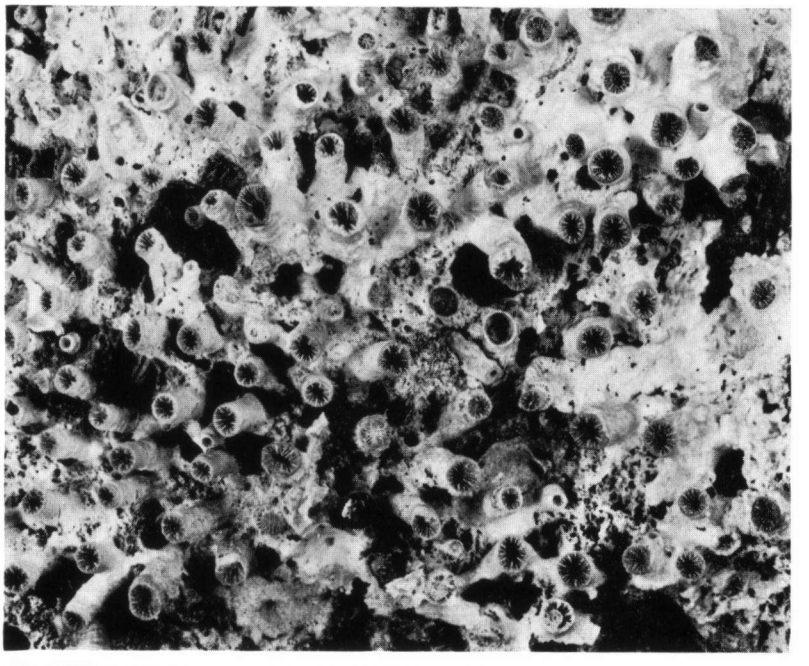
XXXIIa. *Diploria labyrinthiformis* (Linnaeus), CURAÇAO, Sta. Martabaai (ZMA 862, × 2.8).

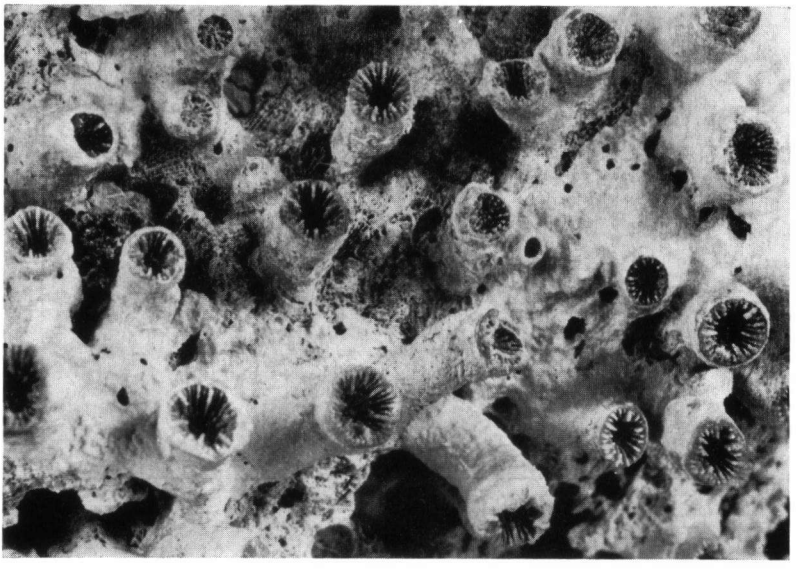
XXXIIb. *Diploria labyrinthiformis* (Linnaeus), "AMERICAN SEA" (ZMA 265, × 0.30).



XXXIIIa. *Colpophyllia natans* (Muller), Locality? (ZMA 637, × 1.4).

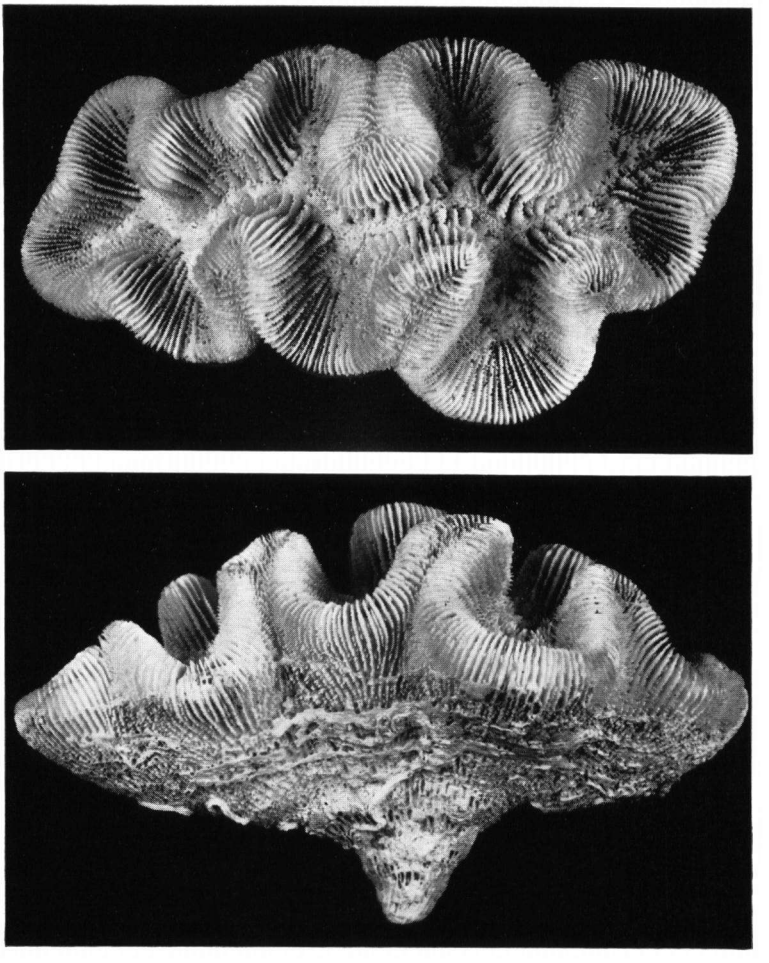
XXXIIIb. *Colpophyllia natans* (Muller), (same specimen, × 0.14).





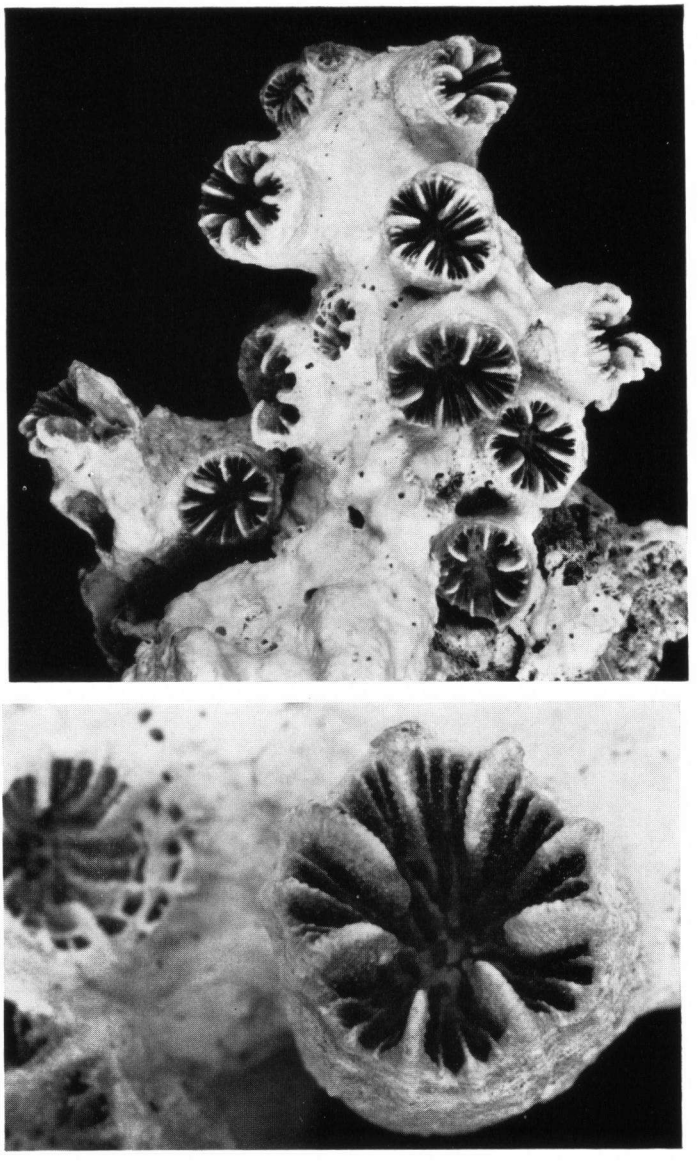
XXXIVa. *Astrangia solitaria* (Lesueur), CURAÇAO, Spaanse Water (ZMA 172, × 1.3).

XXXIVb. *Astrangia solitaria* (Lesueur), CURAÇAO, Spaanse Water (same specimen, × 2.9).



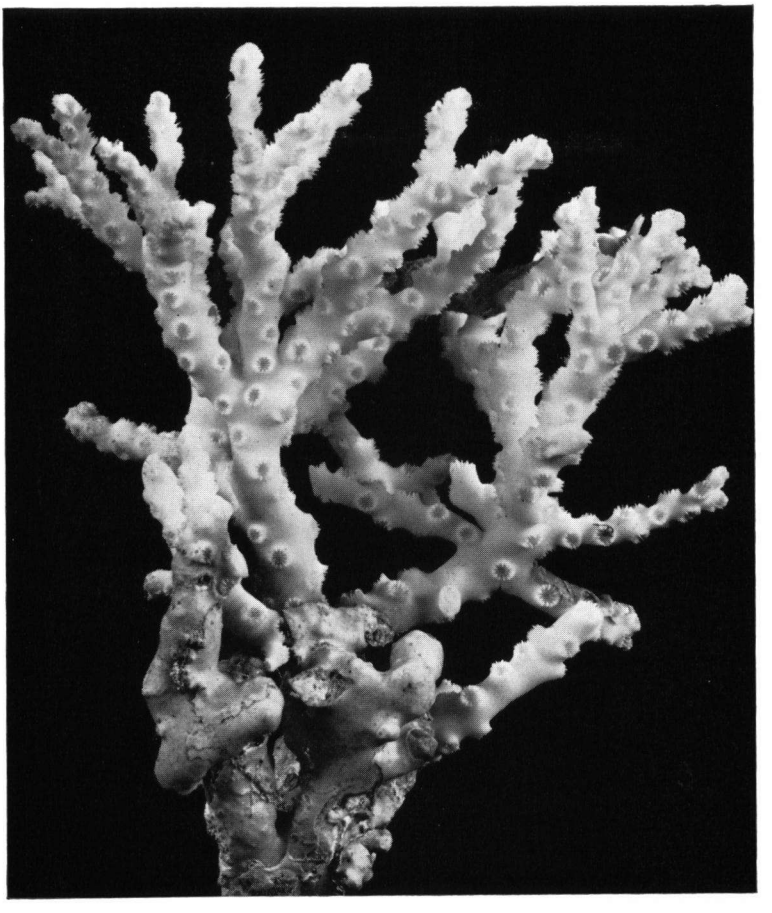
XXXVa. *Manicina areolata* (Linnaeus), ST. MARTIN, Anse des Pères (ZMA 3734, × 1.2).

XXXVb. *Manicina areolata* (Linnaeus), ST. MARTIN, Anse des Pères (same specimen × 1.2).

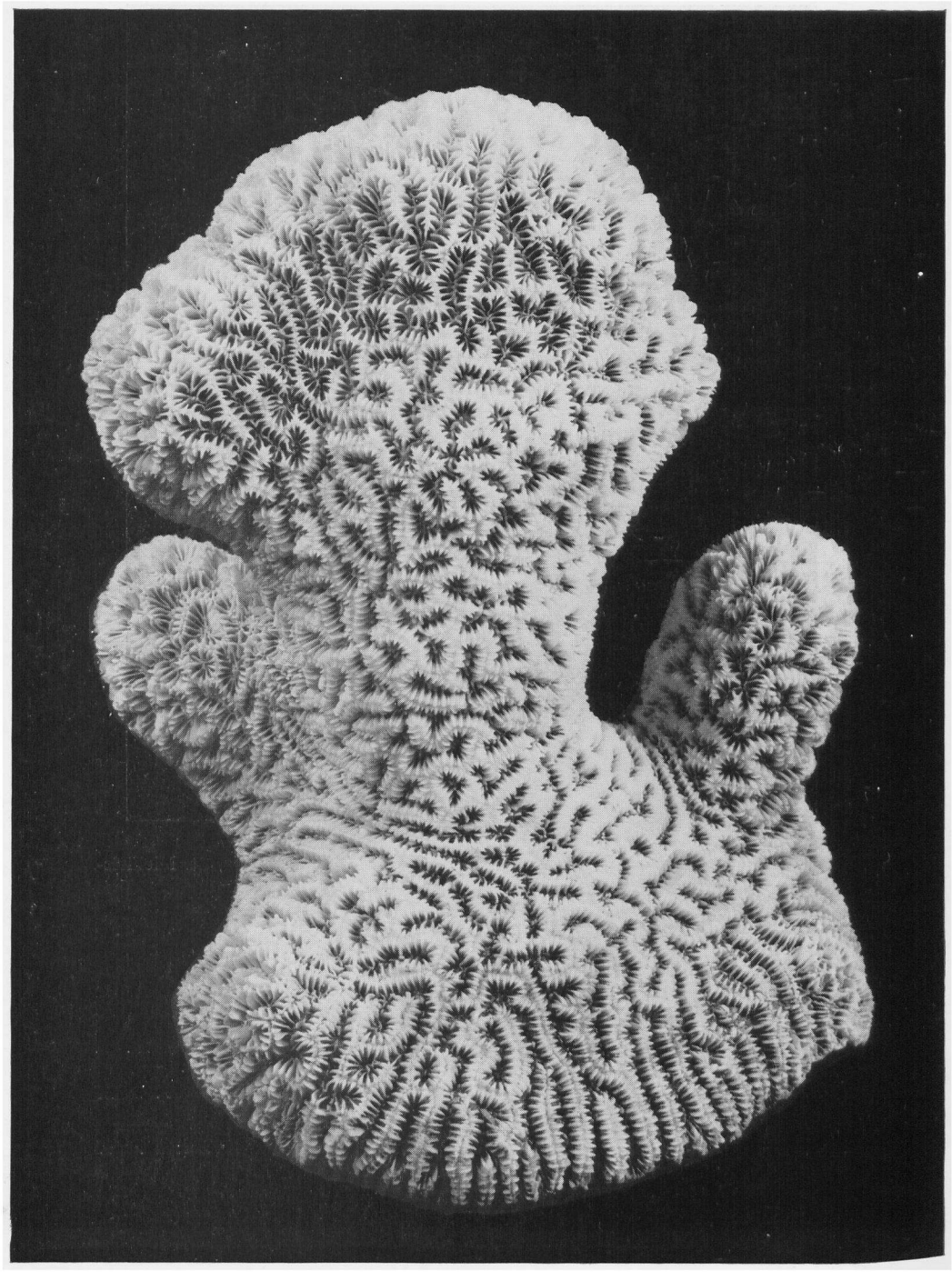


XXXVIa. *Phyllangia americana* Milne-Edwards & Haime, CURAÇAO, Spaanse Water (ZMA 954, × 2.4).

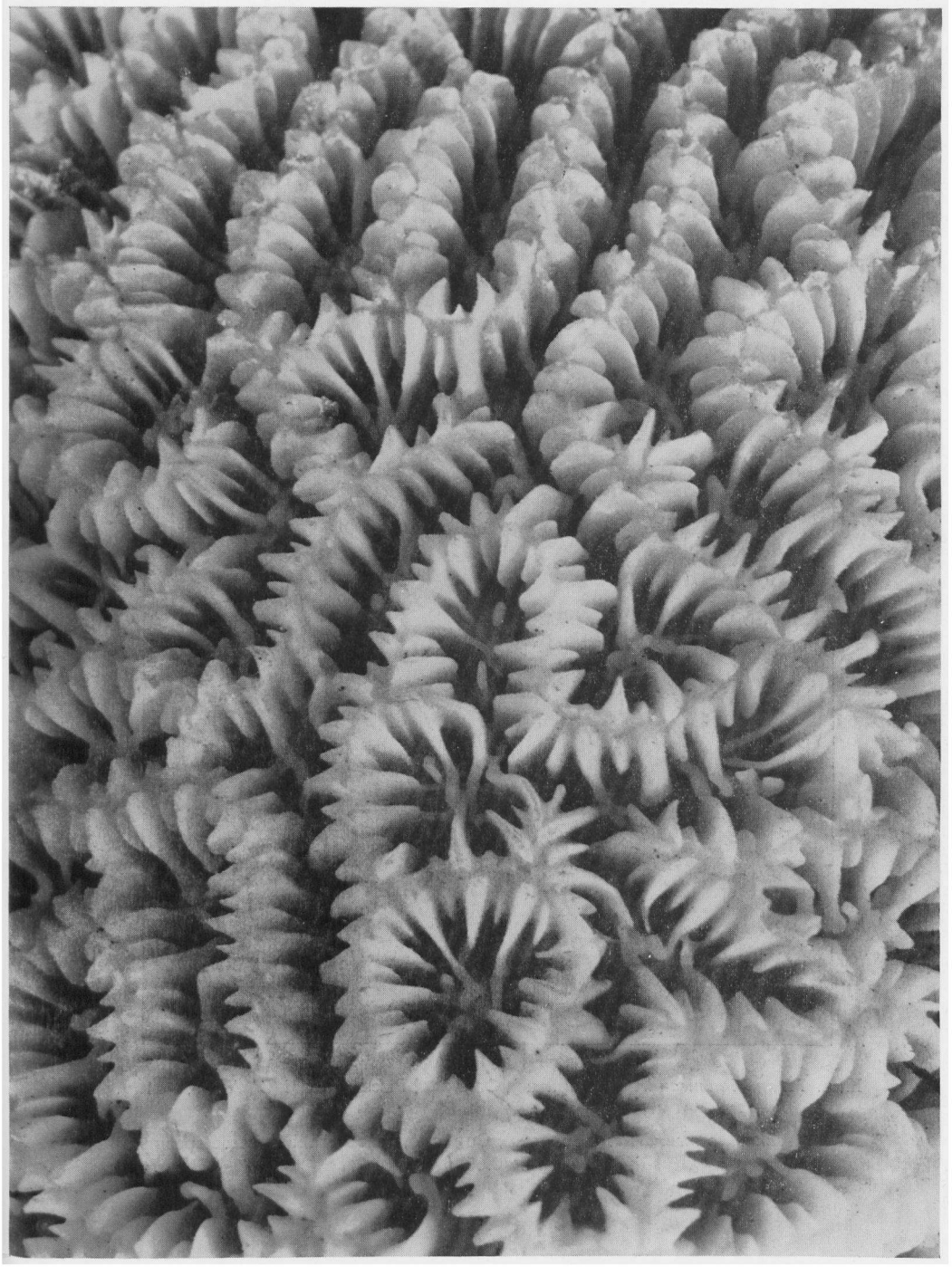
XXXVIb. *Phyllangia americana* Milne-Edwards & Haime, CURAÇAO, Spaanse Water (same specimen, × 6.5).



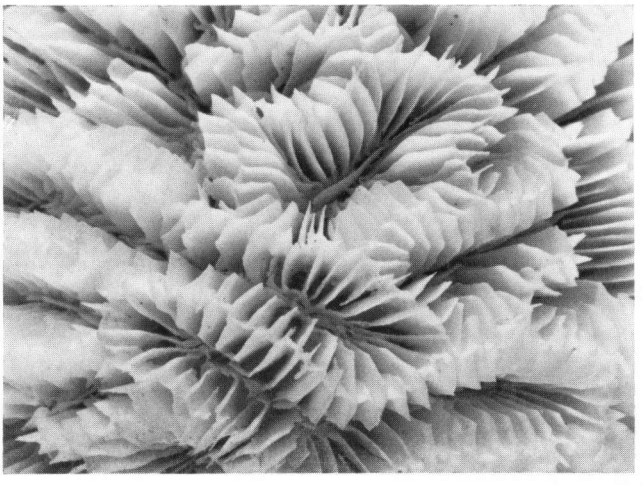
XXXVII. *Oculina valenciennesi* Milne Edwards & Haime, CURAÇAO, St. Michielsbaai (ZMA 3747, × 1.1).

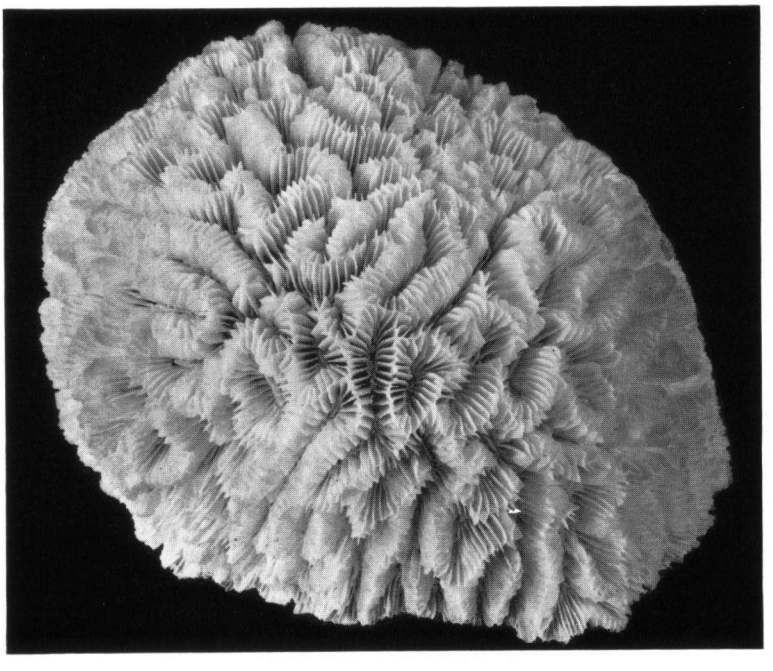


XXXVIII. *Dendrogyra cylindrus* Ehrenberg, CURAÇAO, Piscaderabaai (ZMU, × 0.81).



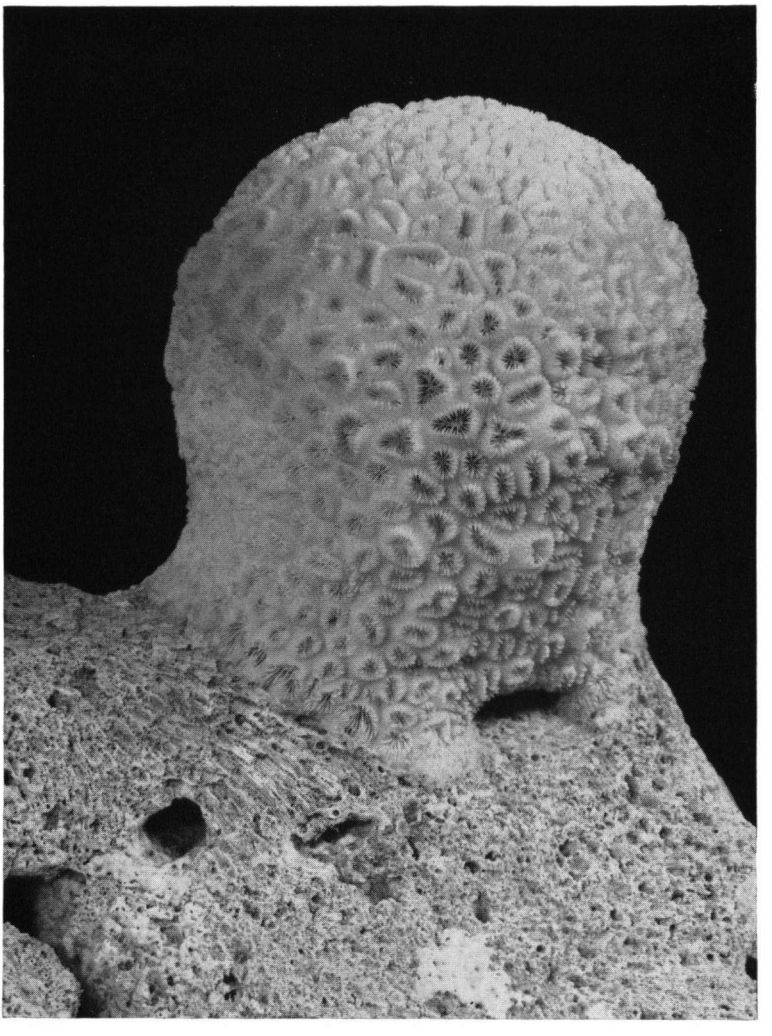
XXXIX. *Dendrogyra cylindrus* Ehrenberg, CURAÇAO, Piscaderabaai (ZMA 246. × 4.0).



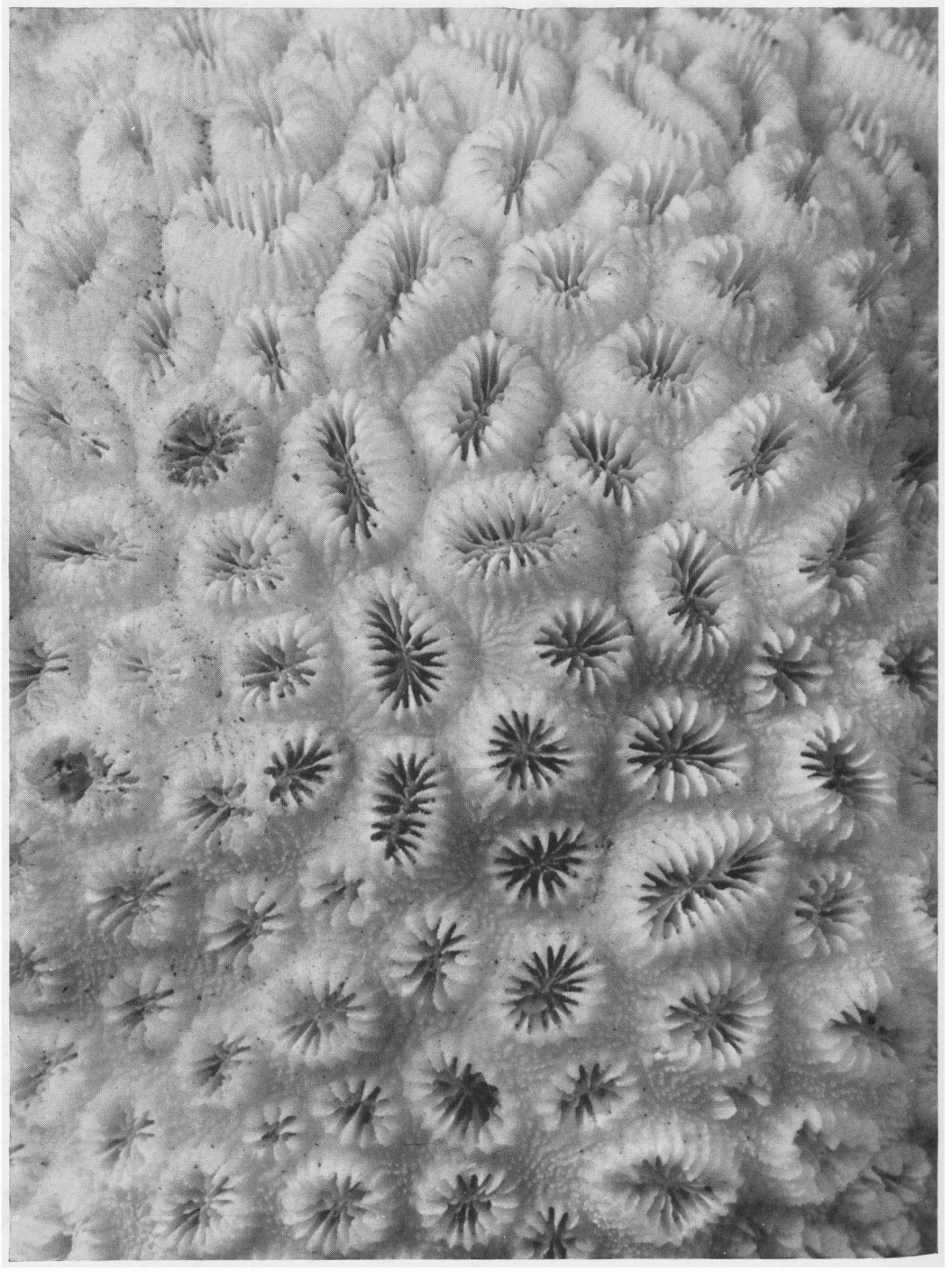


XLa. *Meandrina meandrites* (Linnaeus), CURAÇAO, Piscaderabaai (ZMA 865, × 1.5).

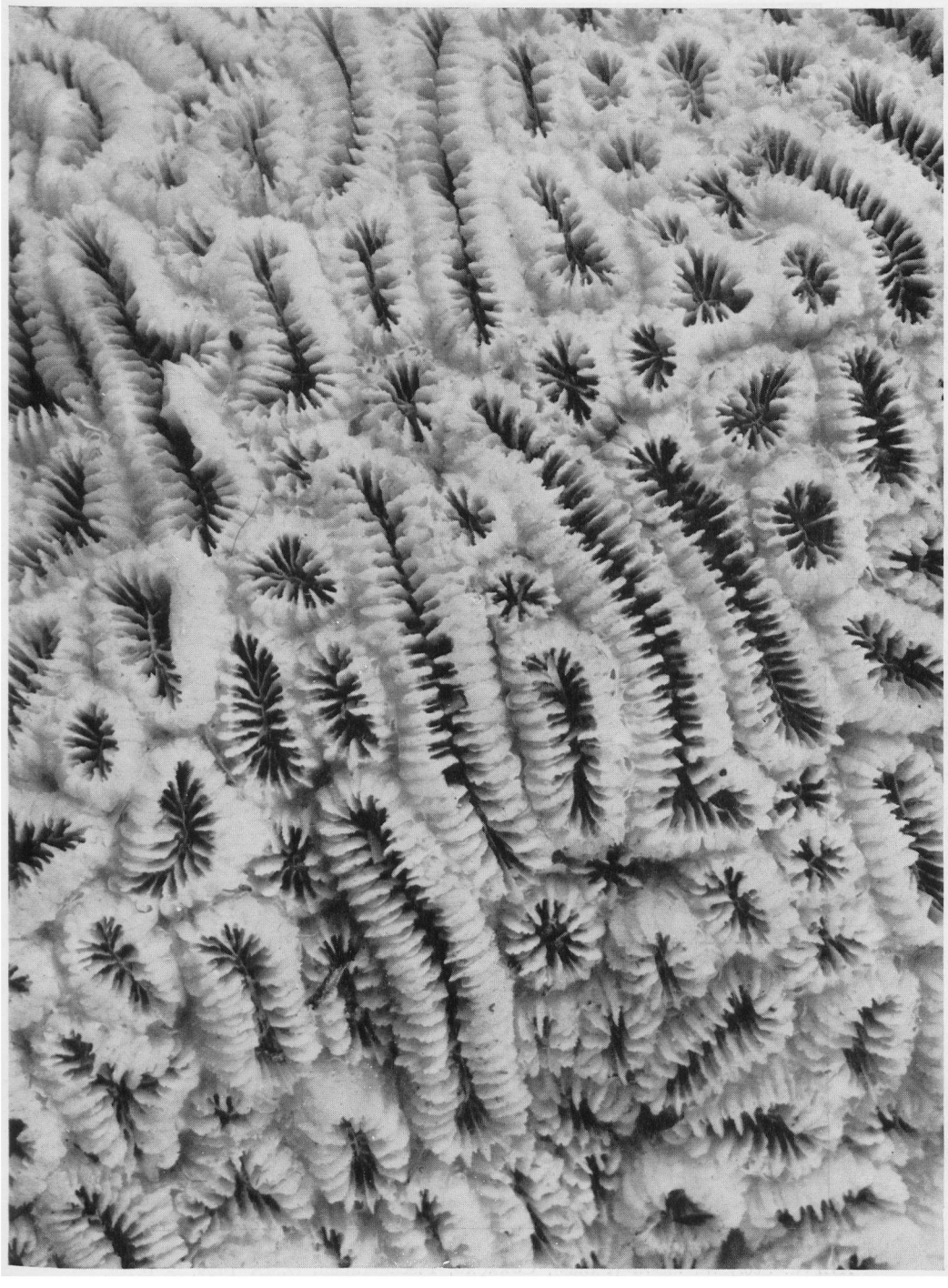
XLb. *Meandrina meandrites* (Linnaeus), CURAÇAO, Piscaderabaai (same specimen, × 0.65).



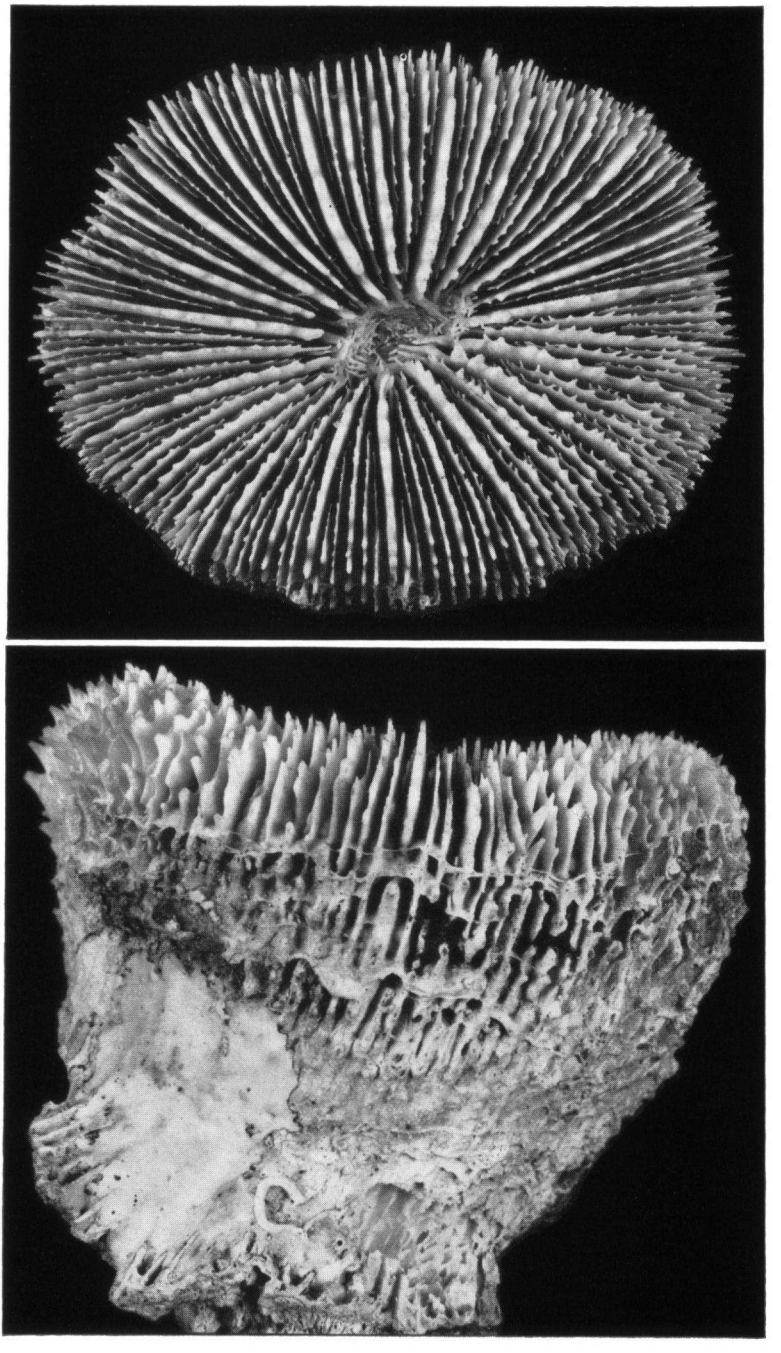
XLI. *Dichocoenia stokesii* Milne-Edwards & Haime, CURAÇAO (ZLU, × 0.72).



XLII. *Dichocoenia stokesii* Milne-Edwards & Haime, CURAÇAO (same specimen as XLI, × 3.2).

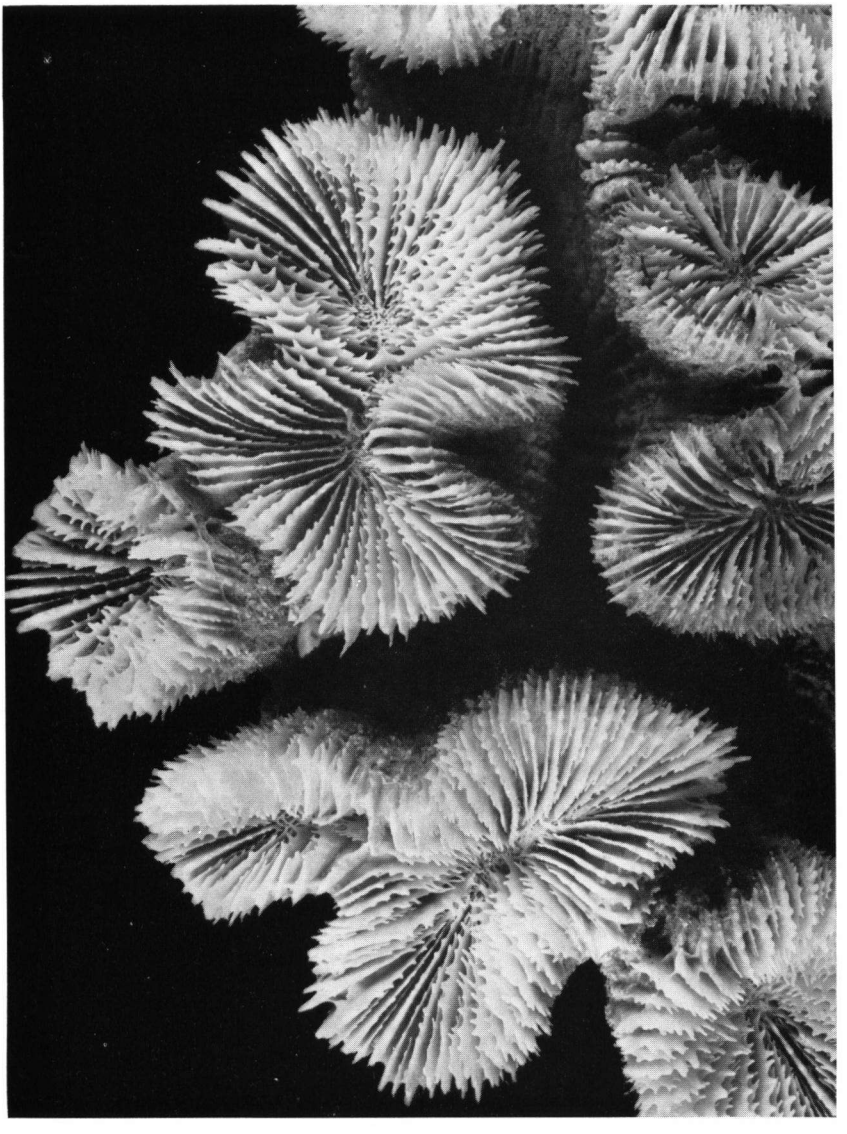


XLIII. *Dichocoenia stokesii* Milne-Edwards & Haime, CURAÇAO, Caracasbaai (ZMA 257, × 2.8).

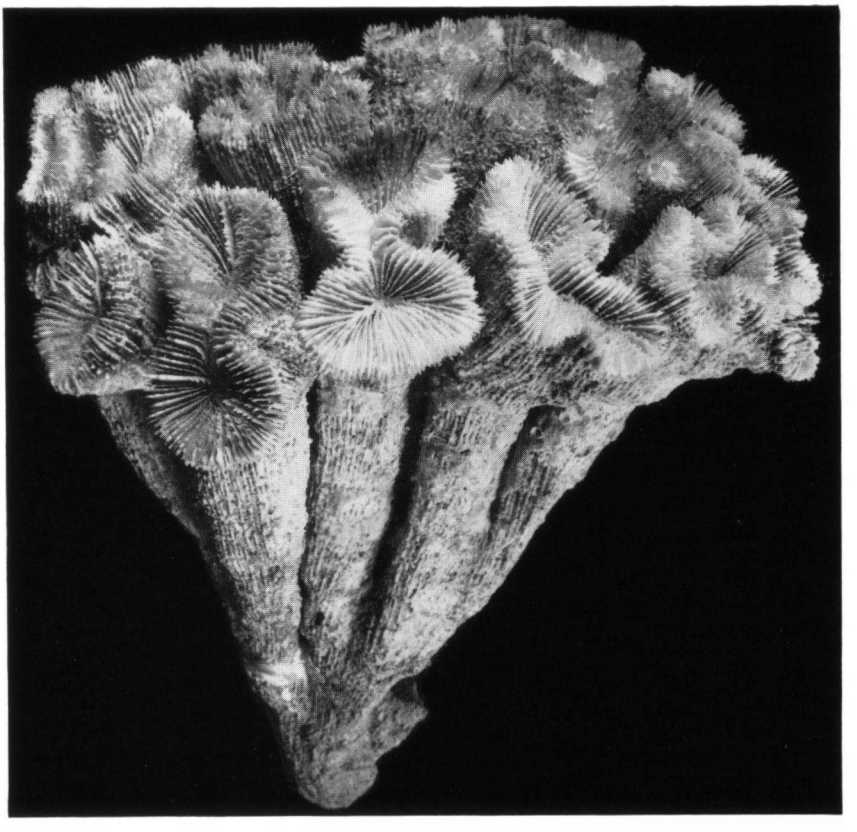


XLIVa. *Scolymia lacera* (Pallas), CURAÇAO, Piscaderabaai (ZMA 1459, × 0.90).

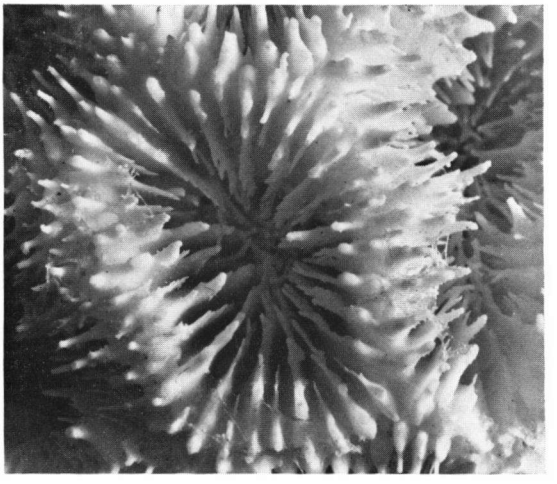
XLIVb. *Scolymia lacera* (Pallas), CURAÇAO, Piscaderabaai (same specimen, × 0.92).

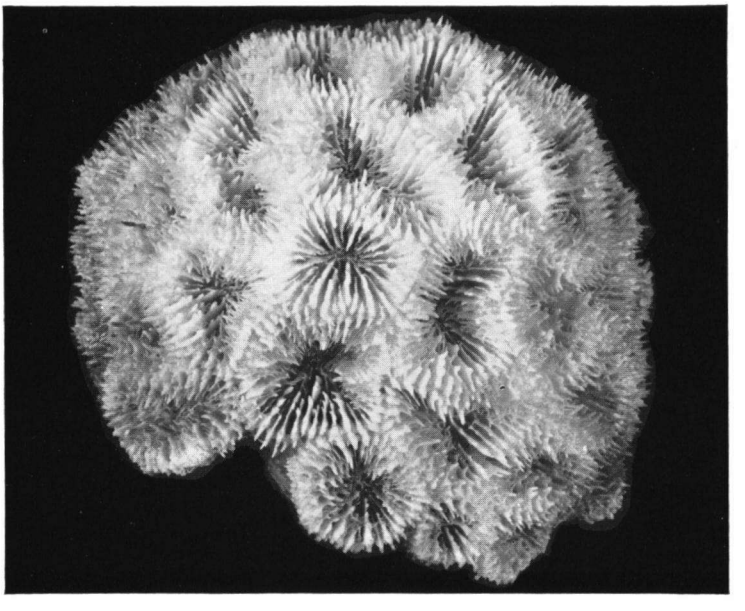


XLV. *Mussa angulosa* (Pallas), CURAÇAO, Piscaderabaai (ZMA 1456, × 0.98).



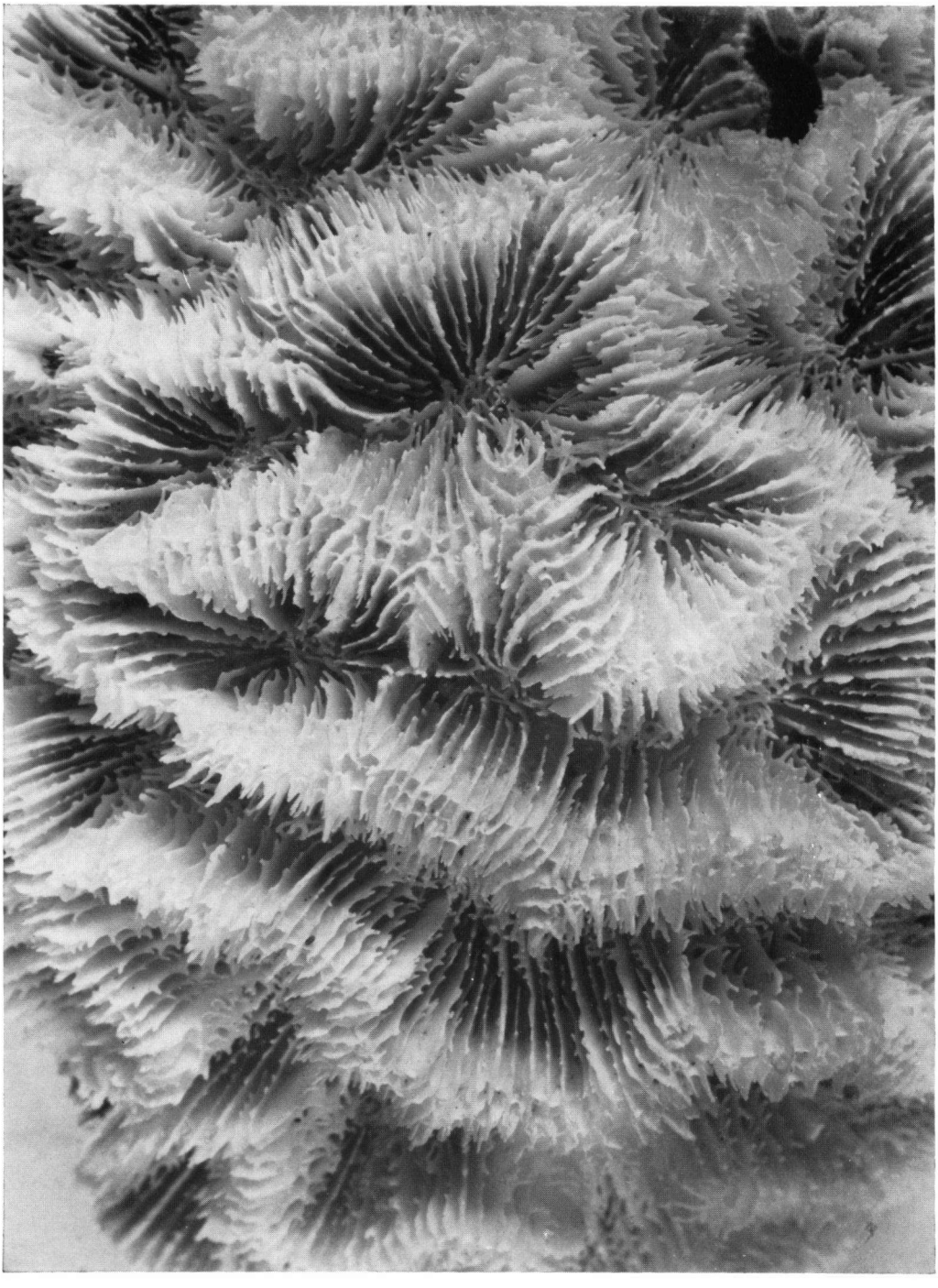
XLVI. *Mussa angulosa* (Pallas), CURAÇAO, Piscaderabaai (same specimen as XLV, × 0.38).



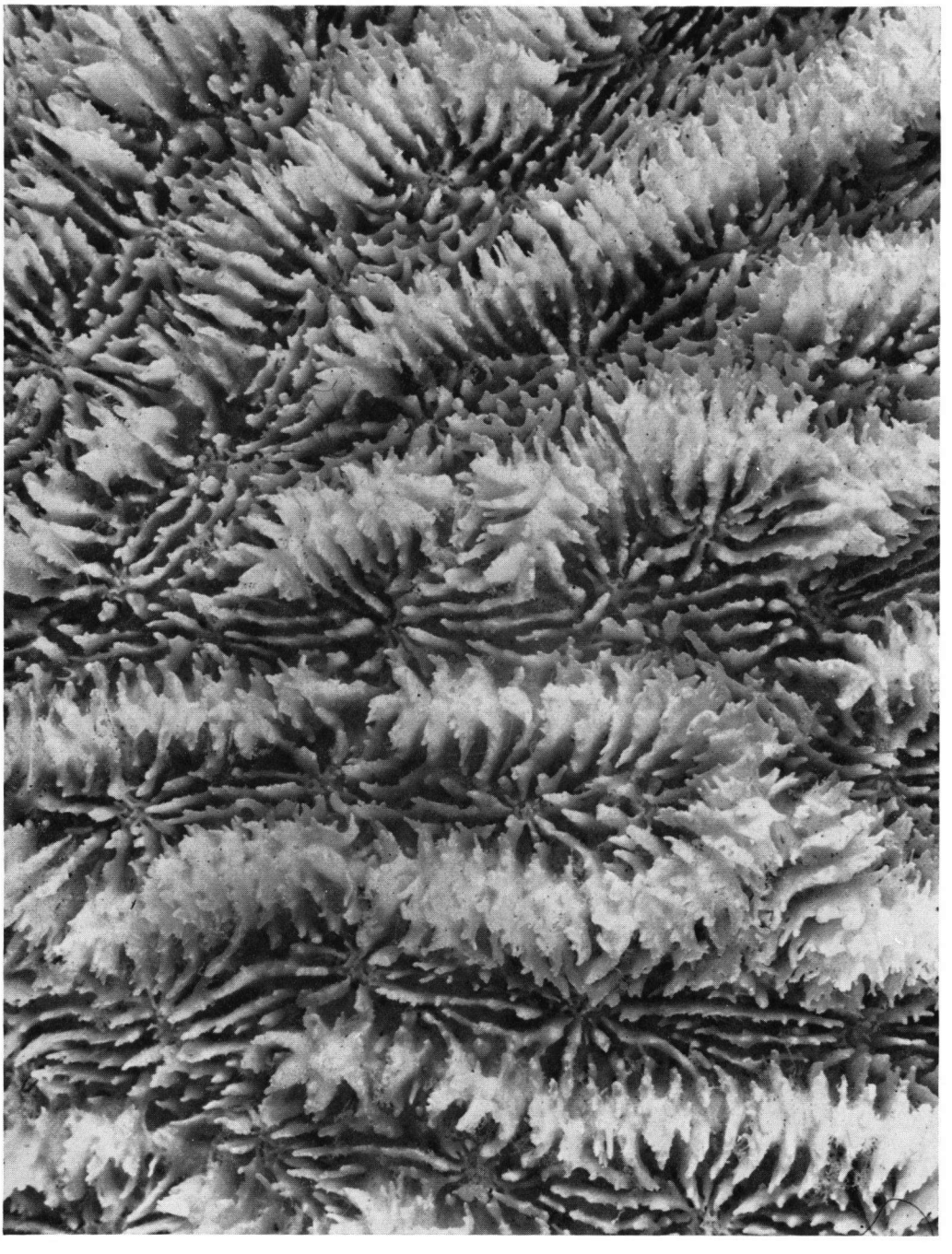


XLVIIa. *Isophyllastrea rigida* (Dana), CURAÇAO, Lagún (ZMA 333, × 4.0).

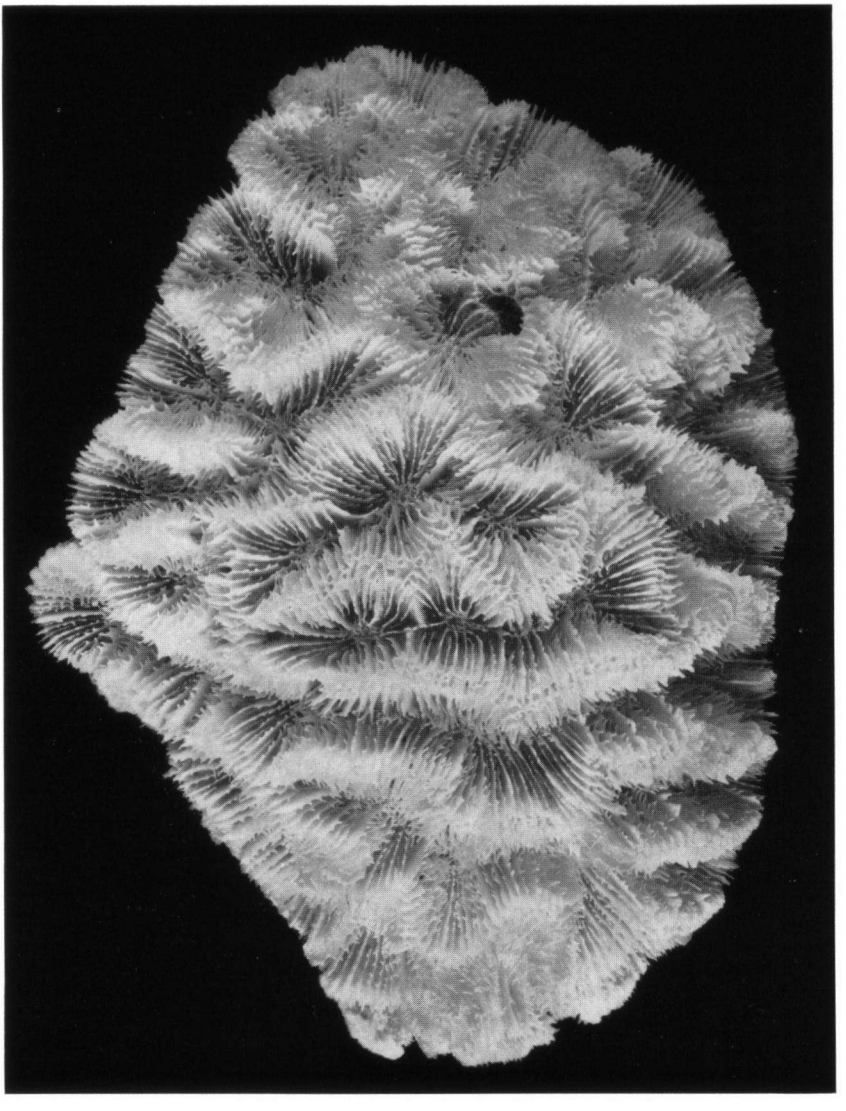
XLVIIb. *Isophyllastrea rigida* (Dana), CURAÇAO, Lagún (same specimen, × 1.2).



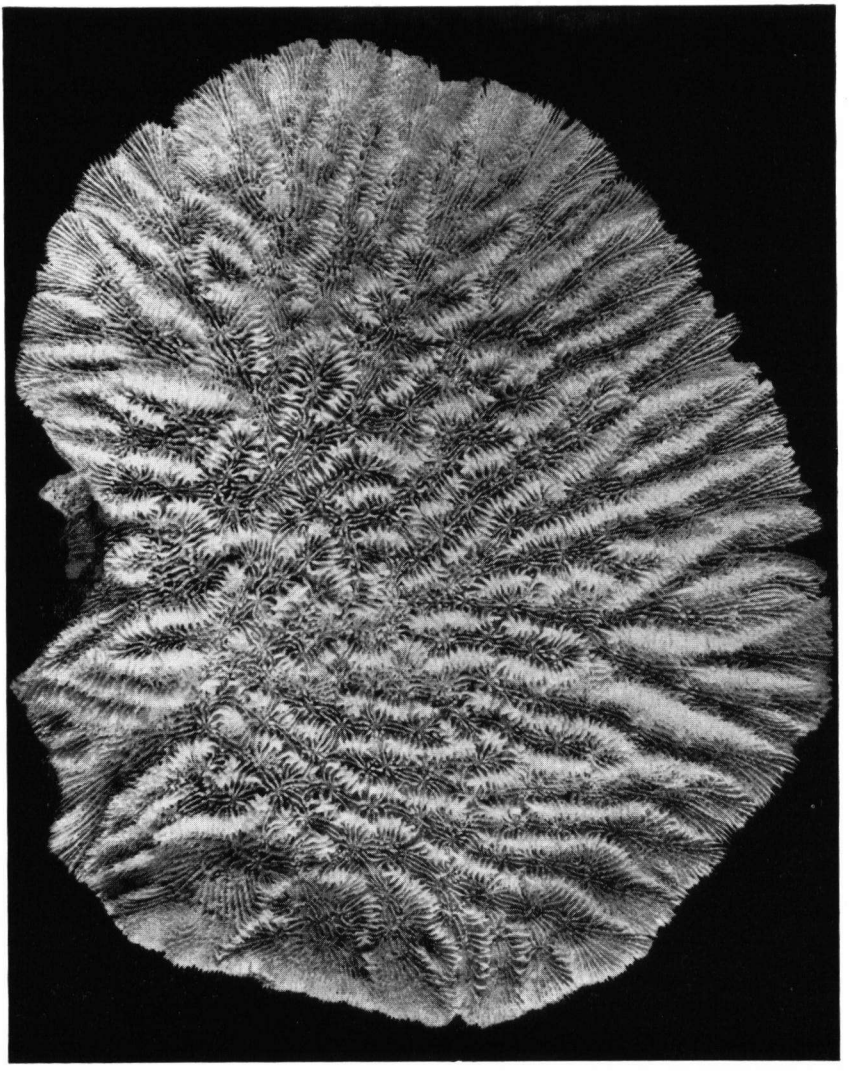
XLVIII. *Isophyllia sinuosa* (Ellis & Solander), St. Martin, Great Bay (ZMA 3736, × 2.0).



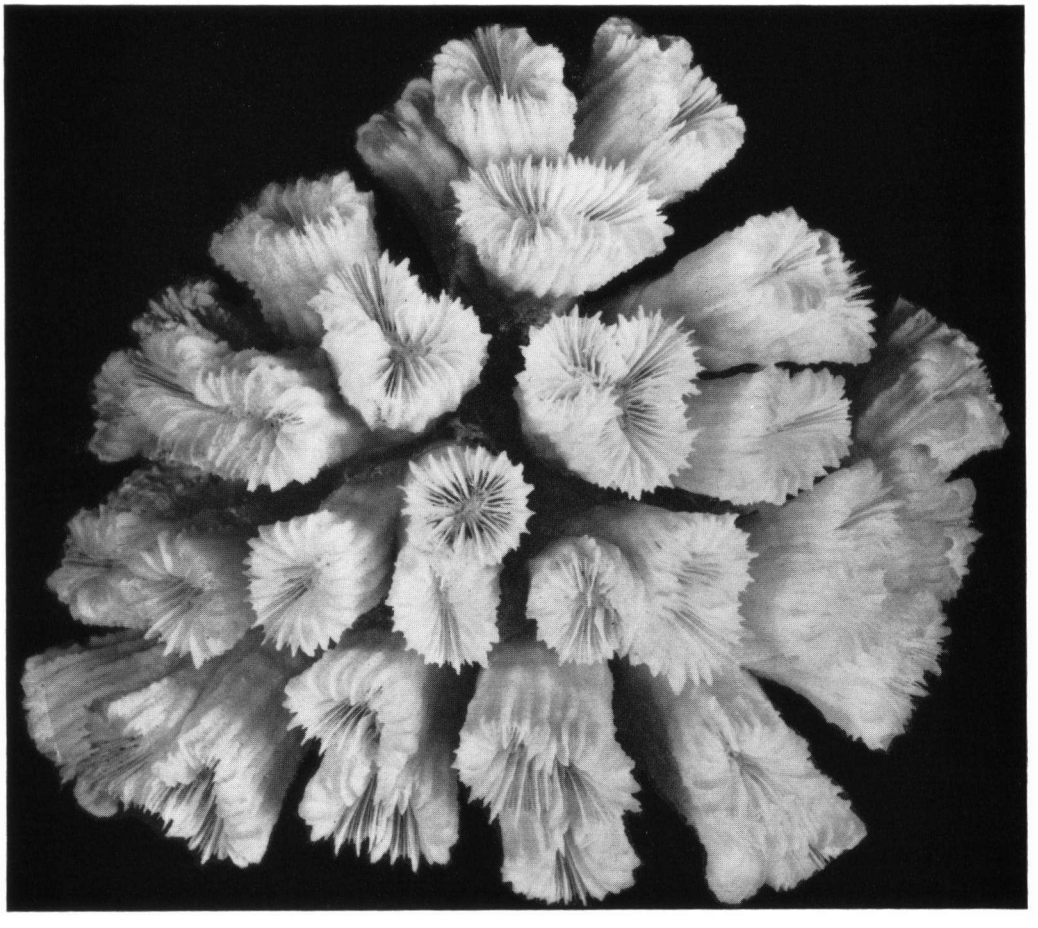
XLIX. *Mycetophyllia lamarckana* (Milne-Edwards & Haime), CURAÇAO, Piscadera-baai (ZMA 799, × 2.0).



L. *Isophyllia sinuosa* (Ellis & Solander), St. Martin, Great Bay (same specimen as XLVIII, × 1.0).

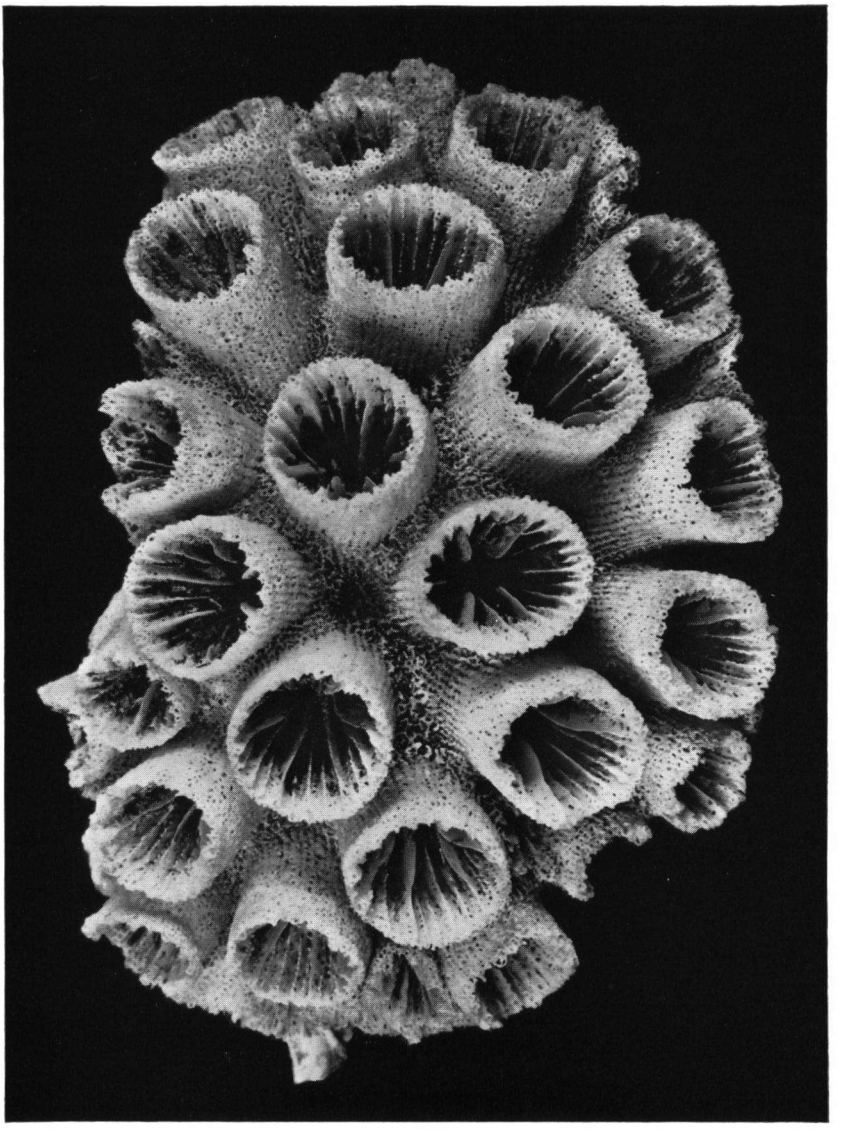


LI. *Mycetophyllia lamarckana* (Milne-Edwards & Haime), CURAÇAO, Piscaderabaai (same specimen as XLIX, × 0.59).



LIIa. *Eusmilia fastigiata* (Pallas), CURAÇAO, Kaap Malmeeuw (ZMA 297, × 2.4).

LIIb. *Eusmilia fastigiata* (Pallas), CURAÇAO, Kaap Malmeeuw (same specimen, × 0.88).



LIII. *Tubastrea tenuilamellosa* (Milne-Edwards & Haime), CURAÇAO, Ship's bottom (ZLU, × 2.3).