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THE CORAL GENUS *ACROPORA* (SCLERACTINIA: ASTROCOENIINA: ACROPORIDAE) IN THE CENTRAL AND SOUTHERN GREAT BARRIER REEF PROVINCE

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ABSTRACT

The genus *Acropora* (excluding subgenus *Isopora* Brook) is revised from zonation studies on two reefs, and incidental collecting from many other localities in the Great Barrier Reef Province. As a result of field studies, many species are placed in synonymy, and a resulting forty species are redescribed. The revision includes description of field characteristics of the species, many of which were previously known only from small skeletal series. Problems of identification and delimitation of the various species are discussed.

In the Great Barrier Reef Province, as in most Indo-Pacific reef areas, the regions of densest coral growth are regions dominated by the branching coral genus *Acropora*. Over 300 species have been described for this genus. Some 80 have been recorded from the Great Barrier Reef, and many more would have been added to this list had the reef slopes and deeper waters been more accessible to early collectors. The original 300 may be reduced to around 70 by synonymy, and the 40 species here treated are considered to represent at least 90% of the branching *Acropora* in the Great Barrier Reef Province.

The following is a working paper on the taxonomy of this neglected genus. It is based on regional studies in the Great Barrier Reef region, and in particular on line transect studies carried out at Big Broadhurst Reef (Wallace 1975, Wallace and Dale 1977) and Bushy-Redbill Reef (Wallace and Lovell 1977, Wallace unpublished). It is an attempt to open the study of the genus to workers in all aspects of coral study and to this end it concentrates on field description of the species.

It is clear to the author after some experience with the genus that few species can be fully understood by simple morphological studies of colonies, even with the addition of ecological information. Even the population cannot be considered a sufficient unit for study as there are often other key species in the surrounding assemblage which may look like, physically interact with, or affect the members of the population in some way. This paper seeks to indicate such problems.

TAXONOMIC HISTORY

The name *Acropora* Oken, 1815 was officially validated in 1963 (Boschma 1961, China 1963). It came into general use with Verrill (1902), although not without some argument and nostalgia for the previously widely used *Madrepora* Lamarck: 'it is with a feeling of regret that we are forced to abandon the use of a generic name which remained unquestioned by four generations of authors during the golden days of systematic zoology' (Mayor 1924, p.vii).

Many authors have described species in this genus. Few have attempted to synonymise or group species, fewer still to define and standardise terms. The most notable single contribution to the taxonomy of the genus was that of Dana (1846) who gave very careful attention to his specimens collected during the United States Exploring Expedition. His arrangement of species according to colony shape and radial corallite shape without defined subgeneric status remains the simplest and most acceptable treatment of the genus.

Brook (1893) produced the only true monograph of the genus, summarizing all previous work and re-describing all described species. He ordered the species into subgeneric groups, attempting to

take into account all skeletal characters, but his subgenera have not found general acceptance: indeed, current synonyms often span the groupings. Brook unfortunately did not examine Dana's specimens, although he did see most of the European located types, and most Dana species can be shown to have a Brook synonym. Verrill (1902) also split many Dana species needlessly. Nemenzo (1967) revived the use of group names, although not affording subgeneric status to his groups.

Of the twentieth century authors, Vaughan (1918), Hoffmeister (1925), Crossland (1928, 1952) and Wells (1954) have treated the genus in detail, with ecological data, although not concentrating exclusively on *Acropora*.

Detailed underwater studies of *Acropora* were first made by J. Verwey in the Bay of Batavia in the 1930's, and the taxonomic results of his study are still unpublished (see Umbgrove 1939, p.56, 1940, p.303; Wells 1954, p.414). In discussions with Dr Verwey I have found that we are usually in agreement in our general assessment of species limits (though obviously not always on names). His opinions pre-date those of this paper by some forty years, and it is hoped that his work, which is to be a complete monographic treatment of the genus, will soon be available.

Characters and Terminology

(For coral terminology not specifically referrable to *Acropora* see Moore, Hill, and Wells 1956).

Acropora lacks most of the skeletal characteristics used in the species identification and study of variability of other corals, e.g. columella, dissepiments, septal structures. The main character defining the genus is the method of branching: an axial polyp builds a corallite of increasing length, and buds off radial polyps from its growing tip. Any radial polyp has the potential to take up an axial role. A variety of branching patterns occur, and these (with commonly applied terminology) are summarized in Figure 1.

The polyps have twelve tentacles, one of which (overlying a directive septum) is longer than the others. Two cycles of simple trabecular septa can be expressed in the corallites, although further cycles may be apparent in the walls. The walls, regarded as synapticulothecae (Wells 1956) have recently been shown to have septal contribution (Ricart y Menendez and Freidman 1977). See plate 43 and Figure 1 for a summary of these features).

The axial corallites are usually described by measurements, (in this paper expressed as inner and outer diameter) and by septal development (here expressed as maximum observed development, to an approximate fraction of the radius, e.g. to 1/3R). The radial corallites are described according to their shapes, summarized in Figure 2.

'Coenosteum' as described for *Acropora* commonly refers to both external corallite and intercorallite features. The walls of corallites are often clearly costate, in which case the intercorallite material is usually a spongy reticulum, with or without spines. Sometimes there is little or no difference between the appearance of the two areas. This is usually when the coenosteum is a dense arrangement of elaborated spines. With electron microscopy different categories of spines can be seen and the coenosteum can be more accurately described (Wallace and Grimmer, in preparation).

Variability

All Scleractina are capable of broad morphological variety, but in *Acropora* this can be

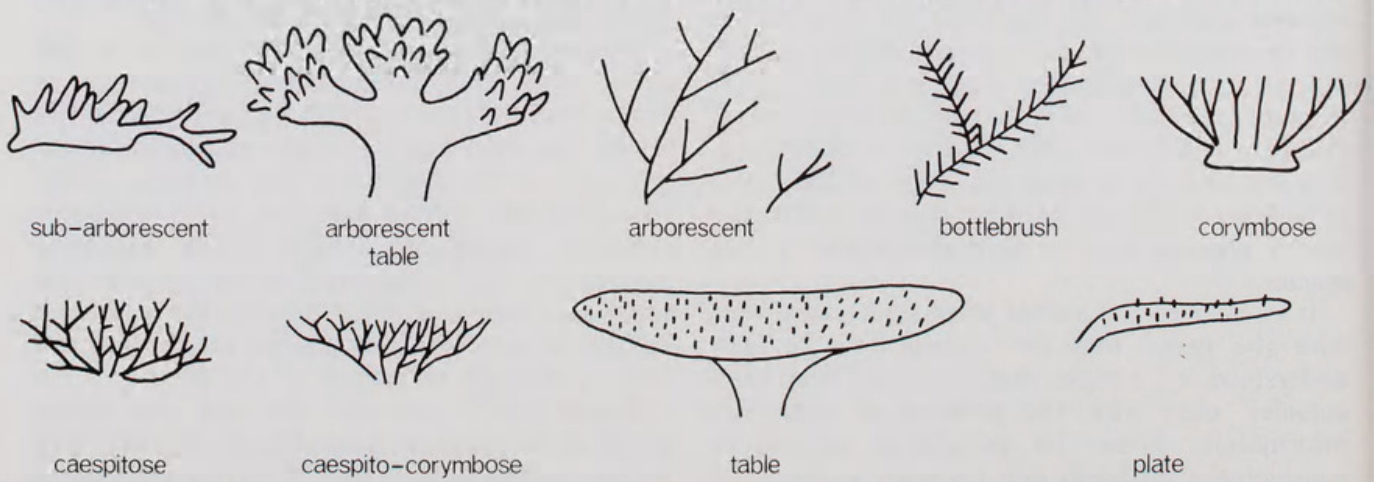

Fig. 1: Common colony shapes in Great Barrier Reef *Acropora* and their nomenclature.

particularly subtle. A number of features contribute: the axial method of growth allows a continuum of shape possibilities, which may be exploited differently by the species, the population, the colony, or even parts of the colony. The simplified skeletal structure allows the application of only a limited descriptive terminology, and description of small variations is always difficult. Detailed measurements for analysis of variation often show similar variability within the colony to that in the entire population (Wallace, unpublished, for *A. millepora* and *A. aspera;* similarly high variability in *Porites* is shown by Brakel 1977). In fact the absolute variation in size of most skeletal features within the entire genus is relatively small for a coral group.

In this much speciated genus there is a tendency for numbers of species to co-occur. Often differences between species can be seen in population strategies and slight differences in habitat preference.

Despite the above, some of the taxonomic confusion so repeatedly quoted in the literature disappears when the taxonomist enters the water. This is particularly so with reef slope species where growth form and other features can often be seen to alter gradually with depth. It can be stated unequivocally that the most complex species taxonomically are those occurring on the shallow reef flat, and none of these can be considered to be fully described in the present paper.

Some generalizations can be made, and should be born in mind when interpreting the taxonomic section:

(1) Some reef regions support predominantly characteristic colony shapes, which can be attributed to physical parameters (in particular low-profile corymbose shapes on the outer reef flat where exposure is great (low water depth); small flat plates on the deep reef slope where light availability is limited). In these areas the species composition can be expected to include (a) species capable of only that shape; (b) species having the shape within a range of phenotypic variability; (c) morphs of polymorphic species.

(2) All species which extend down the reef slope exhibit a gradual flattening out of shape with depth, and the ratio of radial to axial corallite numbers decreases. These flat colonies can be recognised for what they are if the observer investigates shallower sections of the populations. (In skeletal collections they are more difficult to sort). A few species are characteristically flat but with high radial to axial corallite ratio, and do not extend into deep water. At least one species *(A. granulosa)* is apparently adapted to low-light situations, and has a characteristic distribution which includes shallow but shaded situations.

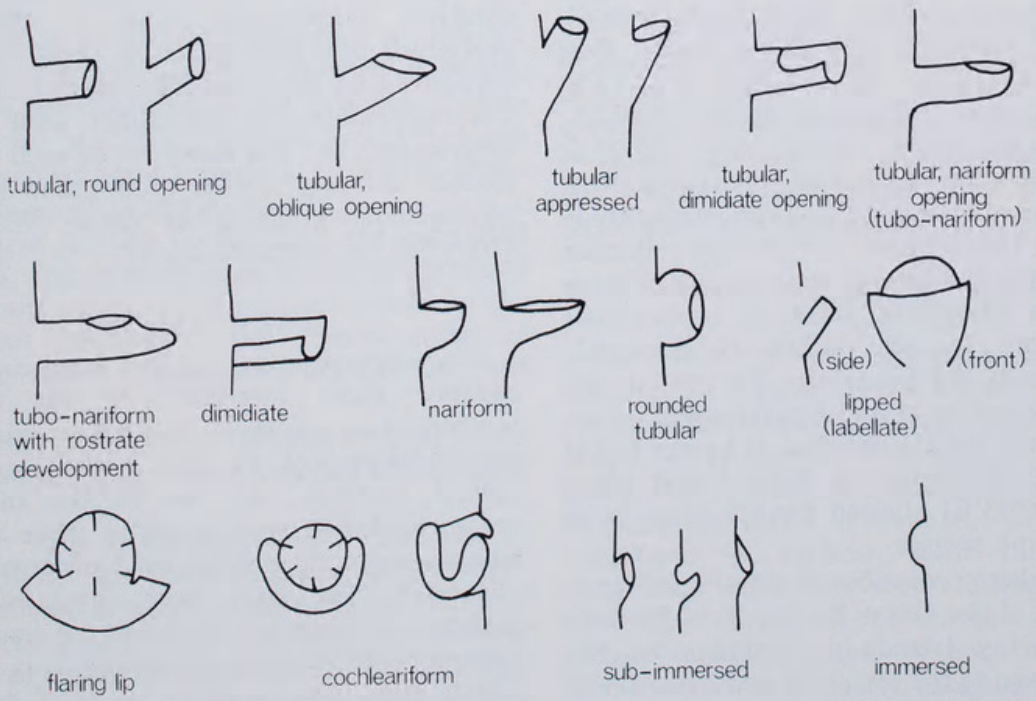

FIG. 2: Radial corallite shapes in Great Barrier Reef *Acropora* and their nomenclature.

(3) Some basically arborescent species which occur on the reef flat may exhibit diverse growth forms adapted to different habitats.
(4) The greatest variety of colony shape seems to occur in areas with good water cover and reasonable water circulation, such as deep 'middle reef flat' areas and leeward patch reefs. Many species can be thought of as achieving their most 'characteristic' shape in these areas. Here also many colonies achieve colossal size.

Many species have characteristic colouration, at least locally, which can be used as a guide to identification but it should never be supposed that this is the only possible colour for the species.

Methods

Field Studies: The observations in this paper are the result of a variety of studies on reefs in the Central and Southern Great Barrier Reef Province (see Maxwell 1968). They concentrate on reef slope and other below-L.W.M. areas, as the corals here have previously been least observed. On Big Broadhurst Reef (18°55'S; 147°44'E) observations and collections were made serially across the outer reef flat and down the reef slope (see Wallace 1975; Wallace and Dale 1977). Similar techniques were used on the reef flat at Redbill Island (20°57'S; 150°05'E) (Wallace, unpublished). Collections with habitat data were made at Bushy-Redbill Reef (see Wallace and Lovell 1977), Darley Reef (19°24'S; 148°05'E), Bowden Reef (19°02'S; 147°06'E), Prawn Reef (19°02'S; 148°05'E), Viper Reef (18°53'S; 148°10'E), Tryon Reef (23°15'S; 151°47'E), Lady Musgrave Reef (23°55'S; 152°24'E), and Heron Island reef (23°27'S; 151°55'E). Detailed samples of populations of *A. millepora* and *A. aspera* for a morphometric study were made at Heron Island. A reference collection was made in the Fiji Islands, type locality of many of the species. Occasional reference is also made to observations by the author at Enewetak, Marshall Islands and Tongatabu, Tongan Islands. A recent opportunity to study specimens at James Cook University (JCU) collected at Lizard Island (14°40'S; 145°28'E) and the Palm Island group (18°40'S; 146°33'E) allowed further notes to be added for some species.

Other workers contributed specimens from various parts of the Great Barrier Reef Province and the Murray Islands. Information on this material is given to the text, and locations of reefs can be seen in Maxwell (1968, figs. 17A-D). Other material examined in the Queensland Museum included the collections of the Great Barrier Reef Committee (G.B.R.C.) and specimens mentioned by Stephenson and Wells (1956).

Type Material: Types were studied in the Smithsonian Institution (USNM), Yale Peabody Museum (YPM), British Museum of Natural History (BM), Museum National d'Histoire Naturelle, Paris (PM), University of the Philippines (UP). Fragments of type material were received on loan from the first three institutions, and photographs of type specimens were received from the Museum für Naturkunde, Berlin (MNB), the USNM and the BM. Collections were examined at the Rijksmuseum van Naturlijke Historie, Leiden (Verwey collections), Zoological Museum Amsterdam, and the University of the South Pacific, Fiji.

Laboratory Studies: Most specimens were stored as cleaned skeletons (preferably macerated and cleaned in water). Small fragments of some specimens have been preserved entire in buffered formalin. Observations on skeletons were made with a Wild M5 binocular microscope with linear measuring eyepiece. Where possible, particularly with type material, five observations per character were made for each specimen, but expediency prevented this procedure being used for all specimens. Additionally, representative specimens of each species were examined with scanning electron microscopy, and a standardized procedure for photographing axial and radial corallites and inter-corallite spines was followed. This information is sometimes used to clarify descriptions, but it is mainly to be used for a study further defining species groups and pursuing a phylogenetic grouping of them (Wallace and Grimmer, in preparation).

Use of the Text

Any taxonomic text has two main categories of readers: those interested in the taxonomic interpretation as such, and those requiring an identification tool. For this genus, I suspect the second category will be in the majority. I recommend that no attempt be made to identify single specimens without field observations, and conversely that field work (even when done without taxonomic emphasis) include casual assessment of affinities of colonies. Any field notes which allow specimens to be later grouped as series are useful.

For observing skeletal specimens with an incident light microscope a finger held between the light source and the specimen (to diffuse the light) enables corallite shape and septal features to be viewed clearly.

The photographic plates are considered to form a major part of the taxonomic description, because they (1) display field appearance of colony and habitat, (2) indicate size and shape of corallites, and where possible coenosteal texture, (3) indicate variety in all features. A fourth and most important role intended for the plates is that of a visual key. The identification process will be simplified if the user scans the plates before attempting to identify material. Reference to plate numbers is made once only for each description.

Where synonymy lists of other authors have been accepted without investigation these are quoted as (synonymy) after the author reference. Check-lists and catalogues (e.g. Rathbun 1887) are not used for synonymy lists. In this context Faustino (1927), being mainly a reiteration of previous descriptions, is regarded as a check list unless it makes an addition to information on a species.

The arrangement of species is partly in accordance with previous arrangements, and reflects my own views of affinities. Strongly supported affinities are grouped as species-groups. As both detailed morphological and phylogenetic affinities of species will be pursued in a later paper this arrangement must be considered a working guide only.

One species group, that including *A. palifera* (Lamarck) (i.e. the subgenus *Isopora* of Brook, 1893), has been omitted as this is under scrutiny in population studies by Potts (1976, 1977) and will be given separate taxonomic treatment (Potts and Wallace, in preparation).

Specimens quoted in the text are registered specimens, and in most cases further unregistered material and spirit specimens are located in the Queensland Museum (QM). Small reference collections will be lodged in the USNM, BM, and MNB.

Depth ranges recorded for species apply to the areas studied, and these may differ in other areas.

Finally, some of the taxonomic format used by other authors has been omitted. For example, many authors describe undersurface details of colonies. As these depend on general colony shape and are reductions of upper surface features their usefulness is questionable. Radial corallite measurements are not given, as a statistically acceptable assessment of these which is comparable across different shapes has not been arrived at (the illustrations and previous authors' descriptions give an indication of size range).

SYSTEMATICS

Family ACROPORIDAE Verrill, 1901

Acroporidae Verrill, 1901, p.163; Wells, 1936, p.99; Wells, 1956, p.F372.

Massive or ramose colonies by extratentacular budding; hermatypic. Corallites small, synapticulothecate or septothecate, pseudocostate or costate, slightly differentiated from coenosteum. Septa non-exsert, in 2 cycles, formed by simple spiniform trabeculae projecting inward and upward from vertical mural trabeculae, commonly fusing to form laminae. Columella absent or trabecular and weak. Dissepiments thin and tabular when developed. Coenosteum extensive, light reticulate, flaky, generally spinose or striate on surface. (Modified from Wells 1956, p.F372).

Genus **Acropora** Oken, 1815

Acropora Oken, 1815, p.66; Verrill, 1901, p.164; Verrill 1902, p.208 (synonymy); Vaughan, 1918, p.159; Wells, 1956, p.F373 (synonymy); Nemenzo, 1967, p.47.

TYPE SPECIES: *Millepora muricata* Linnaeus, 1758.

Acroporidae which are ramose, rarely massive or encrusting; branching with an axial or leading corallite larger than the more numerous radial corallites budded from it; united by light, reticulate, spinose or pseudocostate or costate coenosteum. Columella and dissepiments absent. (Modified from Wells 1956, p.F374).

THE **'Acropora robusta'** GROUP

The four species *Acropora palmerae, A. robusta, A. rotumana,* and *A. abrotanoides* are very similar in corallite morphology but not colony shape. *A. palmerae,* described as a completely encrusting species (Wells 1954) can bear short vertical branches (Wallace, in prep.). *A. rotumana* is stalked, with thick alciform branching units or even forming a sturdy arborescent table. *A. robusta* can vary phenotypically from encrusting to open branching. *A. abrotanoides,* still poorly categorized, occurs as clumps of mainly vertical branches.

Ignoring this last species, the other species have strong habitat preferences: *A. palmerae* for rocky (typically algal ridge) locations; *A. rotumana* for deeper-water reef flat areas, *A. robusta* for the shallow outer reef. On Enewetak atoll in the Marshall islands *A. palmerae* and *A. rotumana* are very abundant and *A. robusta* rare (Wallace, in prep.). On the Central Great Barrier Reef where there is no distinct algal ridge, *A. palmerae* is absent, any encrusting colonies being recognisable as members of an *A. robusta* population; *A. rotumana* appears as a rare species.

Within each species there is also a phenotypic component to radial corallite variation: the radials are best developed on the most freely branching parts of the colony.

These features, and the added fact that the clumsy colonies never lend themselves to the collection of a truly representative sample, have led to the naming of many species from single or few fragments. As well as the species placed in synonymy here, a number of more obscure species-names possibly belong with these species, e.g. *A. cyclopea* (Dana), *A. cuspidata* (Dana), *A. conigera* (Dana), *A. smithi* (Brook). With the current lack of geographic studies on *Acropora* it is difficult and unwise to lump these.

The separation of the three species treated here is maintained on the basis of their apparent distinctness in Great Barrier Reef populations, and pending further regional studies.

Acropora robusta (Dana, 1846)
(Plates 44, 45)

Madrepora robusta Dana, 1846, p.475, pl.39, fig.3, 3a, pl. 31, figs. 3a–c; Brook, 1893, p.42 (synonymy).
Madrepora pacifica Brook, 1891, p.465; 1893, p.39, pl.30, fig.B.
Acropora pacifica: Crossland, 1952, p.202, pl.31, fig. 2, pl.32, fig.2; Nemenzo, 1967, p.54, pl.18, fig.4.
Madrepora decipiens Brook, 1892, p.456; 1893, p.51, pl.14, figs. B to D.
Acropora decipiens: Vaughan, 1918, p.165, pl.67, figs. 2, 2a, 2b; Nemenzo, 1967, p.60.

Material Examined

USNM: Fiji Islands, U.S. Expl. Exped., *A. robusta* holotype 297.

BM: Samoa, Rev. Whitmore, *A. pacifica* holotype 1875.10.2.13.[1] Rocky Is., G.B.R. Saville Kent *A. decipiens* syntypes 1892.6.8.82; 1892.6.8.85.

QM: Big Broadhurst Reef: SW. side, reef slope: 4m, 27.iii.1973, C.W., G10190; 2·2m, 11.x.1973, C.W., G10250; 1·5m, 18.x.1973, C.W., G10191; 1m, 26.iii.1973, C.W., G10194; SW. side, Outer reef flat: 11.x.1973, C.W., G10246, 18.x.1973, C.W., G10248; 22.x.1973, C.W., G10247.

Bushy-Redbill Reef: SE. side, reef crest, 27.xii.1972, C.W., G10193; S side, reef crest; 27.xii.1972, E. Lovell, G10192; 25.xii.1972, E. Lovell, G10257; W. side, reef crest, 22.xii.1972, C.W., G10258; W. side, reef slope, 19.xii.1972, E. Lovell, G10259; NW. side, reef crest, 30.xii.1972, C.W., G10193; NNE side, reef slope, 30.xii.1972, C.W., G10193; NNE side, reef slope, 30.xii.1972, C.W., G10197.

Bowden Reef: SW. side, reef crest, 15.vii.1972, C.W., G10198, G10199; slope of opening in SW. side, 26.vii.1972, C.W., G10256.

Bramble Cay: Dec. 1924, C. Hedley, G10201; Oct. 1924, C. Hedley, G10262.

Coates Reef, 13.viii.1924, 'Geranium', G10261.

Feather Reef, 11.viii.1924, 'Geranium', G10260.

Flinders Reef, Moreton Bay, W. side, 6.ix.1973, C.W., G10200.

Masthead Reef, NNE. side, reef crest, August 1974, J. Buhman, G10254, G10255.

Field Diagnosis

Colonies have stout branches which can be vertical cones, distorted humps, or freely branching horizontal units on different parts of the same colony. Sections of the colony can be completely encrusting. Those parts of the colony on solid substrate have the solid vertical cones, but these extend horizontally and branch freely where small holes in the reef, or the reef edge itself, allow. The low, distorted rounded humps are formed in very shallow (e.g. reef crest) areas. Prominent tubular radial corallites mixed with shorter ones are obvious at the tips of the cones and branches. Common colours are bright green with deep pink branch-tips and pink-brown, yellow-brown or cream.

Laboratory Diagnosis

Laboratory difficulties occur because usually only a piece of the heavy colony is collected. Two very different fragments are illustrated in Plate 45 figs. a and c. Crossland's plate 32, fig.2, shows another shape the branches can take.

Branching pattern: This is described above. The free branches are usually 20 to 35 mm diameter, but branchlets as narrow as 10 mm can occur; maximum length measured is 250 mm. The cones may be as thick as 40 mm at the base. The humps are either solid or encrusting, taking the shape of the substrate.

Axial corallites: Outer diameter 2·5 to 3·0 mm; inner diameter 1·2 to 1·5 mm. Septation: primaries to 3/4R, secondaries to 1/4R, usually incomplete. The axial corallites are not strongly different from large radial corallites, and on the rounded humps they may be absent altogether.

Radial corallites: Tall and short radial corallites mixed. The differences between the two are emphasised at the growing tips where the tall radials may be 5 mm long. On the low humps the differences may disappear entirely. The tall radials are tubular, with rounded, oblique or dimidiate openings. Their angle of extension from the branch decreases from 90° at the base to about 45° at the tips. The short radials usually have only a small section of outer wall present. Septation is usually well-developed in the tall radials (primaries to 1/2R, secondaries to 1/3R), and less developed in the short radials (sometimes only the directives visible).

Coenosteum: Costate on corallites, reticulate with simple spines in between.

Within Reef Distribution

The species occurs only in the shallow outer flat–reef crest area, and flourishes at the windward (SE.) end of the reefs.

Identification Difficulties and History

In the field this species is conspicuous and distinctive. In the laboratory the colony is poorly represented by fragments and there is the temptation to find a 'best fit' with one of the many described robust species, few of which have been described from the field. Only the most certain synonyms have been included: some of the robust species mentioned in the introduction may also be this species. The more slender free-growing branches resemble *A. intermedia*, and specimens of the two species can be confused in the laboratory (but never in the field). *A. palmerae* Wells may be synonymous. An encrusting colony of *A. robusta* with few vertical branchlets is illustrated in colour in Roughly 1936 (plate 6 upper).

Geographic Distribution

Indo-Pacific: China Sea, Philippines, Great Barrier Reef, Fiji Islands, Samoa, Marshall Islands (C.W.).

Acropora rotumana (Gardiner, 1898) (Plate 46)

Madrepora rotumana Gardiner, 1898, p.258, pl.23, fig.2.

Acropora rotumana: Hoffmeister, 1925, p.69; Wells, 1954, p.419, p.112, fig.1–3, pl.113, figs.4, 5.

Acropora tutuilensis (part) Hoffmeister, 1925, p.71.

Material Examined

USNM: Pago Pago Harbor, Tutuila, Samoa *A. tutuilensis* no. 4 (mentioned Hoffmeister, 1925); Rongerik Atoll 44477; Rongerlap Atoll 44478; Bikini Atoll, 44469, 44470, 44472, 44473, 44474, Enewetak Atoll 44475: *A. rotumana* (mentioned Wells, 1954).

QM: Big Broadhurst Reef: SW. side, outer reef flat: 14.x.1973, C.W., G10233; 22.x.1973, C.W., G10234, G10235; E. side, reef slope, 1m, 21.x.1973, C.W., G10236.

Bowden Reef: SW. side, reef crest, 15.vii.1972, C.W., G10263.

Field Diagnosis

Mature colonies are about 1·5 m in height and width. They have a sturdy tree-like appearance due to the small number of very stout branches which have some proximal vertical growth component, then become horizontal for most of their extent, and proliferate into small branchlets at the tips. This is not the full range of shapes possible in the species. At Enewetak Atoll, for example, it can form a stalked table (Wallace, in preparation). Colours: deep pinkish-brown or apple green. (See Gardiner 1898 for detailed field diagnosis).

Laboratory Diagnosis

The fragments collected from this species are usually branch-tips with a greater or lesser amount of branch remaining. They often have a 'distorted' appearance, due to the irregular secondary branching pattern.

Branching pattern: described above.

Axial corallites: Outer diameter 2·0 to 2·5 mm (in the G.B.R. specimens); inner diameter 0·8 to 1·2 mm. Septation: primaries present to 1/2R, few secondaries, up to 1/4R.

Radial corallites: Tall and short radial corallites mixed. Tall radials extend from branch at 45° to 90° and are tubular with round, oblique, dimidiate or nariform openings. Short radials usually have less than half the wall developed, and range down to immersed. Primary septa not well developed, up to 1/3R; secondaries absent or a few just visible.

Coenosteum: Costate or pseudocostate on radials, reticulate with simple spines in between.

Within Reef Distribution

Occasional colonies found just below the reef top on the upper reef terrace or in surge channel openings on the outer reef. Elsewhere (e.g. on Enewetak Atoll) it occurs in deep-water reef flat situations.

Identification Difficulties and History

This is one of the few *Acropora* species to be originally described from the field as well as from

skeletal material. Both Hoffmeister and Wells regard it as a good species because of its distinctive colony shape. Gardiner states it to be 'by far the most abundant coral on the reefs of Rotuma'. It cannot be distinguished from *A. robusta* or *A. abrotanoides* on radial corallite shape.

GEOGRAPHIC DISTRIBUTION

Pacific Ocean: Great Barrier Reef, Rotuma, Samoa, Marshall Islands.

Acropora abrotanoides (Lamarck, 1816)
(Plate 47)

Madrepora abrotanoides Lamarck, 1816, p.280; Brook, 1893, p.56 (synonymy).
Acropora abrotanoides: Crossland, 1952, p.204; Wells, 1954, p.418, pl.123, figs. 1, 2.
non *Acropora abrotanoides:* Vaughan, 1918, p.166, pl.68, fig. 2.
Madrepora deformis [non Michelin]; Dana, 1846, p.484, pl.43, fig. 1.
Madrepora danai Milne Edwards and Haime, 1860, p.560.
Madrepora danae: Brook, 1893, p.57 (synonymy).
Acropora danai: Wells, 1954, p.418, pl.111, figs. 4–6.

MATERIAL EXAMINED

USNM: Tahiti, U.S. Expl. Exped., *A. danai* holotype 303 (*M. deformis* of Dana); Marshall Islands, J. W. Wells, *A. danai* 45175 (mentioned Wells 1954).

YPM: Tahiti, fragment of type (labelled *A. deformis*) 4162 (mentioned Verrill, 1864)

QM: Big Broadhurst Reef, patch reef in lagoon, 28.iii.1973, C.W., G10238.

Bushy-Redbill Reef, NW. side, reef crest, 22.xii.1972, C.W., G10239.

Bowden Reef, slope of opening in SW. side, 26.vii.1972, C. W., G10240–2.

Viper Reef, patch reefs in lagoon, 1·5m., 16.vii.1972, C. W., G10243.

Great Astrolabe Reefs, Fiji Islands, 1974, C. W., G10244.

FIELD DIAGNOSIS

Colonies occur as tufts of sturdy vertical to oblique branches with appearance roughened by the presence of numerous incipient branchlets. Colour: yellow-brown.

LABORATORY DIAGNOSIS

Branching pattern (taken from five specimens): From a basal area (usually dead) a small number of sturdy branching units is given off. Each branching unit has a small number of main branches which are vertical or almost so, and the branches may branch again. In addition, each branch is roughened by the presence of incipient branches. The longest branch is 150 mm, and the widest 40 mm.

Axial corallites (on main branches): Outer diameter 2·5 to 3·8 mm; inner diameter 0·8 to 1·2 mm. Septation: primaries present to 1/3R, secondaries sometimes complete to 1/4R.

Radial corallites: Tall and short radials mixed. Tall radials tubular with round, oblique or dimidiate openings. Those with round openings usually can be recognised as incipient axials, themselves budding radials from their circumference.

Coenosteum: Costate on radials, reticulate with simple spines in between.

WITHIN REEF DISTRIBUTION

This species seems to be restricted to upper reef areas, mainly the outer reef flat and crest, and the tops of patch reefs in deep lagoons.

IDENTIFICATION DIFFICULTIES AND HISTORY

Brook describes his specimens in detail, and apparently examined Lamarck's type, which I have been unable to locate. All other authors had meagre or immature specimens (e.g. Vaughan's 'three small immature specimens'). There are no morphological characters supporting the separation of *A. danai*. *A. listeri* (Brook) may also be a synonym, but its validity could be tested by a study on the Tongan reefs.

This species still remains categorized only as a group of specimens, with no field identity. The fact that it eludes categorization in the field suggests that it is not a 'good' species. The abundance of incipient branches is a poor species character, but this is at present the main feature defining this species.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Singapore, Great Barrier Reef, Marshall Islands, Tahiti.

Acropora intermedia (Brook, 1891)
(Plates 48, 49)

Madrepora intermedia Brook, 1891, p.463; 1893, p.31, pl.1, fig. C.
Acropora intermedia: Crossland, 1952, p.200, pl.32, fig. 1; Stephenson and Wells, 1956, p.16; Pillai and Scheer, 1976, p.24, pl.2, fig. 1.

MATERIAL EXAMINED

BM: Maldive Islands, *A. intermedia* syntype 1886.11.22.6.

QM: Big Broadhurst Reef, SW. side, reef slope: 2m, 11.x.1973, C. W., G11400; 2m, 26.iii.1973, C. W., G11295; 3m, 28.iii.1973, C.W., G11310; 5m, 25.ii.1973, C.W., G11302; 5.3m, 13.x.1973, C.W., G11576; 6m, 25.iii.1973, C. W., G11301; 6·1m, 13.x.1973, C. W., G11582; 6·3m, 13.x.1973, C. W., G11579; 7·6m, 13.x.1973, C. W., G11575; 7·7m, 14.x.1973, C. W., G11578, G11580; 8m, 26.iii.1973, C. W., G11300; 8·3m, 15.x.1973, C. W., G11581; 8·6m, 15.x.1973, C. W., G11577; SW. side, outer reef flat: 11.x.1973, C. W., G11308, G11583; 22.x.1973, C. W., G11327, G11584; SW. side, floor of surge channel opening: 20.x.1973, C. W., G11307, G11309, G11585.

Bowden Reef, SW. side, upper reef slope, 26.vii.1972, C. W., G11316.

Bushy-Redbill Reef, S. side, reef slope, 3m, 27.xii.1972, C. W., G11311; adjacent Redbill Is., reef crest, 18.xii.1972, C. W., G11305; NW. side, first reef crest, 22.xii.1972, C. W., G11312, G11313; NNE. side, reef slope, Jan. 1973, C.W., G11391.

Heron Is., W. side, reef flat, 6.vii.1973, Y. Loya, G11297.

Field Diagnosis

Colonies vary from small clumps to small thickets of around 3m diameter and are sturdy-branched arborescent. The radial corallites are a mixture of tall and short tubular and are obvious under water. Colours are cream to pale brown, pale green or greenish brown or bright blue.

Laboratory Diagnosis

Branching pattern: Branches are given off at wide angles (45° to 90°) and branch width varies from 15 to 25 mm. Branches usually taper strongly.

Axial corallites: From barely exert to 2 mm exert. Outer diameter 3·0 to 4·0 mm (in QM specimens); inner diameter 1·1 to 1·5 mm. Septation: primaries well developed, often reaching 3/4R, secondaries usually present, up to 1/4R.

Radial corallites: Tall and short radial corallites are mixed. The tall radial corallites are tubular, up to 5 mm long, with round, oval or dimidiate openings and usually extend from the branches at 90° to 45°. Lower wall may be slightly thickened. Primary septa are developed up to 2/3R, and secondaries present, up to 1/4R. The smaller radials are tubular appressed or emergent, or sub-immersed, and oriented with their openings facing in random directions to the branch.

Coenosteum: Strongly costate on radial corallites, open reticulate with simple spines between radials.

Within Reef Distribution

Middle and outer reef flat, upper reef slope to about 12 m, surge channel floors and sandy bottoms around patch reefs.

Identification Difficulties and History

This species appears to be morphologically similar in radial corallite and coenosteal features to the *A. robusta* group. Many specimens are difficult to place exactly in either this species, *A. formosa* or *A. grandis*, and clearly all three species require further field study.

Geographic Distribution

Indo-Pacific: Maldives, Great Barrier Reef.

Acropora grandis (Brook, 1892)
(Plate 50 A,B)

Madrepora grandis Brook, 1892, p.457; 1893, p.42, pl.1, figs. A, B.

Acropora grandis: Crossland, 1952, p.202, pl.31, figs. 1, 3, 4.

Material Examined

BM: Palm Island, Saville-Kent, *A. grandis* syntype 1892.6.8.60; Herring Island, Bowen, Saville-Kent, *A. grandis* 1892.6.8.314; Rocky Island, Saville-Kent, *A. grandis* var. 1892.6.8.261.

QM: Big Broadhurst Reef, SW. side, reef slope: 6m, 25.iii.1973, C.W., G11320; 6·1m, 13.x.1973, C.W., G11366; 7m, 27.iii.1973, C.W., G11299; 7·1m, 13.x.1973, C.W., G11367; 7·7m, 14.x.1973, G11368.

Bushy-Redbill Reef, NW. side, first reef crest, 22.xii.1972, C.W., G11306, G11315, G11317.

Darley Reef, patch reef in lagoon, 4 m, 24.iii.1973, C.W., G11298.

Field Diagnosis

Openly arborescent colonies have scattered radial corallites of mixed size with large obvious openings, and may be brown, bright blue, bright purple or even greenish-brown with blue tips.

Laboratory Diagnosis

Branching pattern: Branches commonly spread at from 60° to 40° . Branches are from 10 to 30 mm thick, and may be as long as 30 cm without branching. They usually taper gradually.

Axial corallites: Up to 3 mm exert; outer diameter 2·5 to 3·5 mm; inner diameter 1·0 to 1·7 mm. Septation: both cycles may be present, the primary septa up to 1/3R, the secondary up to 1/4R.

Radial corallites: Two sizes of radial corallite occur. Towards the branch tips the large radials reach 3 mm length, but elsewhere they are much

shorter than this. The openings are round to oval, and are directed straight out from the branch, or nearly so. The septa are poorly developed: both cycles may be completely absent, or primary septa may be present up to 1/4R, plus a few secondaries.

Coenosteum: The surface has a light, crumbly appearance, the coenosteum being costate or reticulate on the radial corallites and open reticulate between.

Identification Difficulties and History

This species has only been recorded from the Great Barrier Reef, and in my experience it is not common on the outer reefs, but is more characteristic of the fringing reefs of the continental islands. Crossland treats the species in detail. Although this species is morphologically different from *A. formosa* and *A. intermedia* in many features, there remains a suspicion that it may be related to one or other of these, and all three species require further study in the field.

Geographic Distribution

Recorded from the Great Barrier Reef only.

Acropora formosa (Dana, 1846)
(Plates 51, 52)

Madrepora formosa Dana, 1846, p.473, pl.31, fig.2a, 2b, pl.38, fig.4.

Acropora formosa: Hoffmeister, 1925, p.55, pl.8, figs.1-3 (Synonymy); Wells, 1950, p.35; 1954, p.415, pl.102, figs.1-9, pl.103, figs.1-5, pl.104, fig.4 (synonymy); Stephenson and Wells, 1956, p.14 (synonymy); Nemenzo, 1967, p.61, pl.21, fig.3; Pillai and Scheer, 1974, p.453; Pillai and Scheer, 1976, p.23.

Madrepora brachiata Dana, 1846, p.474, pl.38, fig.3, 3a, 3b.

Madrepora gracilis Dana, 1846, p.482, pl.41, fig.3, 3a, 3b.

Madrepora nobilis Dana, 1846, p.481, pl.40, fig.3, 3a.

Acropora nobilis: Hoffmeister, 1925, p.59, pl.11, fig.1 (synonymy); Wells, 1954, p.416, pl.104, figs.1, 2; Nemenzo, 1967, p.62, pl.21, fig.5.

non *Acropora nobilis:* Pillai and Scheer, 1974, p.453, fig.3c.

Acropora laevis (part) Crossland, 1952, p.230, pl.45, figs.1, 2.

Material Examined

USNM: Fiji Islands, U.S. Expl. Exped., *A. formosa* syntypes 888, 282; Fiji Islands, U.S. Expl. Exped., *A. gracilis* holotype 333; Sooloo Sea, U.S. Expl. Exped., *A. brachiata* holotype 295; Singapore, U.S. Expl. Exped., *A. nobilis* holotype 427.

QM: Big Broadhurst Reef: SW. side, reef slope: 1·6 m, Oct. 1973, C.W., G11388; 2 m, 20.x.1973, C.W., G11339; 2 m, 11.x.1973, C.W., G11343; 2 m, 26.iii.1973, C.W., G11398, G11405; 2·3 m, 20.x.1973, C.W., G11349, G11353, G11360; 2·6 m, 22.x.1973, C.W., G11346; 2·8 m, 12.x.1973, C.W., G11356; 3·8 m, 12.x.1973, C.W., G11335, G11347; G11362; 5·3 m, 13.x.1973, C.W., G11365; 5·7 m, 23.x.1973, C.W., G11348, G11364; 6 m, 25.iii.1973, C.W., G11320; 6 m, 13.x.1973, C.W., G11336; 6·1 m, 13.x.1973, C.W., G11363, G11373, 6·3 m, 20.x.1973, C.W., G11334; 6·3 m, 23.x.1973, C.W., G11361; 6·3 m, 13.x.1973, C.W., G11369, G11371; 7·6 m, 13.x.1973, C.W., G11367; 7·7 m, 14.x.1973, C.W., G11333, G11341, G11368, G11372; 7·8 m, 14.x.1973, C.W., G11330, G11337, G11358, G11370; 8·1 m, 22.x.1973, C.W., G11340; 8·7 m, 15.x.1973, C.W., G11352; 12·4 m, 23.x.1973, C.W., G11363; 12·5 m, 17.x.1973, C.W., G11350, G11355; 28.iii.1973, C.W., G11396; SW. side, outer reef flat: 20.x.1973, C.W., G11331, G11354; 11.x.1973, C.W., G11359; 18.x.1973, C.W., G11344; SW. side, reef crest: 1·3 m, 22.x.1973, C.W., G11345; 1·3 m, 23.x.1973, C.W., G11351; SW. side, surge channel, 7·5 m, 20.x.1973, C.W., G11342.

Bowden Reef: SW. side, upper reef slope: 26.vii.1972, C.W., G11318, G11319, G11322, G11323, G11325; floor of opening in SW. side, 5 m, 26.vii.1972, C.W., G11380, G11381, G11375.

Bushy-Redbill Reef: NW. side, first reef crest: 23.xii.1972, E. Lovell, G11374, G11376, G11377; 22.xii.1972, C.W., G11306, G11378, G11379, G11384, G11385.

Darley Reef, patch reef in lagoon: 1 m, 24.iii.1973, C.W., G11401; 4 m, 22.iii.1973, C.W., G11404.

Viper Reef, July 1972, C.W., G11326, G11394.

Field Diagnosis

This is the common, thicket-forming arborescent species with numerous small tubular radial corallites, commonly coloured cream to brown, less often bright blue or blue-tipped.

Laboratory Diagnosis

Branching pattern: Branching is always openly arborescent. Branch diameters vary from slender (10 mm) to thick (35 mm).

Axial corallites: From barely exert to 1·5 mm exert. Outer diameter 2·0 to 2·8 mm; inner diameter 0·8 to 1·2 mm. Septation: Primary septa well developed, up to 1/2R; secondary septa usually present, but poorly developed, up to 1/4R.

Radial corallites: Tubular, varying from sub-immersed to 5 mm, prominent, with openings from round to sharply oblique, the corallites oriented at anything from 90° to the branch to fully appressed. Septal development varies greatly, but most commonly secondary septa are absent or only poorly represented.

Coenosteum: Costate or neatly arranged simple spines on radial corallites, reticulate with simple spines between.

WITHIN REEF DISTRIBUTION

Reef crest and slope to position of surge channel floor (10–12 m), lagoonal floors and lagoonal patch reefs (may even form entire basis of lagoonal patch reefs), middle reef flat, occasional small colonies on outer reef flat, fringing reefs.

IDENTIFICATION DIFFICULTIES AND HISTORY

The interpretation that I have placed on this species follows that of Wells (1954) and Stephenson and Wells (1956) preceded by Hoffmeister (1925). The reader is referred to their discussions. The species, as interpreted, may well be a mixture and there is certainly no satisfactory interpretation of variability (for example slender and sturdy branched thickets may occur adjacent to each other). There is some suggestion (J. Collins, pers. comm.) that the sturdy branched colonies may be old colonies. The colonies offer no readily perceptable clues in the field. If there are several species involved, the mosaic of their variabilities may be adding to the confusion.

This species requires individual attention, and the only assistance that can be offered at present is in distinguishing from the field the other 'easily recognizable' arborescent species: *A. haimei, A. microphthalma, A. intermedia, A. aspera, A. pulchra* and *A. splendida. A. acuminata* Verrill does not seem to occur in the areas studied.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Ceylon, Cocos-Keeling, Amboina, New Ireland, Great Barrier Reef and Torres Straits, Fiji Islands, Samoa, Marshall Islands, Tahiti. (Further Indian Ocean localities in Pillai and Scheer, 1974).

Acropora splendida Nemenzo, 1967
(Plates 53, 54)

Acropora splendida Nemenzo, 1967, p.51, pl.17, fig.2.

MATERIAL EXAMINED

UP: Hundred Islands, Pangasiman, 1959, A. de la Cruz, holotype C931.

USP: Fiji Reefs 3916.

QM: Big Broadhurst Reef, SW. slope: 23·5 m, 17.x.1973, C.W., G8715; 15 m, 16.x.1973, C.W., G8716; 9·7 m, 15.x.1973, C.W., G8714; 8 m, 28.iii.1973, C.W., G8704–6; 7·8 m, 15.x.1973, C.W., G8713; 7·5 m, 15.x.1973, C.W., G8712; 7 m, 26.iii.1973. C.W., G8701, G8702; 6·9 m, 14.x.1973, C.W., G8710, G8711; 6·6 m, 14.x.1973, C.W., G8708, G8709; 6 m, 25.iii.1973, C.W. G8699; 5 m, 26.iii.1973, C.W., G8700; 4·9 m, 13.x.1973, C.W., G8707; 3 m, 27.iii.1973, C.W., G8703.

Bowden Reef: Lagoon slope, Nov. 1972, R. Pearson, G8696; floor of opening in SW. end of reef, 26.vii.1972, C.W., G8697.

Darley Reef, patch reefs in lagoon, 4 m, C.W., G8698.

FIELD DIAGNOSIS

Colonies are large (commonly around 1m diameter) bowl to bracket shaped, the shape given by long openly arborescent branches which curve and divide to varying extent, depending on their position within the colony. The bowl shape occurs in specimens on flat surfaces and attachment becomes lateral with steepness of the attaching surface. With increasing depth the colonies become flatter and smaller. A specimen collected at 23·5 m (G8715) is completely horizontal. Common colours are dark olive green with paler green tips to the branches, dark blue with paler blue tips, brown with pale blue tips, brown or cream.

LABORATORY DIAGNOSIS

Branching pattern: As the colonies are large, fragments are usually collected. These are often easily confused with other large arborescent species. Specimens from the centre of the bracket usually have long curving branches with little secondary branching; those from the edge zone are more proliferous, with shorter branches and some fusions, and may be flat underneath.

Axial corallites: Outer diameter 2·0 to 3·5 mm; inner diameter 0·8 to 1·5 mm. Septation: primaries to 2/3R, all or some secondaries present to 1/2R.

Radial corallites: Tubular, projecting from branches at 90° (less towards tips) with openings round, oval, nariform, or dimidiate. Radials are usually evenly sized and distributed but smaller radials may be present amongst these, and their openings may be variously directed. Septal development varies, but primaries are usually present to 1/3R, and some secondaries visible.

Coenosteum: Usually neatly costate on radial corallites, open reticulate with simple or laterally flattened spines in between.

WITHIN REEF DISTRIBUTION

Reef slope from a few metres below crest to limits of *Acropora* distribution (species no.3 in Wallace 1975); deep water lagoonal patch reefs; fringing reefs.

IDENTIFICATION DIFFICULTIES AND HISTORY

Nemenzo's species was based on a single fragment, and he was not aware of the shape of the colony. The species seems to have been neglected in all other literature, although it is possible that fragments may have been identified with other arborescent species. This is the only *Acropora* with an 'arborescent bracket' shape and it is very distinctive in the field. Laboratory specimens without field notes become unnecessarily confused with other arborescent 'problems'.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Philippines, Great Barrier Reef, Fiji Islands, (common in Fijian fringing reefs, from my personal observations), Palau (M. Pichon, pers. comm.).

Acropora horrida (Dana, 1846)
(Plates 55, 56)

Madrepora horrida Dana, 1846, p.472, pl.39, fig.2, 2a; Verrill, 1864, p.41; Brook, 1893, p.188 (synonymy).
Acropora horrida: Wells, 1954, p.417, pl.107, fig.1.
Madrepora angulata Quelch, 1886, p.160; Brook, 1893, p.195.
Madrepora inermis Brook, 1891, p.462; 1893, p.194, pl.29, figs. A, B.
Acropora inermis: Wells, 1954, p.431.

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Exped., *A. horrida* holotype 291.

YPM: Fiji Islands, U.S. Expl. Exped., *A. horrida* fragment of type 2013.

BM: Zamboangana, 'Challenger' Exped., *A. angulata* holotype 1886.12.9.233; South Seas, purchased, *A. inermis* syntypes 1841.12.11.6, 1841.12.11.7.

QM: Big Broadhurst Reef: SW. side, reef slope: 7·3 m, 15.x.1973, C.W., G8755; 7·6 m, 23.x.1973, C.W., G8757, G8758; 5 m, 27.iii.1973, C.W., G8759; 8 m, 28.iii.1973, C.W., G8761; 4 m, 28.iii.1973, C.W., G8763; SW. side, surge channel, 8·5 m, 20.x.1973, C.W., G8756.

Bowden Reef: Slope of opening in SW. side: 26.vii.1972, C.W., G8764–7; 1–5 m, 26.vii.1972, C.W., G8768; 1–2 m, 26.vii.1972, C.W., G8769; 25.vii.1972, C.W., G8771; floor of opening in SW. side, 26.vii.1972, C.W., G8770.

Bushy-Redbill Reef: NW. side, floor outside slope: 12 m, 30.xii.1972, C.W., G9076; 8 m, 31.xii.1972, C.W., G9077; NW. side, middle reef flat, 22.xii.1972, C.W., G9078; 20.xii.1972, C.W., G9079; NW. side, reef patches, 12 m, 14.vi.1975, C.W., G9080; W. side, reef slope: 8 m, 3.vi.1975, C.W., G9081; Dec. 1972, C.W., G8774; adjacent Redbill Is., reef slope, 5 m, 2.vi.1975, C.W., G9084.

Darley Reef, patch reef in lagoon: 22.iii.1973, C.W., G8773; 6 m, 22.iii.1973, C.W., G8762, 23.iii.1973, C.W., G8760.

Heron Island, W. side, reef slope, July 1973, C.W., G8773.

Fiji Islands, Great Astrolabe Reefs (Kadavu), W.side of Yaukuvi Levu fringing reef, 1.ii.1974, C.W., G9085.

FIELD DIAGNOSIS

Occurs as sprawling arborescent to shrubby patches. Branches are slender and have a ragged appearance due to the scattered distribution of the radials and their poorly-formed walls. The polyps of this coral are usually extended, an unusual feature in *Acropora*. The colour is usually light powder-blue to light grey.

LABORATORY DIAGNOSIS

Branching pattern: Branching is primarily open-arborescent. Specimens from loose substratum areas tend towards horizontal primary growth; those from firmer substrates are more upright. Main branches are 7 to 15 mm in width, and taper gradually towards the tips. Secondary branchlets are irregularly sized and placed. They can be short, scattered twigs which alter the shape of the colony little, or bundles of branchlets which give a shrub-like appearance, or bottlebrush formations of subequal length arranged all over the branches.

Axial corallites: Outer diameter 1·6 to 2·3 mm; inner diameter 0·6 to 1·2 mm. Septation: Primary septa present, up to 2/3R, secondary cycle poorly developed, usually a few septa just visible.

Radial corallites: Scattered, sub-immersed to emergent tubular, sometimes appressed, with round openings. Walls are thin and very fragile around the opening. Primary septa developed, up to 1/3R, secondary septa usually absent, or one or two just visible.

Coenosteum: Open reticulate with simple to forked spines, both on corallites and between.

WITHIN REEF DISTRIBUTION

This species occurs where there is some constant water cover, down to at least 15 m, and apparently favours high sediment areas, i.e. deeper reef flat areas, reef slopes, rubble and sandy bottom areas around patch reefs and on surge channel floors. It occurs with *A. vaughani* in the deeper areas.

IDENTIFICATION DIFFICULTIES AND HISTORY

The species is distinctive in the field because of the extended polyps, ragged appearance and

unusual colouring. The extended polyps also give it a silky sheen. Laboratory differences from *A. vaughani* are explained by Wells 1954 (p.417). Brook's *A. inermis* specimens are apparently slender branches of this species. Quelch's *A. angulata* is named from a single branch tip.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Philippines, Great Barrier Reef, Fiji Islands, Marshall Islands.

Acropora vaughani (Wells 1954)
(Plate 57)

Acropora vaughani Wells, 1954, p.416, pl.105, fig. 1, pl.106, figs. 1–8, pl.107, figs. 2–6.

MATERIAL EXAMINED

USNM: Bikini lagoon, 18 fms, holotype 44452; Seaward slope, Bikini Atoll, 21–25 fms, paratype 44457.

QM: Big Broadhurst Reef, SW. side, reef slope: 9·8m, 16.x.1973, C.W., G10264; 8·1m, 14.x.1973, C.W., G10265; 7m, 13.x.1973, C.W., G10266; 6·1m, 13.x.1973, C.W., G10267, G10268; 3m, 27.iii.1973, C.W., G10269; 7m, 28.iii.1973, C.W., G10270; 8m, 28.iii.1973, C.W., G10271.

Bushy-Redbill Reef, NNE. side, off-reef floor, 12m, 30.xii.1972, C.W., G10272.

FIELD DIAGNOSIS

Occurs as scattered 'shrubby arborescent' patches, particularly on areas of loose bottom material (sand or rubble). Scattered short final branchlets are given off from the main branches. Colour is usually cream or pale brown.

LABORATORY DIAGNOSIS

Branching pattern: Branching is basically arborescent, but the length and positioning of secondary branches varies greatly. Branch widths are from 10 to 20 mm. Secondary branches (or 'branchlets') can be regularly arranged along the main branches, or scattered. In general, the slender main branches tend to be more proliferous than the sturdy ones.

Axial corallites: Outer diameter: 1·6 to 2·5 mm; inner diameter: 0·6 to 0·9 mm. Septation: both cycles usually complete, the primaries up to 2/3R, secondaries up to 1/4R.

Radial corallites: Tubular with round or occasionally oval to nariform openings. They are unequal in length and orientation (usually oriented within a range 45° to 90°, except towards basal areas, where they may be appressed).

Coenosteum: Spines are distributed evenly over corallites and inter-corallite areas. In heavily calcified specimens these have elaborated tips; in less calcified specimens the tips are simple to laterally flattened.

(For more detailed laboratory diagnosis see Wells, 1954).

WITHIN REEF DISTRIBUTION

From about 3m to 15m on reef slope, deep-water lagoons, and patch reef areas, on rubble or sandy floors, fringing reefs. Usually it occurs with *A. horrida* (Dana), from which it can easily be distinguished, on the Great Barrier Reef, because *A. vaughani* is more sturdy, does not usually extend the polyps in daylight, and is commonly cream or pale brown, while *A. horrida* is pale blue or grey. The upper range is more limited than for *A. horrida*, which can occur in some reef flat situations.

IDENTIFICATION DIFFICULTIES AND HISTORY

The appearance of the branchlets can be very varied (see Wells), but with good field notes the species can be identified without confusion with other arborescent species.

GEOGRAPHIC DISTRIBUTION

Pacific: Marshall Islands, Great Barrier Reef.

Acropora pulchra (Brook, 1891)
(Plates 58, 59, 60C)

Madrepora pulchra Brook, 1891, p.468; 1893, p.44, pl.28, fig. A.
Madrepora pulchra var. *stricta* Brook, 1893, p.44, pl.28, fig. B.
Madrepora pulchra var. *alveolata* Brook, 1893, p.45, pl.28, fig. C.
Acropora pulchra: Vaughan, 1918, p.162, pl.66, figs. 3, 3a; Crossland, 1952, p.203; Stephenson and Wells, 1956, p.17.
Acropora pulchra var. *stricta:* Crossland, 1952, p.204, pl.34, fig. 2.
Acropora pulchra var. *alveolata:* Vaughan, 1918, p.162, pl.66, figs. 1, 2; Crossland, 1952, p.203.

MATERIAL EXAMINED

BM: Keeling Is., *A. pulchra* holotype 1884.2.16.1.

QM: Bushy-Redbill Reef, adjacent Redbill Is., reef flat: 7.vi.1975, C.W., G11102, G11105; 11.vi.1975, C.W., G11097, G11103, G11104; 12.vi.1975, C.W., G11093, G11095, G11096, G11100, G11101.

Heron Island, W. side, reef flat: 2.vii.1973, Y. Loya, G11117; 3.vii.1973, C.W., G11120; July 1973, C.W., G11115; G11119, 11.xii.1973, C.W., G11111, G11116, G11121, G11122; 15.xii.1973, C.W., G11118.

Fiji Islands, Great Astrolabe Reefs, Feb. 1974, C.W., G11123–5.

Low Isles, August 1954, W. Stephenson (Stephenson and Wells 1956): G2617–20; G2699–G2712, G2715, G2716, G2721–5.

North West Island, C. Hedley, 3–4 June 1924, G.B.R.C. 170.

FIELD DIAGNOSIS

Colonies of this species are arborescently branching, and can vary in overall shape from open thickets to compact corymbose form. Small radial corallites with oblique apertures give the branch surface a smoother appearance than that of other arborescent or corymbose species. Colour is pale to dark brown, often with pale blue tips.

LABORATORY DIAGNOSIS

Branching pattern: The angle of emergence, length, and width of branches varies widely, as the plates show. Branch widths are from 7 to 15 mm, and the overall general colony form can be anything from an arborescent thicket to a neatly caespito-corymbose clump.

Axial corallites: 1 to 2 mm exert; external diameter 2·0 to 3·5 mm, internal diameter 0·6 to 1·2 mm. Septation: primary septa well developed, up to 2/3R, secondary septa absent or poorly represented, occasionally all present, up to 1/4R.

Radial corallites: Mixed sizes, all very small, project at 90° from branch, upper wall poorly developed, lower wall extended and lip-like. The opening is oval to dimidiate. Primary septa may be present to 2/3R, or may be just visible; secondary septa not usually visible, or a few may be present to 1/4R.

Coenosteum: Costate on radial corallites, openly reticulate to costate between. General appearance is light and spongy.

WITHIN REEF DISTRIBUTION

This is a reef flat species, occurring particularly on the inner and middle reef flat. It occurs with *A. aspera,* often in close association, as plate 60C shows.

IDENTIFICATION DIFFICULTIES AND HISTORY

Brook (1893) described the radial corallities well and his descriptions should be consulted. The main problem with this species is seen when it occurs with *A. aspera.* The two species show similar colony shape variations, apparently in response to similar environmental conditions. Although the radial corallites are different in both shape and size, colonies sometimes appear to have a mixture of characteristics of both species. This problem was encountered on Redbill reef flat, at places where populations of the two species intermingled: some colonies suggest a hybrid appearance. It is possible that some of Vaughan's *A. pulchra* specimens were *A. aspera.*

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Cocos-Keeling Islands, Great Barrier Reef.

Acropora aspera (Dana, 1846)
(Plates 60, 61, 62)

Madrepora aspera Dana, 1846, p.468, pl.38, fig. 1, 1a, 1b; Brook, 1893, p.62 (synonymy).

Acropora aspera: Crossland, 1952, p.205, pl.33, figs. 2, 3; Nemenzo, 1967, p.65.

Madrepora hebes Dana, 1846, p.468, pl.35, fig. 5; Brook, 1893, p.128 (synonymy).

Acropora hebes: Vaughan, 1918, p.174, pl.73, figs. 2, 2a, pl.74, figs. 1, 2, 2a, 2b, pl.13, fig. 6; Hoffmeister, 1925, p.57, pl.9, figs. 3a, 3b; Wells, 1950, p.36; Crossland, 1952, p.217; Wells, 1954, p.423, pl.104, fig. 3; Stephenson and Wells, 1956, p.14; Nemenzo, 1967, p.64, pl.22, fig. 1.

Madrepora cribripora Dana, 1846, p.470, pl.31, fig. 1, 1a–1c; Brook, 1893, p.123.

Madrepora manni Quelch, 1886, p.150, pl.9, fig. 1, 1a; Brook, 1893, p.63 (synonymy).

Acropora manni: Faustino, 1927, p.263, pl.85, figs. 6, 7; Nemenzo, 1967, p.63.

Acropora luzonica Verrill, 1902, p.231, pl.36c, fig. 4, pl.36F, fig. 9.

?Madrepora arabica Milne Edwards and Haime, 1860, p.145; Brook, 1893, p.66 (synonymy).

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Exped., *A. aspera* holotype 285; Fiji Islands, U.S. Expl. Exped., *A. hebes* syntypes 287, 286; Rewa River Mouth, Fiji Islands, U.S. Expl. Exped., *A. cribripora* holotype 289.

YPM: Manilla Bay, Luzon, Philippines *A. luzonica* holotype 1809.

PM: Mer Rouge, *A. arabica* holotype 331.

QM: Big Broadhurst Reef: S. side, surge channel on outer flat, 2 m, 21.x.1973, C.W., G10928; patch reef in lagoon, 28.iii.1973, C.W., G10929, G10930; SW. side, reef slope, 18.x.1973, C.W., G10962.

Bushy-Redbill reef: W. side, middle reef flat, 14.vi.1975, C.W., G10947; N. side, inner flat-algal bank area, 6.vi.1975, C.W., G10937–41, G10943, G10960, G10961; adjacent Redbill Is., reef flat, 7.vi.1975, C.W., G10944–6.

Bowden Reef, SW. side, reef slope, 1 m, 15.vii.1972, C.W., G10925.

Heron Island: July 1973, C.W., G10849–G10854; G10913–G10917; G10921; W. side, inner reef flat,

11.xii.1973, C.W., G10860–2; W. side, reef flat: 15.xii.1973, C.W., G10886–92; 17.xii.1973, C.W., G10893, G10896; N. side, reef flat, 11.xii.1973, C.W., G10855; N. side, reef flat (solid area), 14.xii.1973, C.W., G10883–5; N. side, inner reef flat, 11.xii.1973, C.W., G10856, G10857; N. side, middle reef flat, 11.xii.1973, C.W., G10858; S. side, outer reef flat, 12.xii.1973, C.W., G10865–72; SW.side, outer reef flat, 13.xii.1973, C.W., G10873–81; WSW. side, outer reef flat, 12.xii.1973, C.W., G10864; SE. side, outer reef flat, 17.xii.1973, C.W., G10897–902.

Low Isles, 1975, C. Limpus, G10931.

Masthead Reef, reef flat, August 1974, J. Buhmann, G10926.

Michaelmas Cay, 1975, C. Limpus, G10932, G10933.

Maer Island, Murray Island Group, N. side, outer reef flat, 17.vii.1974, G. Ingram, G10927.

Bramble Cay, Oct. 1924, C. Hedley, G.B.R.C. 7, 93–7, 149–52, 168, 169, 211.

Feather Reef, 11.viii.1924, 'Geranium', G.B.R.C. 181.

Ellison Reef, 25.vii.1924, Paradice, G.B.R.C. 2–6, 54–67, 176.

Surprise and Flora Reefs, Sept. 1924, 'Geranium', G.B.R.C. 8, 9, 12, 13, 16, 19–21, 24, 28.

Fiji Islands: Makaluvau Reef, 10.i.1974, C.W., G10955, G10957; Great Astrolabe Reefs, Feb. 1974, C.W., G10949–54.

Field Diagnosis

This is a basically arborescent species in which the colonies show considerable phenotypic flexibility. Different colonies or parts of a colony can have long, slender spreading branches with scattered radial corallites or shorter thicker branches, even to the extent of appearaing corymbose, with crowded corallites. Radial corallites are in two sizes and have poorly developed walls. Colours are commonly pale blue-grey, green-grey, or cream, less commonly bright blue. It is a characteristic of this species on the Great Barrier Reef that specimens, when collected, exude large quantities of mucous.

Laboratory Diagnosis

Branching pattern: Ranges from open branching (at 90°) to closed branching, the branches being given off vertically to obliquely to give a corymbose appearance. Branch widths vary from 10 to 15 mm.

Axial corallites: From non-exert to 3 mm exert. Outer diameter 3·5 to 4·5 mm; inner diameter 1·3 to 1·8 mm. Septation: Both septal cycles usually present, the primaries up to 2/3R, the secondaries up to 1/3R.

Radial corallites: Two sizes of radial corallite are mixed. These are best regarded as 'large diameter' and 'small diameter', although the 'large diameter' radials are also always more prominent. The 'large diameter' radials have round openings, upper wall undeveloped, and lower wall short and thickened, or extended horizontally as a lip, which may be rounded or pointed. The 'small diameter' radials are sub-immersed to immersed. In general colonies with short, thick branches tend to have the radial corallites crowded with short, thick lips, and colonies with long slender branches have radial corallites scattered, with thin pointed lips. On the larger radials primary septa are usually visible up to 1/3R; and secondary development varies, but often some septa are present, up to 1/4R.

Coenosteum: Open reticulate with simple to laterally flattened spines between radials, costate on radials.

Within Reef Distribution

This is a reef flat species, occurring from the inner reef flat to outer flat, but not on elevated outer flat platforms. It can occur in very silty and coral-depauperate areas and shallow lagoonal situations.

Identification Difficulties and History

The two species *'A. hebes'* and *A. aspera* are both 'well known' and typical specimens of the two species appear very different from each other. However, the relationship of the two can be easily established in the field. The placing of less known synonyms is more difficult, and possibly there are other species names still to be included. Two major problems of identification occur with this species. The first is in separating some corymbose specimens from sturdy specimens of *A. millepora,* the second in separating some arborescent colonies from arborescent *A. pulchra.* (see discussions for these species).

Geographic Distribution

Indo-Pacific: ?Red Sea, Cocos-Keeling, Philippines, Great Barrier Reef, Fiji Islands, Samoa, Marshall Islands, Tongan Islands (C.W.).

The 'Acropora corymbosa' Group

A number of species have radial corallites with scale-like lips, and a disproportionately large number of species descriptions have been written to cover these species.

In the following list there is barely a species which has not been placed in synonymy or compared with, or mistaken for some other species in the list, and of the 'real' species that exist, each has been placed under a number of the commonest

names. The main species concerned are: *A. corymbosa* (Lamarck), *A. efflorescens* (Dana), *A. cytherea* (Dana), *A. spicifera* (Dana), *A. hyacinthus* (Dana), *A. surculosa* (Dana), *A. millepora* (Ehrenberg), *A. prostrata* (Dana), *A. subulata* (Dana), *A. convexa* (Dana), *A. armata* (Brook), *A. reticulata* (Brook), *A. arcuata* (Brook), *A. cytherella* (Verrill), *A. conferta* (Quelch), *A. pectinata* (Brook), *A. recumbens* (Brook), *A. squamosa* (Brook).

The most widely applied name on this list is the oldest, *A. corymbosa* (Lamarck). Three contenders for this name are the species I am identifying as *A. hyacinthus, A. cytherea* and *A. millepora*. Older interpretations of this species tended to favour an *A. cytherea*-like appearance. A specimen regarded as the type (of *A. corymbosa)* was seen and described by Brook (1893) who points out the similarity between *A. cytherea* and this. Professor J. Wells has kindly shown me photographs of (apparently) this type, sent to him some time ago by the Paris Museum. Neither my own search of the Lamarck collection, nor a later search by Dr J. P. Chevalier could locate a type.

My opinion is that the currently accepted view of this species (e.g. Wells 1954) is morphologically between *A. millepora* and *A. hyacinthus*. While it is possible that this is a true species, at least some of the specimens so identified are other species: for example Stephenson and Wells 1956 mention two specimens, of which one (G2626) is a small reef flat specimen of *A. hyacinthus*, and the other (G2623) a stunted *A. millepora*.

The species has been mentioned by many other authors since 1893, e.g. von Marenzeller (1907), Vaughan (1918), Hoffmeister (1925, 1929), Thiel (1932), Crossland (1952), Nemenzo (1967), Pillai and Scheer (1976), and is regarded as having a wide Indo-Pacific distribution. In the interests of taxonomic stability, I am not attempting to trace its synonyms on the basis of a regional study, but I feel a caution must be taken that the interpretation of this species by the various authors may not coincide. Hopefully, with extensive regional studies, this group will be given a more complete taxonomic treatment.

The species which I interpret as *A. hyacinthus* and *A. cytherea* are dominant members of the reef-front assemblage. They are the early colonizers and often influence the effective shape of some reef areas. Special problems are associated with the separation of these species at their overlapping limits. *A. spicifera* has not been present in my areas of study. *A. millepora* is a common reef-flat species which has usually (on the Great Barrier Reef) been identified as its synonym, *A. squamosa*.

Acropora hyacinthus (Dana, 1846)
(Plates 63, 64A-C, 65, 66A,B)

Madrepora hyacinthus Dana, 1846, p.444, pl.32, fig.2; Brook, 1893, p.107 (synonymy).
Acropora hyacinthus: Thiel, 1932, p.123, pl.16, fig.2; 1933, p.20; Stephenson and Wells, 1956, p.16; Nemenzo, 1967, p.115, pl.33, fig.1; Pillai and Scheer, 1976, p.29.
Acropora hyacinthus (?part): Hoffmeister, 1925, p.64, pl.13, fig.3; Wells, 1954, p.421.
?Madrepora conferta Quelch, 1886, p.164, pl.10, fig.3; Brook, 1893, p.108.
Madrepora pectinata Brook, 1892, p.460; 1893, p.95, pl.27, fig.D, E.
Madrepora recumbens Brook, 1892, p.461; 1893, p.106, pl.27, fig.F.
Acropora pectinata: Vaughan, 1918, p.172, pl.71, fig.1, 1a-1c, 2; Thiel, 1932, p.119, pl.14, fig.4 (synonymy).
Acropora corymbosa (part): Stephenson and Wells, 1956, p.12.
Madrepora surculosa var. *turbinata* Dana, 1846, p.446; Brook, 1893, p.200 (synonymy).
Madrepora turbinata: Verrill, 1864, p.42.
Acropora turbinata: Verrill, 1902, p.242.

Note: This synonymy does not include all references to synonyms, as their interpretations are difficult to trace.

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Exped., *A. hyacinthus* holotype 246; Tahiti, U.S. Expl. Exped., *A. surculosa* (var. *turbinata)* syntype 251.

YPM: Tahiti, *A. surculosa* var. *turbinata* type fragment 2017.

BM: Fiji Reefs, Challenger, *A. conferta* holotype 1885.2.1.12; Thursday Is., Saville Kent, *A. pectinata* syntype 1892.6.8.155; Low Woody Is., G.B.R., *A. recumbens* (var.) 1892.6.8.161.

QM: Big Broadhurst Reef: SW side, reef slope: 1m, 11.x.1973, C.W., G9860, G9861; 1m, 13.x.1973, C.W., G9862; 1·3m, 22.x.1973, C.W., G9863; 1·5m, 11.x.1973, C.W., G9859; 2·7m, 12.x.1973, C.W., G9864; 3m, 29.iii.1973, C.W., G9872; 5·3m, 13.x.1973, C.W., G9865; 6·3m, 13.x.1973, C.W., G9866; 8·3m, 15.x.1973, C.W., G9867; Oct. 1973, C.W., G9868; patch reef in lagoon, 21.x.1973, C.W., G9869; E. side, reef slope, 4m, 21.x.1973, C.W., G9870.

Bowden Reef, opening in outer reef, 26.vii.1972, C.W., G9877, G9878; SW side, reef crest, 0·6m, 15.vii.1972, C.W., G10716.

Bushy-Redbill Reef: S. side, outer flat, 31.v.1975, C.W., G9874; NW.side, top of patch reef off reef edge, 19.xii.1972, E. Lovell, G10727; W. of Redbill Is., edge of surge channel, 0·5m, 19.xii.1972, C.W., G10232.

Darley Reef, patch reef in lagoon, 24.iii.1973, C.W., G9876.

Great Keppel Island, E. side, fringing reef, Dec. 1975, R. Woolley, G10723, G10726.

Heron Island: reef flat, W. side: 2.vii.1973, Y. Loya, G9875; 6.vii.1973, Y. Loya, G10720. July 1973, C.W., G10718, G10722; N. side, 9.viii.1950, W. Stephenson, G9684; reef flat, April 1954, E. Grant, G2680; N. side, 14.v.1954, W. Stephenson, G2681–3.

Lady Musgrave Reef, W. side, outer slope, 16.vii.1971, I. Neuss, G6268.

Tryon Reef, E. side, reef flat, 12.vii.1971, C.W., G6267; NW. side, reef slope, 18.xii.1971, I. Neuss, G6478, G6480, G6494.

Viper Reef, patch reef in lagoon, 1m, 16.vii.1973, C.W., G10717.

Bramble Cay, Oct.1924, C. Hedley, G.B.R.C. 34–9, 86–92.

Coates Reef, 13.vii.1924, 'Geranium', G.B.R.C. 141, 195.

Flora Reef, 21.v.1924, Dr Paradice, G.B.R.C. 138.

Flinders Reef, Moreton Bay, NW. margin, 9.viii.1972, E. Lovell, G6984; NW. slope, 21.vi.1973, E. Lovell, G7297, G7298.

Field Diagnosis

Tabular to plate like colonies to over 3m diameter, formed by the developmental process described by Hoffmeister (1925). Colonies are sturdy in texture, and the vertical branchlets have a rosette like appearance due to the regular arrangement of labellate corallites around them. Colours are blue with pink growing edge (common reef flat colouration), pale to dark brown, pink-, yellow-, green- or blue-brown.

Laboratory Diagnosis

Branching pattern: From a central to lateral stalk, branching is horizontal, with branches anastomosing to a greater or lesser extent. Secondary branchlets are single or in groups of up to seven, from 1 mm to 22 mm long, and from 3 mm to 8 mm wide (commonly around 10 mm long and 4 mm wide). In very shallow reef flat situations, the branchlets may be reduced to mere buds, but very wide (up to 8 mm). The longest branchlets are in lagoonal specimens. In this species and in *A. cytherea*, layers may be added to the original plate.

Axial corallites: Up to 1·5 mm exert; outer diameter 1·4 to 2·0 mm; inner diameter 0·6 to 1·1 mm. Septation: primaries present to 2/3R, secondaries absent, or a few present to 1/4R.

Radial corallites: Tubular appressed, with only lower (or outer) wall developed (2/3 circumference or less) to form a rounded lip. Radials are arranged evenly and closely around the branchlet, giving a rosette-like appearance, typical of this species. Septation may be strongly developed, all primaries being present to 1/4R, plus a few secondaries, or so weakly developed that only the directive septa can be distinguished. On horizontal branches immersed corallites occur.

Coenosteum: Costate on radial corallites, reticulate with occasional laterally-flattened spines between.

Within Reef Distribution

This species occurs in lagoons, deep water reef flat situations, shallow outer reef flat, and on the reef slope to about 30 m (species no. 4 in Wallace 1975).

Identification Difficulties and History

Dana's type of *A. hyacinthus* (illustrated by Hoffmeister 1925) is a young specimen just in the 'vasiform' stage of development. This compares closely with juveniles of the species I have described, which is a sturdier species than *A. cytherea*. Much reef flat material of the species (well calcified) has probably been identified as *A. corymbosa*, while the interpretations of *A. hyacinthus* (e.g. by Hoffmeister) tend to be of a lighter-textured form. Whether his material was of *A. cytherea* or of a geographic variant of *A. hyacinthus* I am not able to judge. The deepest occurring colonies of *A. hyacinthus* are light textured with reduced radial corallite lips. These could be confused with *A. cytherea* from shallower depths but from a comparable depth *A. cytherea* has the distinctive *'A. reticulata'* form. *A. conferta* (Quelch) has slightly smaller axial corallite dimensions than those given here, but on radial corallite characteristics it appears to be a synonym. This is one of the most successful Indo-Pacific species of *Acropora:* it is an early colonizer, and occurs with great abundance in some areas. Hoffmeister's detailed treatment of a species under this name, without parallel detailed treatment of *A. cytherea* (or *'A. reticulata'*), leaves unsolved a taxonomic puzzle. A study of these two species on the Samoan reefs would be extremely useful.

Geographic Distribution

Widespread Indo-Pacific distribution from the Mascarene Archipeligo (G. Faure pers. comm.) to Tahiti. Exact localities cannot be quoted because of taxonomic confusion.

Acropora cytherea (Dana, 1846)
(Plates 63, 64A, D, 66C, D, 67)

Madrepora cytherea Dana, 1846, p.441, pl.32, fig.3a, 3b; Brook, 1893, p.99 (synonymy).

Acropora cytherea: Crossland, 1952, p.215.
Madrepora efflorescens Dana, 1846, p.441, pl.33, fig.6; Brook, 1893, p.35 (synonymy).
?*Acropora efflorescens:* Pillai and Scheer, 1976, p.26, pl.3, fig.3.
Madrepora armata Brook, 1892, p.452; 1893, p.100, pl.10, figs. A, B (synonymy).
Madrepora reticulata Brook, 1892, p.461; 1893, p.68, pl.4, figs. A, B.
Madrepora reticulata var. *cuspidata* Brook, 1893, p.69.
Acropora reticulata: Wells, 1954, p.422, pl.110, figs.4-6, pl.114, figs.1-6 (synonymy); Pillai and Scheer, 1976, p.28, pl.7, fig.1.
Madrepora arcuata Brook, 1893, p.102, pl.12; Studer, 1901, p.395.
Acropora cytherella Verrill 1902, p.253, pl.36, fig.7, pl.36a, fig.7, pl.36F, fig.1. (synonymy).
Acropora corymbosa 'cytherea Form': von Marenzeller, 1907, p.32, pl.1, figs.1, 2; pl.2, fig.3.
Acropora hyacinthus (part): Hoffmeister, 1925, p.64; Wells, 1954, p.421.

Material Examined

USNM: Tahiti, U.S. Expl. Exped., *A. cytherea* syntype 226; Samoa, *A. hyacinthus* (id. Hoffmeister), no.14 Mayor Collection.

YPM: Fiji Islands, U.S. Expl. Exped., *A. cytherella* holotype 2007; East Indies, *A. efflorescens* ?type 1799.

BM: Singapore, *A. armata* syntypes 1850.1.16.1, 1857.4.6.1; Amirante Islands, *A. reticulata* syntype 1882.10.17.131; Navigator Island, *A. arcuata* syntypes 1862.1.27.5, 1875.10.2.9.

QM: Big Broadhurst Reef: S W. side, reef slope: 1 m, 13.x.1973, C.W., G9841, G9842; 1·3 m, 11.x.1973, C.W., G9837, G9838; 2 m, 26.iii.1973, C.W., G9853; 2·3 m, 12.x.1973, C.W., G9839, G9840; 3 m, 28.iii.1973, C.W., G9856; 5 m, 27.iii.1973, C.W., G9855; 7 m, 13.x.1973, C.W., G9843; 8·1 m, 14.x.1973, C.W., G9845; 8·2 m, 14.x.1973, C.W., G9844; 8·3 m, 15.x.1973, C.W., G9847; 8·7 m, 15.x.1973, C.W., G9846; 9·7 m, 15.x.1973, C.W., G9849; 10·6 m, 6.x.1973, C.W., G9848; SW. side, surge channel floor, 5 m, 20.x.1973, C.W., G9850.

Bushy-Redbill Reef, NW. side, reef slope, 21.xii.1972, C.W., G9857.

Tryon Reef: NNE. side, outer slope, 21.xii.1971, I. Neuss, G6482; NW. side, outer slope, 6-10 m, 19.xii.1971, I. Neuss, G6479.

Viper Reef, patch reef in lagoon, 1 m from top, 16.vii.1972, C.W., G10717.

Flinders Reef, Moreton Bay: 1973, E. Lovell, G7290, G7291; NW. margin, 3-12 m, 9.viii.1972, E. Lovell, G6999, G7032; W. margin, 10 m, 10.iv.1972, E. Lovell, G7303, G7309.

Solitary Islands, 1972, J. Veron *et al.*, G7057, G7058.

Field Diagnosis

Tabular to plate-like colonies to over 3 m diameter, formed by the developmental process described by Hoffmeister (1925) for *A. hyacinthus*. Colonies have a light crumbly texture. Axial corallites are usually obviously exert, and contrast with slight scale-like radial corallites. Horizontal branches are reticulated to fully anastomosed. Colours are cream, pale brown, pink-, yellow-, green- or blue-brown or -grey.

Laboratory Diagnosis

Branching pattern: From a central to lateral stalk, branching is horizontal, with branches anastomosing to a greater or lesser extent. Secondary branchlets are vertical and single or in groups of up to six, from long and slender (up to 20 mm length, width around 3 mm at this length), to short bundles of tubular axials approximately 5 mm long with occasional proliferation of radial corallites at their base. In the series of specimens from lesser to greater depths on the Big Broadhurst Reef, a transition occurs from long branchlets with non-proliferous tips (identifiable with *'A. arcuata'* and *'A. armata'*), through shorter branchlets with proliferous tips, the proliferations often partially naked of radial corallites, to very short branchlets with few radial corallites (identifiable as *'A. reticulata'*). All specimens are openly reticulated and lightly calcified.

Lagoonal colonies are more anastomosed and heavily calcified and the branchlets are similar to those of deep reef slope colonies. Specimens from the geographically extreme southern locations (Flinders Reef, Moreton Bay and the Solitary Islands) have the main branches strongly anastomosed, and bundles of short thick proliferous branchlets: they identify with *A. cytherea sens. strict.*

Axial corallites: From 1·0 to 5·0 mm exert. Outer diameter 1·3 to 1·7 mm in Great Barrier Reef specimens, 1·6 to 2·5 mm in the Flinders Reef — Solitary Island specimens; inner diameter 0·7 to 1·0 mm. Septation: primary septa present, up to 2/3R; secondary septa often absent, never fully present, up to 1/4R.

Radial corallites: Tubular appressed with only lower (or outer) wall (1/2 circumference or less) developed, to form an elongate lip. In *A. cytherea s.s.* forms these lips are thickened: on the reef slope they are light structured and may be reduced to single or double points. Septal development of radials very poor: usually only directives can be seen, sometimes a few other primaries are present

as fine points. On horizontal branches immersed corallites occur.

Coenosteum: Costate on radial corallites, reticulate with laterally flattened spines in between.

Within Reef Distribution

On the Great Barrier Reef this is a reef slope species (species no.5 in Wallace 1974), but occasional colonies occur in lagoonal and deeper water reef flat areas. On other reefs (e.g. Enewetak Atoll) it has a similar distribution (C.W.).

Identification Difficulties and History

Two special taxonomic problems are associated with this species: (1) In combining *A. cytherea* with *A. reticulata,* and (2) In distinguishing between lightly structured colonies of *A. hyacinthus* and colonies of *A. cytherea* with good branchlet development.

A. cytherea s.s. occurs in geographically extreme locations (Tahiti, Solitary Islands, Moreton Bay). The temptation is to retain *A. reticulata,* which best describes the species in its main tropical range.

The second problem can also be stated as a problem of interpretation of *A. arcuata* and *A. armata.* These and *A. cytherea* have been combined with *A. hyacinthus* by recent authors. On *A. arcuata* and *A. armata* my own observations are of a co-occurrence of these 'species' with definite *A. hyacinthus* at the same depth on the Big Broadhurst reef front, and their graduation into typical '*A. reticulata*' with depth. Crossland's works are important to the ecological documentation of this species: in 1928 he identified *A. cytherea* as *A. hyacinthus,* in 1931 reversing the identification. In 1952 he notes that both species are common in Tahiti.

This species, as I have defined it, is easily separated from *A. hyacinthus* in the field by its light crumbly skeleton. The two species co-occur on the reef front, *A. cytherea* extending a little deeper, and *A. hyacinthus* extending more into reef flat areas.

Geographic Distribution

The species has a wide Indo-Pacific distribution from the Mascarene Archipeligo (G. Faure, pers. comm.) to Tahiti.

Acropora millepora (Ehrenberg, 1834) (Plates 68, 81 D)

Heteropora millepora Ehrenberg, 1834, p.109.
Madrepora millepora: Brook, 1893, p.116 (synonymy).
Acropora millepora: Verrill, 1902, p.257; Thiel, 1932, p.124, pl.18, fig.1, pl.19, fig.1; Nemenzo, 1967, p.94, pl.28, figs.1, 2.
Madrepora spathulata Brook, 1891, p.469; 1893, p.121, pl.32, fig.B.
Madrepora squamosa Brook, 1892, p.463; 1893, p.120, pl.20, fig. B;
Acropora squamosa: Vaughan, 1918, p.173, pl.72, figs.1, 2, 2a, 3; Crossland, 1952, p.216; Stephenson and Wells, 1956, p.18.
Acropora sarmentosa: Vaughan, 1918, p.17A, pl.72, fig.4.

Material Examined

BM: Claremont Is., Great Barrier Reef, Saville Kent: *A. millepora* (mentioned Brook, 1893) 1892.6.8.165; *A. squamosa* syntype 1892.6.8.163; Treasury Is., Solomon Islands, D.A. Guppy, *A. spathulata* holotype 1884.12.11.25.

MNB: *A. millepora* holotype, 854 (photograph).

QM: Big Broadhurst Reef: patch reef in lagoon, 28.iii.1973, C.W., G11052–6; E. side (weather side), channel in outer flat, 21.x.1973, C.W., G11055.

Bushy-Redbill Reef: NW. side, outer reef flat, 23.xii.1972, C.W., G11047, G11049; NW. side, reef slope, 23.xii.1972, C.W., G11046.

Bowden Reef, SW. side, reef crest, 26.vi.1972, C.W., G11064.

Darley Reef, patch reef in lagoon, 1 m, 18.vi.1972, C.W., G11057; 3 m, 22.iii.1973, C.W., G11058; 4 m, 22.iii.1973, C.W., G11059.

Heron Island: N. side, reef flat, 14.xii.1973, C.W., G10996–G11001; S. side, outer reef flat, 12.xii.1973, C.W., G10973, G10976–83; SW. side, outer reef flat, 13.xii.1973, C.W., G10985–93; W. side, reef flat: 15.xii.1973, C.W., G11002–5; 17.xii.1973, C.W., G11006–8; SE side, reef flat, 17.xii.1973, C.W., G11009–16.

Great Keppel Is., Dec. 1975, R. Woolley, G11061.

Maer Island, Murray Island group, N. side, inner reef flat: 16.vii.1974, G. Ingram, G11060; 18.vii.1974, G. Ingram, G11062.

Masthead Reef, reef flat, Aug. 1974, J. Buhmann, G11063.

Michaelmas Cay, 1974, C. Limpus, G11067.

Low Isles, 1974, C. Limpus, G11066, G11068.

Fiji Islands, Great Astrolabe Reefs, Feb. 1974, C.W., G11033–43.

Field Diagnosis

Low corymbose or stalked corymbose colonies, commonly with neat round outline; branches terete or slightly tapering, covered by evenly sized and closely arranged radial corallites with flaring, scale like lips. Commonest colouration (on both the Great Barrier Reef and Fijian reefs) is a dull to brilliant green with dull to bright orange branch tips. The colonies can also have multiple colouration, being predominately blue or pink,

with touches of other pastel colours and a grey sheen, or bright orange to pale cream.

LABORATORY DIAGNOSIS

Branching pattern: Branches are given off vertically to obliquely from a central to lateral region which may be consolidated into a stalk. In some colonies from sandy situations a growing point is barely recognizable, and the growth is bush like and relatively indeterminate. A small amount of secondary branching occurs, and the top of the colony is in a single plane. Branch width varies from 7 to 13 mm.

Axial corallites: Barely exert. Outer diamter 2·4 to 3·9 mm; inner diameter 0·9 to 1·6 mm. Septation: primary cycle fully developed, up to 1/2R; secondary cycle usually represented, but not all septa developed, up to 1/4R.

Radial corallites: No upper wall is developed, the lower half of the wall is expanded as a rounded lip, and the outer edges of this lip may flare away from the opening of the corallite. The primary septa are often well developed, up to 2/3R, secondaries absent or a few present to 1/4R.

Coenosteum: Costate on radial corallite lips, reticulate with simple spines between radials.

WITHIN REEF DISTRIBUTION

Reef flat, from sandy middle reef flat to consolidated outer flat, occasionally to a few metres below the reef top; tops of lagoonal patch reefs and fringing reefs.

IDENTIFICATION DIFFICULTIES AND HISTORY

The usual name applied locally to this species is *A. squamosa,* but the material from the Great Barrier Reef identified as *A. millepora* by Brook (apparently the last person to observe and describe Ehrenberg's type) belongs to this species, and in fact forms a series from the same locality as his *A. squamosa* types. Verrill (1902) synonymised the two, but he has not been followed by later authors.

Two species regarded as being similar to *A. millepora* (or *'A. squamosa')* may now be dismissed: *A. sarmentosa* was misinterpreted by Vaughan (1918), and is a clearly definable species; *A. aspera* (= *A. hebes)* with many synonyms is a highly versatile reef flat species which in its low corymbose form appears very similar to this species. *A. millepora* has a more restricted reef flat distribution than *A. aspera,* and extends closer to the reef crest. In aggressive interactions observed at Heron Island and on Bushy-Redbill Reef *A. millepora* tissues appear to be inclined to overgrow those of *A. aspera.* Small colonies of the species have probably been identified as *'A. corymbosa'* by some authors. *A. imbricata* (Ehrenberg) is another possible synonym.

GEOGRAPHIC DISTRIBUTION

The most definite records of this species are only from the Great Barrier Reef, Solomon Islands, Fiji Islands (C.W.) and Marshall Islands (C.W.). Other less certain records extend the range to Ceylon, the Philippines, New Ireland, New Hebrides.

Acropora delicatula (Brook, 1891)
(Plate 69)

Madrepora delicatula Brook, 1891, p.461; 1893, p.109, pl.28, figs. D, E.

Acropora delicatula: Wells, 1954, p.420, pl.115, figs.1, 2.

non *Acropora delicatula:* Stephenson and Wells, 1956, p.12.

MATERIAL EXAMINED

BM: Solomon Islands, Guppy, *A. delicatula* holotype 1884.12.11.23.

QM: Big Broadhurst Reef, SW.side, reef slope: 2 m, 26.iii.1973, C.W., G11442; 6 m, 25.iii.1973, C.W., G11441; 6 m, 27.iii.1973, C.W., G11439; 8 m, 26.iii.1973, C.W., G11436; 8·1 m, 14.x.1973, C.W., G11434; 8·6 m, 15.x.1973, C.W., G11438; 13·4 m, 17.x.1973, C.W., G11437; 17 m, 23.x.1973, C.W., G11435.

Bushy-Redbill Reef, NW. side, reef slope, 3–7 m, 21.xii.1972, C.W., G11440.

FIELD DIAGNOSIS

Shallow caespitose or corymbose-plate colonies have slender vertical branchlets with small, scale-like radial corallites. Colours are cream, pale brown or greenish brown.

LABORATORY DIAGNOSIS

Branching pattern: From an attachment that is lateral or nearly so, branching is at first horizontal, then branchlets or bundles of branchlets are given off vertically upwards. The branchlet bundles can be as tall as 40 mm, and branchlet width is around 5 mm. A small amount of branching from the undersurface may occur.

Axial corallites: 0·5 to 1·5 mm exert. Outer diameter 1·5 to 2 mm; inner diamter 0·6 to 0·9 mm. Septation: primary septa well developed, up to 3/4R, secondary cycle usually absent, or a few septa may be present up to 1/4R.

Radial corallites: Appressed tubular, nariform or dimidiate, the outer wall only developed, and extended as a lip which is correspondingly rounded, elongate or spade-shaped. The septal development varies, but commonly all primary septa are visible, up to 1/4R, and two or three secondaries just visible.

Coenosteum: Costate or rows of simple spines on radial corallites, neat rows of simple spines, or reticulate with scattered spines, between.

WITHIN REEF DISTRIBUTION

I have observed only a very few colonies, all in reef slope situations. The species is much more commonly represented from fringing reefs, and a series in J.C.U. is from the Lizard Island and Palm Islands reefs.

IDENTIFICATION DIFFICULTIES AND HISTORY

This species is poorly documented, and working with a poor series I am unable to resolve some problems. *A. subulata* (Dana), may be a senior synonym. Stephenson and Wells' specimen from Low Isles (QM G2648) is *A. tenuis*.

GEOGRAPHIC DISTRIBUTION

Great Barrier Reef, Solomon Islands, Marshall Islands.

Acropora haimei (Milne Edwards and Haime, 1860)
(Plates 70, 71)

Madrepora haimei Milne Edwards and Haime, 1860, p.151; Brook, 1893, p.77 (synonymy); von Marenzeller, 1907, p.51 pl.16 figs. 45–48.

Acropora haimei: Vaughan, 1918, p.163, pl.70, figs.3, *3a, 3b, pl.66, figs. 4, 5; Crossland, 1952, p.207, pl.33, fig. 1, pl. 35, fig. 1; Rossi, 1954, p.48; Stephenson and Wells, 1956, p.14; Nemenzo, 1967, p.82, pl.25, fig. 1.*

MATERIAL EXAMINED

QM: Big Broadhurst Reef: SW. side, reef slope: 9·8 m, 16.x.1973, C.W., G10216, G10217; 9·6 m, 15.x.1973, C.W., G10215; 8·7 m, 15.x.1973, C.W., G10213, G10214; 8·6 m, 15.x.1973, C.W., G10212; 8·3 m, 15.x.1973, C.W., G10211; 8 m, 14.x.1973, C.W., G10210; 7·8 m, 23.x.1973, C.W., G10206–9; 7 m, 13.x.1973, C.W., G10205; 5–6 m, 23.x.1973, C.W., G10204; 6 m, 13.x.1973, C.W., G10224; 5·7 m, 23.x.1973, C.W., G10225; 5 m, 27.iii.1973, C.W., G10182, G10221; 5 m, 25.iii.1973, C.W., G10181; 4·2 m, 22.x.1973, C.W., G10222; 3·8 m, 12.x.1973, C.W., G10180; 1·6 m, 22.x.1973, C.W., G10223; 1·5 m, 12.x.1973, C.W., G10179; 1·3 m, 11.x.1973, C.W., G10202; 1·3 m, 14.x.1973, C.W., G10203; 1 m, 26.iii.1973, C.W., G10194; SW. side, surge channel opening, 10 m, C.W., G10183; patch reef in lagoon, 21.x.1973, C.W., G10184, G10185.

Bushy-Redbill Reef: NNE. side, reef slope, 3 m, 30.xii.1972, C.W., G10186, G10187, G11303; NW. side, reef crest, 30.xii.1972, C.W., G10195, G10227, G10228; W. side, reef crest, 18.xii.1972, C.W., G10226.

Bowden Reef, opening in SW. side of reef, 26.vii.1972, C.W., G10188, G10189, G10229–31.

FIELD DIAGNOSIS

This is a medium sized compact arborescent species, which occurs as scattered turf like patches, bushes or thickets. It is distinguished from other arborescent species by very open radial corallites. Colour is usually cream or pale brown.

LABORATORY DIAGNOSIS

Branching pattern: Branching is open and irregular. Main branches are up to 15 mm wide and tapering.

Axial corallites: Outer diameter 2·2 to 3·5 mm; inner diameter 0·8 to 1·2 mm. Septation: primary septa present up to 2/3R; secondary septa all present, or mostly present, up to 1/3R.

Radial corallites: Tubular, extend at from 45° to 90° from branch; openings cochleariform; the upper part of the corallite wall (about 1/3 of the diameter) is thinner and shorter than the rest of the wall, and the thicker lower portion often flares slightly. Septal development is usually very marked: primaries can extend to R, and a full set of secondaries can be present. A good key to the identification of this species is the presence, on the proximal part of branches, of well formed cochleariform radials with strong septal development.

Coenosteum: Costate on radials, reticulate with simple or laterally flattened spines in between.

IDENTIFICATION DIFFICULTIES AND HISTORY

Although following Crossland's interpretation, I am still not fully satisfied that *A. haimei* is the correct identification of this species. Milne Edwards and Haime's type cannot be located. Other authors, particularly von Marenzeller, describe a greater variety of colony shapes than I have seen, including shallow water reef flat forms which approach corymbose. To a worker with some experience in the field, this species becomes easy to distinguish from other arborescent species because of its large open radial corallites.

WITHIN REEF DISTRIBUTION

The species occurs as small patches on middle and outer reef flats, but achieves its greatest

abundance on the reef slope (to about 10 m), in surge channel openings and on sandy bottoms in deep lagoons and around broken reef-patch areas.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Red Sea, ?Diego Garcia, Maldive Islands, Ceylon, Mauritius, Singapore, Great Barrier Reef, Fiji Islands.

Acropora tenuis (Dana, 1846)
(Plates 72, 73)

Madrepora tenuis Dana, 1846, p.451; Ortmann, 1888, p.152; Brook, 1893, p.83 (synonymy).
?Madrepora eurystoma Klunzinger, 1879, p.16, pl. 1, fig. 8, pl. *A*, fig. 7, pl. 9, fig. 12.
Madrepora eurystoma: Brook, 1893, p. 137 (synonymy).
Madrepora macrostoma Brook, 1891, p.464; 1893, p. 105, pl. 19, fig. B.
Madrepora bifaria Brook, 1892, p.453; 1893, p.110, pl. 30, fig. A.
Madrepora kenti Brook, 1892, p.458; 1893, p. 110, pl. 11, fig. B.
Madrepora dilatata Brook, 1893, p.81.
Madrepora anthocercis Brook, 1893, p. 106, pl.13, fig. C (synonymy).
?Acropora anthocercis: Nemenzo, 1967, p. 109.

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Exped., *Madrepora tenuis* holotype 259.

BM: Koseir, Red Sea, *A. eurystoma* 1886. 10.5.5; Diego Garcia, G. C. Bourne, *A. eurystoma* 1891.4.9.1. (mentioned Brook, 1893); Mauritius, *A. macrostoma* holotype 1878.2.4.7; Java, *A. bifaria* holotype 1859.12.12.2; Thursday Island, Saville-Kent, *A. kenti* holotype 1892.6.8.202; Palm Island, Saville-Kent, *A. anthocercis* syntype 1892.6.8.235; Rocky Island, Saville-Kent, *A. anthocercis* syntypes 1892.6.8.236, 1892.6.8.237.

QM: Big Broadhurst Reef, SW. side, reef slope: 1·9 m, 22.x.1973, C.W., G11413; 3·3 m, 22.x.1973, C.W., G11429; 4 m, 24.iii.1973, C.W., G11431; 6 m, 27.iii.1973, C.W., G11428; 7 m, 28.iii.1973, C.W., G11430; 7·8 m, 14.x.1973, C.W., G11456; 8 m, 26.iii.1973, C.W., G11433; 8 m, 14.x.1978, C.W., G11420; 8·1 m, 14.x.1973, C.W., G11424; 8·2 m, 14.x.1973, C.W., G11422, G11423; 8·6 m, 15.x.1973, C.W., G11425; 9·2 m, 15.x.1973, C.W., G11421; 9·8 m, 16.x.1973, C.W., G11426, G11432.

Bushy-Redbill Reef: W. side, outer reef flat, Dec. 1972, C.W., G11417; NW. side, reef slope: 19.xii.1972, E. Lovell, G11412, G11415, G11416; NW. side, floor outside slope, 22.xii.1972, C.W., G11427.

Darley Reef, patch reef in lagoon, 22.iii.1973, C.W., G11414, G11418.

Heron Island, W. side, reef flat, 6.vii.1973, Y. Loya, G11457.

Masthead Reef, SW. side, upper reef slope, Aug. 1974, J. Buhmann, G11419.

FIELD DIAGNOSIS

Colonies are 'thick plates' or caespito-corymbose. The radial corallites are evenly arranged and have distinctive, lip like, flaring outer wall and strong septal development, which can often be seen with the naked eye. Once learnt in the field, this species is always easily recognised. The commonest colour is cream, less commonly colonies are greenish-blue or bright blue. Polyps are often partly extended during the day, and in cream colonies these are often bright orange (axial polyps) and bright purple (radial polyps).

LABORATORY DIAGNOSIS

Branching pattern: From a growing area which may be central to lateral, branching is horizontal, then secondary branchlets or groups of branchlets are given off vertically to obliquely, their tips in one plane. Branching may also occur from the lower surface but these lower branches are never as long as the upper. Branchlet widths are from 6 to 8 mm. Shallow water specimens are 'thick plates' of up to 110 mm vertical depth; deeper water specimens may be thin plates as little as 35 mm thick.

Axial corallites: Up to 2 mm exert. Outer diameter: 1·9 to 3·0 mm; inner diameter 0·8 to 1·2 mm. Septation: both cycles usually developed, the primaries up to 2/3R, the secondaries up to 1/3R.

Radial corallites: Tubular, ascending, the inner wall less developed (both in thickness and length) than the outer; the outer wall flaring, so that the opening appears large and round or slightly oval. Towards the middle of the branches these radials have a classic 'cochleariform' appearance. Both septal cycles are usually developed, and in some reef flat and lagoonal specimens these may fill the corallite. The size of the radials is very even over the corallum. With increasing water depth the corallite wall becomes less flaring, the 'cochlear-iform' appearance is lost, and the corallites are more scattered.

Coenosteum: Either strongly costate or in rows of simple spines on the radial corallites, reticulate with simple spines between.

WITHIN REEF DISTRIBUTION

Reef flat (deeper water areas), lagoonal patch reefs, reef slope to about 10 m.

IDENTIFICATION DIFFICULTIES AND HISTORY

The synonymy list for *A. tenuis* is large, and possibly still incomplete. The synonyms differ in features such as length of branches and degree of calcification. In the field, the colonies look quite similar to those of *A. aculeus* (Dana). Some field experience is necessary to distinguish them. The main differences are:

(a) wide flaring lip and larger radial corallites in *A. tenuis;*
(b) colour pattern: *A. tenuis* is usually cream or pinkish brown while *A. aculeus* has a distinctive double colouration;
(c) *A. tenuis* very often has the polyps expanded, as noted.

The shape of the radial corallites shows some similarity to that in *A. haimei,* and strong similarity to that in *A. striata* Verrill, which does not occur in the Great Barrier Reef regions studied, but is a common species in the Marshall Islands. One specimen from Lizard Island in the J.C.U. with bottlebrush growth form is possibly *A. striata.*

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Mauritius, Red Sea, Diego Garcia, Indonesia, Philippines, China Sea, Great Barrier Reef, Fiji Islands.

Acropora tubicinaria (Dana, 1846)
(Plate 74)

Madrepora tubicinaria Dana, 1846, p.451, pl.32, fig.7; Brook, 1893, p.139 (synonymy).
Acropora tubicinaria: Verrill, 1902, p.219; Wells, 1954, p.423, pl.122, figs.3-5.

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Exped., *A. tubicinaria* holotype 258.

QM: Bushy-Redbill Reef: W. side, inner reef flat: 28.v.1975, C.W., G11071–6, G11080; Jan. 1973, C.W., G11077; 18.xii.1972, C.W., G11081; NW. side, first reef crest, 22.xii.1972, C.W., G11082; S. side, microatoll zone, 2.i.1973, C.W., G11078, G11079, G11083.

Masthead Reef, August 1974, J. Buhmann, G11088. Great Keppel Island, Dec. 1975, R. Woolley, G11089.

FIELD DIAGNOSIS

Colonies are small rounded caespitose clumps (largest seen 25 cm diameter) in which the openings of the radial corallites are obvious. Colour is brown, occasionally with blue tips.

LABORATORY DIAGNOSIS

Branching pattern: From a central growing area branches are given off vertically to obliquely, and these branch again, sometimes infrequently, sometimes frequently. As colonies mature the base and basal parts of branches may die, and portions of the colony become separate from each other. Branches are from 8 to 10 mm thick, and may be truncate or strongly tapered.

Axial corallites: Non exert. Outer diameter 1·8 to 3·2 mm; inner diameter 1·0 to 1·2 mm. Septation: both septal cycles developed, primaries up to 3/4R, secondaries up to 1/4R.

Radial corallites: Short tubular, usually upper part of wall less developed than lower, opening circular. Usually both septal cycles are developed, but just visible, although on parts of the corallum primaries can reach 1/2R and secondaries 1/4R.

Coenosteum: On some colonies lines of simple spines are arranged both on and between radials. More commonly the coenosteum is costate or in lines of spines on the radials, and reticulate with simple spines between.

WITHIN REEF DISTRIBUTION

On Bushy-Redbill Reef, this species is common in the coral depauperate inner reef flat (recorded as *A. digitifera* by Wallace and Lovell 1977). With *A. palifera* and species of *Porites* it dominates this zone and it is rare on other parts of the reef.

IDENTIFICATION DIFFICULTIES AND HISTORY

This species is rarely mentioned in the literature. On my evidence and that of Wells, it tends to specialize in certain reef zones (which may be characterized by poor coral cover), but is common in these areas. It is rare in collections brought to the QM for identification, and I have not yet seen it from fringing reefs. *A. striata* Verrill mentioned by Wells (1954) as a 'related form' does not occur on the Great Barrier Reef.

GEOGRAPHIC DISTRIBUTION

Great Barrier Reef, Fiji Islands, Marshall Islands, Tahiti.

Acropora aculeus (Dana, 1846)
(Plates 75, 76)

Madrepora aculeus Dana, 1846, p.450, pl.32, fig.6; Brook, 1893, p.104 (synonymy).
Acropora aculeus: Faustino, 1927, p.269; Nemenzo, 1967, p.114.
Madrepora tubigera Horn, 1860, p.435; Verrill, 1864, p.41; Quelch, 1886, p.161; Brook, 1893, p.79 (+ further synonymies); Verrill, 1902, p.239, pl.36, figs.1, 2-2b, pl.36a, figs.1, 2-2b; pl.36f, fig.8.

Acropora tubigera: Crossland, 1952, p.208.
?*Madrepora nana* Studer, 1878, p.533, pl.2, figs. 6a, 6b; Brook, 1893, p.82.
Acropora nana: Wells, 1950, p.39, pl.10, figs.3, 4.
?*Acropora nana:* Nemenzo, 1967, p.85.
Madrepora patula Brook, 1892, p.460; 1893, p.111, pl.9, fig.E.
Acropora patula: Crossland, 1952, p.215; Stephenson and Wells, 1956, p.16; Nemenzo, 1967, p.102.
?*Madrepora elegantula* Ortmann, 1889, p.507, pl.12, fig.5.
Madrepora elegantula: Brook, 1893, p.115.

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Expd., *A. aculeus* holotype 257; Cocos-Keeling, *A. nana* (mentioned Wells, 1950) 44322.

YPM: *A. tubigera* fragment of type 1483.

BM: Port Denison, Great Barrier Reef, *A. patula* holotype? 1892.6.8.274.

QM: Big Broadhurst Reef: SW. side, reef slope: 13.x.1973, C.W., G9093; 3 m, 28.iii.1973, C.W., G9097; 5 m, 27.iii.1973, C.W., G9107; 5·1 m, 23.x.1973, C.W., G9086, G9087; 6 m, 13.x.1973, C.W., G9092; 6·1 m, 13.x.1973, C.W., G9090; 7 m, 28.iii.1973, C.W., G9106; 8 m, 26.iii.1973, C.W., G9108; 8·2 m, 14.x.1973, C.W., G9094; 8·5 m, 23.x.1973, C.W., G9100; 8·7 m, 15.x.1973, C.W., G9095; 9·2 m, 23.x.1973, C.W., G9088; 10 m, 20.x.1973, C.W., G9099; 10 m, 23.x.1973, C.W., G9101; 10·6 m, 16.x.1973, C.W., G9102; 13·3 m, 23.x.1973, C.W., G9089; 25 m, 17.x.1973, C.W., G9091; 25·1 m, 18.x.1973, C.W., G9104; SW. side, surge channel floor, 10 m, 20.x.1973, C.W., G9098, G9108.

Bushy-Redbill Reef: W. side, middle reef flat: 8.vi.1975, C.W., G9122–4; 14.vi.1975, C.W., G9125, G9126; W. side, outer reef flat, 31.vi.1975, C.W., G9116; W. side, reef slope, 1–8 m, 3.vi.1975, C.W., G9118, G9120; NW. side, middle reef flat, 30.xii.1972, C.W., G9114; NW. side, patch reefs: 19.xii.1972, E. Lovell, G9542; 15 m, 16.vi.1975, C.W., G9117; NW. side, reef slope, 3–7 m, 21.xii.1972, C.W., G9115; adjacent Redbill Is., reef crest: 19.xii.1972, C.W., G9113; 1.vi.1975, C.W., G9119; adjacent Redbill Is., reef slope, 20.xii.1972, C.W., G11463.

Darley reef, patch reefs in lagoon: 3 m, 18.vii.1972, C.W., G9110; 3 m, 22.iii.1973, C.W., G9109; 4 m, 22.iii.1973, C.W., G9111.

Prawn reef, patch reef in lagoon, 15.vii.1972, C.W., G9112.

FIELD DIAGNOSIS

This species occurs as 'thick plates' or caespito-corymbose units. The colony can be one plate with a loose central or side attachment, or a number of tiers of plates can develop. The single plates occur on the outer reef flat and deeper water parts of the reef slope: the layering develops in deep water middle reef flat areas and on the reef crest. Small round colonies can occur on the outer reef flat. Colours are blue, grey, green, or brown on lower parts of branches, with tips of branches yellow, lime green, pale blue or brown.

LABORATORY DIAGNOSIS

Branching pattern: From a usually lateral attachment, main branches are horizontal and secondary branchlets or bundles of branchlets are given off horizontally to obliquely on both sides of them. Branchlets are slender (3 to 7 mm). The 'stout branches' of Dana was either a slip of the pen or a reference to the main stem. Small shallow reef flat specimens grow as vertical branchlets directly from an encrusting base.

Axial corallites: Outer diameter 1·8 to 2·4 mm; inner diameter 0·8 to 1·0 mm. Septation: primary septa well developed, up to 2/3R, secondaries usually partly but poorly developed, up to 1/4R.

Radial corallites: Tubular appressed to partly appressed, with round to slightly oval openings at 90° or more to the branch. Primary septa developed up to 1/2R, and some secondaries visible. Radials are usually evenly sized and distributed on branches and show little variation. Wall can be thickened.

Coenosteum: Lines of simple spines on and between radials, or sometimes a spongy appearance between radials.

WITHIN REEF DISTRIBUTION

Middle and outer reef flats, reef crest, reef slope to 20 m, lagoonal patch reefs.

IDENTIFICATION DIFFICULTIES AND HISTORY

Much of the variability in this species is related to colony size. Some idea of the scale of this variability can be seen by comparing Well's *A. nana* specimen (1950, pl.10, figs.3, 4) and my Plate 76, Fig.D. Other features such as thickness of wall, angle of radial lip, and completeness of radial septation, vary little, but are responsible for the various species in synonymy. *A. elegantula* (Ortmann) as interpreted by Brook (1893) (BM 1892.12.5.18) is a heavily calcified specimen of this species.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Cocos-Keeling Islands, Philippines, Great Barrier Reef, Fiji Islands, Samoa, Marshall Islands.

Acropora cerealis (Dana, 1846)
(Plate 77)

Madrepora cerealis Dana, 1846, p.460, pl.35, fig.2; Brook, 1893, (part) p.91 (synonymy).
Acropora cerealis: Faustino, 1927, p.266, pl.86, figs.1, 3; Nemenzo, 1967, p.83, pl.25, fig.2.
Madrepora hystrix Dana, 1846, p.476, pl.40, fig. 1, pl.31, fig.5; Brook, 1893, p.176 (synonymy).
Acropora hystrix: Wells, 1954, p.425; pl.125, figs.1-4.
Madrepora tizardi Brook, 1893, p.89, pl.11, figs. C, D. (synonymy).
Acropora tizardi: Wells, 1954, p.425, pl.125, figs. 5, 6; Nemenzo, 1967, p.103.

MATERIAL EXAMINED

USNM: Sooloo Sea, U.S. Expl. Exped., *A. cerealis* syntype 269; East Indies, U.S. Expl. Exped., *A. cerealis* syntype 270, Fiji Islands, U.S. Expl. Exped., *A. hystrix* holotype 298.

YPM: Fiji Islands, U.S. Expl. Exped., *A. hystrix* fragment of type 2039.

BM: Tongatabu, J. J. Lister, 1891.3.6.9; Amboina, Challenger, 1885,2.1.1; *A. cerealis* (Brook 1893 mentioned specimens); Tizard Bank, *A. tizardi* syntype 1889.9.24.115.

QM: Big Broadhurst Reef, SW. side, reef slope: 4·5 m, 12.x.1973, C.W., G9532; 5·1 m, 14.x.1973, C.W., G9539; 6 m, 13.x.1973, C.W., G9535; 6·3 m, 23.x.1973, C.W., G9538, G9531; 8·6 m, 15.x.1973, C.W., G9533; 8·7 m, 23.x.1973, C.W., G9529; 10 m, 23.x.1973, C.W., G9541; 14·2 m, 23.x.1973, C.W., G9530; 13.x.1973, C.W., G9537; Oct., 1973, C.W., G9540.

Bowden Reef, slope of opening in SW. side, 3 m, 26.vii.1972, C.W., G9519, G9520.

Bushy-Redbill Reef, NW. side, reef crest, 22.xii.1972, C.W., G9543.

Darley Reef, patch reefs in lagoon: 5 m, 24.iii.1973, C.W., G9524; 1 m, 22.iii.1973, G9525, G9528; 3 m, 18.vii.1972, C.W., G9526.

Viper Reef, patch reefs in lagoon, 3 m, 6.vii.1972, C.W., G9521, G9523.

FIELD DIAGNOSIS

Colonies can be untidy caespitose clumps in lagoonal situations, through caespito-corymbose on the upper reef slope, to corymbose plates on the deeper reef slope. Radial corallites are narrow tubo-nariform, with tendency for outer edge to be hooked upwards *('A. tizardi')*, with elongate oblique opening *('A. hystrix')* tubo-nariform tending to nariform *(A. cerealis s.s.)*. The resultant appearance is a colony similar to *A. nasuta*, but with 'spinier' appearance and slender, usually more complexly branching, branchlets. Colour is usually cream to pale brown.

LABORATORY DIAGNOSIS

Branching pattern: From a central to lateral attachment, main branches are given off vertically (mainly in lagoonal colonies) to horizontally. Secondary branching is on all sides of vertical branches or vertically to obliquely upwards from horizontal branches. There is a tendency for further secondary branching. Branchlet widths are around 10 mm, but much of this width is given by the spreading radial corallites.

Axial corallites: Outer diameter 1·8 to 2·1 mm, inner diameter 0·7 to 0·9 mm. Septation: primary septa well developed, up to 3/4R, secondaries absent or a few present to 1/4R.

Radial corallites: The shape of the radial corallites is nariform to tubo-nariform, but the opening varies from rounded to slightly oval (lagoonal specimens) to accentuated elongate. The lower wall may be slightly thickened or may be extended as a 'hook'. In lagoonal specimens, radials tend to be scattered. In reef-slope specimens with elongate radials these tend to be arranged in neat rows along the branches. Septal development varies, but primaries are always strongly visible, and secondaries usually at least partially visible.

Coenosteum: Costate or dense lines of spines on corallites, reticulate with simple spines in between.

WITHIN REEF DISTRIBUTION

Deep water reef flat areas, reef slope (to 15 m in present study), lagoonal patch reefs.

IDENTIFICATION DIFFICULTIES AND HISTORY

Wells (1954) commented on the similarity between *A. tizardi* and *A. hystrix*. Unfortunately *A. cerealis sens. strict.* is the most difficult of the synonyms to place correctly. Without the accentuated oblique radial corallite opening it approaches *A. nasuta* in general appearance. Deeper reef slope specimens are very lightly structured, and are easily confused with specimens of *A. tenuis* from similar localities.

GEOGRAPHIC DISTRIBUTION

China Sea, Philippines, Great Barrier Reef, Fiji Islands, Marshall Islands, Tongan Islands.

Acropora nasuta (Dana, 1846)
(Plate 78)

Madrepora nasuta Dana, 1846, p.453, pl.34, fig.2; Brook, 1893, p.73 (synonymy).
Acropora nasuta: Verrill, 1902, p.257; Hoffmeister, 1929, p.364; Wells, 1954, p.424, pl.113, figs. 5, 6; pl.124, figs.1-3; Nemenzo, 1967, p.88, pl.26, fig.3.

Madrepora nasuta var. *crassilabia* Brook, 1893, p.74.
Acropora nasuta crassilabia: Wells, 1954, p.425, pl.124, fig.4.
Acropora nasuta var. *crassilabia:* Nemenzo, 1967, p.89, pl.26, fig.2.
Madrepora effusa Dana, 1846, p.455; Brook, 1893, p.76 (synonymy).
Acropora effusa: Verrill, 1902, p.229, pl.36, fig.16, 16a, pl.36B, fig.7, 7a.
Madrepora cymbicyathus Brook, 1893, p.86 (synonymy).
Acropora cymbicyathus: Hoffmeister, 1925, p.63, pl.13, figs.2a, 2b; Wells, 1954, p.425; pl.124, figs.5-7; Stephenson and Wells, 1956, p.12.

MATERIAL EXAMINED

USNM: Tahiti, U.S. Expl. Exped., *A. nasuta* holotype 260.

YPM: Point Pedro, Ceylon, *A. effusa* holotype 8147.

QM: Big Broadhurst Reef: patch reef in lagoon: 21.x.1973, C.W., G11212; 28.iii.1973, C.W., G11227; SW. side, outer reef flat, 22.iii.1973, C.W., G11209; SW. side, reef crest: 1·5 m, 11.x.1973, C.W., G11216; 1·5 m, 22.x.1973, C.W., G11213; 2 m, 11.x.1973, C.W., G11215, G11274; SW. side, reef slope: 7 m, 28.iii.1973, C.W., G11224; 7·6 m, 13.x.1973, C.W., G11217.

Bowden Reef, SW. side, reef crest, 1 m, 15.vii.1972, C.W., G11211.

Bushy-Redbill Reef: adjacent Redbill Is., reef flat: 18.xii.1972, C.W., G11204; 7.vi.1975, C.W., G11222; 12.vi.1975, C.W., G11223; W. side, middle reef flat; 5.vi.1975, C.W., G11226; 27.vi.1975, C.W., G11221, G11228; NW. side, first reef crest, 22.x.1973, C.W., G11214.

Darley Reef, patch reef in lagoon, 3 m, 22.iii.1973, C.W., G11218.

Heron Island: W. side, outer reef flat, 7.vii.1973, C.W., G11209; W. side, reef flat, July 1973, C.W., G11205; W. side, reef slope, 7 m, 7.vii.1973, Y. Loya, G11203.

Palm Islands, 1939, T. C. Marshall, G11206–8.

FIELD DIAGNOSIS

Corymbose to tabular colonies, the branchlets covered evenly and neatly with nariform corallites with elongate openings. Colour is most commonly cream to pale brown, usually with pale blue tips, but can also be yellowish or greenish.

LABORATORY DIAGNOSIS

Branching pattern: Branches arise from an encrusting plate, or a sturdy stalk. Secondary branches are vertical in the centre of the colony, and more curved towards the edges; they are not usually very proliferous.

Axial corallites: Outer diameter 2·0 to 3·0 mm; inner diameter 0·5 to 0·9 mm. Septation: primary septa present, up to 3/4R, secondary septa anything from all absent to all present up to 1/4R.

Radial corallites: Nariform, dimidate, or tubo-nariform, opening at 90° to branch or less. The walls of the corallites may be thickened. Primary septa present up to 1/3R, secondary septa poorly developed, usually less than a full cycle present, up to 1/4R.

Coenosteum: Laterally flattened or forked spines are arranged densely on radial corallites, sometimes joining as costae. Between radials coenosteum is reticulate.

WITHIN REEF DISTRIBUTION

Occurs on most parts of the reef flat, reef crest, upper reef slope (to about 8 m in studied areas). This is sometimes the only *Acropora* (other than *A. palifera*) occurring in shallow lagoonal patch reefs in inner lagoons adjacent to coral cays.

IDENTIFICATION DIFFICULTIES AND HISTORY

The close similarity of *A. nasuta* and *A. cymbicyathus* has been commented on by other authors. Although not well represented in the literature, this is a common *Acropora* on the Great Barrier Reef, occurring in a variety of habitats. Colonies are often very regularly formed, and easily recognised, although it can sometimes be confused with more regular colonies of *A. cerealis*. It is a good photographic subject, usually being identified in popular texts as '*A. surculosa*'.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Ceylon, Great Barrier Reef, Fiji Islands, Samoa, Marshall Islands, Tahiti.

Acropora diversa (Brook, 1891)
(Plates 79, 80A, B)

Madrepora diversa Brook, 1891, p.461; 1893, p.141, pl.16, fig.B.
Acropora diversa: Wells, 1954, p.424, pl.117, figs.3-6; Stephenson and Wells, 1956, p.13.
Madrepora concinna Brook, 1891, p.460; 1893, p.165, pl.17.
Acropora otteri Crossland, 1952, p.229, pl.43, figs.1, 2, pl.44, figs.1, 2.

MATERIAL EXAMINED

BM: Diego Garcia, G. C. Bourne, *A. diversa* holotype 1891.4.9.4; Mauritius, *A. concinna* syntypes 1878.2.4.3, 1878.2.4.8; Great Barrier Reef Expedition, *A. otteri* syntypes 1934.5.14.17; 1934.5.14.76; June Reef, outer moat *A. otteri* (? also a syntype) 1934.5.14.315.

QM: Big Broadhurst Reef: SW. side, outer reef flat: 22.x.1976, C.W., G11232, G11233; 18.x.1973, C.W., G11261, G11263, G11269, G11279, G11280; 22.x.1973, C.W., G11272, G11285; SW. side, reef slope: 1·3 m, 22.x.1973, C.W., G11245; 1·5 m, 18.x.1973, C.W., G11266; 3 m, 27.iii.1973, C.W., G11254; 3·3 m, 22.x.1973, C.W., G11237; 4·5 m, 23.x.1973, C.W., G11273; 5·1 m, 23.x.1973, C.W., G11236, G11270; 5·7 m, 23.x.1973, C.W., G11241; 6 m, 27.iii.1973, C.W., G11252; 7 m, 28.iii.1973, C.W., G11259; 7·1 m, 13.x.1973, C.W., G11276; 7·8 m, C.W., G11267; 8 m, 28.iii.1973, C.W., G11246, G11258; 8·1 m, 14.x.1973, C.W., G11231; 8·2 m, 14.x.1973, C.W., G11230, G11243, G11285; 8·6 m, 15.x.1973, C.W., G11240; 8·7 m, 15.x.1973, C.W., G11264; 9·6 m, C.W., G11265; 9·7 m, 15.x.1973, C.W., G11271; 9·8 m, 16.x.1973, C.W., G11239; 10·6 m, 23.x.1973, C.W., G11275; 12·5 m, 17.x.1973, C.W., G11242; 14·2 m, 23.x.1973, C.W., G11235; SW. side, reef crest; 1·5 m, 11.x.1973, C.W., G11278; 1·6 m, 22.x.1973, C.W., G11284; 22.x.1973, C.W., G11234.

Bowden Reef, SW. side, reef crest: 0·75 m, 15.vii.1972, R. Pearson, G11268; 1 m, 15.vii.1972, C.W., G11248, G11251, G11260; SW. side, reef slope: 26.vii.1973, C.W., G11238.

Bushy-Redbill Reef, NW. side, reef slope: Jan. 1973, C.W., G11249; 19.xii.1972, E. Lovell, G11257; G11262; G11282.

Darley Reef, patch reef in lagoon: 1 m, 24.iii.1973, C.W., G11250; 5 m, 19.vii.1972, C.W., G11244, G11256; 24.iii.1973, C.W., G11253, G11255.

Field Diagnosis

Corymbose, caespito-corymbose, tabulate to plate-like colonies have a mixture of tall and short tubular radial corallites which is usually distinctive. A variety of colours occur, vis. cream, yellow-brown, blue-grey, blue-brown.

Laboratory Diagnosis

Branching pattern: From an attachment region which is central to lateral, branches are given off upwards vertically to obliquely. These may be as short as 20 mm to as long as 70 mm, and may branch proliferously or rarely. Branch widths vary from 7 to 20 mm.

Axial corallites: 1 to 3 mm exert. Outer diameter 2·4 to 3·2 mm (slightly larger in *A. diversa* type); inner diameter 0·8 to 1·1 mm. Septation: both cycles usually present, the first cycle up to 3/4R, the second up to 1/3R.

Radial corallites: Tall and short corallites are mixed, in a pattern which may be regular (tall radials arranged in vertical rows) or very irregular. The form of the tall and short radials is similar — tubular, with round, or slightly oval openings, sometimes tubo-nariform. The outer wall may be thickened. The septal development is usually poor, primary septa being present, up to 1/3R, but usually less than this, the secondary cycle usually only partly present, up to 1/4R.

Coenosteum: Simple pointed to laterally flattened spines are densely arranged on the radial corallites, sometimes forming costae. Between the radials their arrangment is less dense.

Within Reef Distribution

Outer reef flat, reef crest and reef slope to about 15 m, lagoonal patch reefs.

Identification Difficulties and History

Amongst my material there is great variability in radial corallite features such as length, shape of opening, ratio of short to long, as well as the expected colony-shape variability. Both in the field and in the laboratory I find areas of overlap and difficulty in distinguishing some specimens from *A. nasuta* and others from *A. variabilis*. A study concentrating on these three species would be profitable.

Geographic Distribution

Indo-Pacific: Mauritius, Diego Garcia, Great Barrier Reef, Marshall Islands.

Acropora variabilis (Klunzinger, 1879) (Plate 80C, D)

Madrepora variabilis Klunzinger, 1879, p.17, pl.1, fig.10, pl.2, figs.1, 5, pl.5, figs.1, 3, pl.9, fig.14; Brook, 1893, p.161.

Acropora variabilis: von Marenzeller, 1907, p.49, pl.15, figs. 40–44; Vaughan, 1918, p.181, pl.80, figs.2, 3, 3a, 3b; Faustino, 1927, p.276; Wells, 1950, p.38; 1954, p.428, pl.128, figs.1, 2, pl.130, figs. 1, 2; Rossi, 1954, p.52; Stephenson and Wells, 1956, p.19; Scheer and Pillai, 1974, p.23, pl.8, fig.2; Pillai and Scheer, 1976, p.31.

Acropora variabilis var. *pachyclados:* Crossland, 1952, p.222, pl.38, figs.1, 6.

Material Examined

MNB: Koseir, Klunzinger, *A. variabilis* var. *pachyclados* 2118; Koseir, Klunzinger, *A. variabilis* var. *cespitofoliata* 2120 (Klunzinger mentioned specimens, examined as photographs only).

QM: Big Broadhurst Reef, SW. side, outer reef flat: 11.x.1973, C.W., G11291; 18.x.1973, C.W., G11287–90.

Field Diagnosis

Colonies may be small round clumps of vertical to oblique branches or stalked corymbose colonies to about 30 cm across. Branches are covered by appressed tubular corallites with round openings. The sizes of the radial corallites may be similar or extremely variable. Colour may be brown,

lavender-brown, greenish-brown, or yellow or cream with purple corallites.

LABORATORY DIAGNOSIS

As this species has been well described by other authors, and my series is poorly representative of the species, further description is not given. Refer to Vaughan 1918 for tables of measurements of skeletal features.

WITHIN REEF DISTRIBUTION

Shallow outer reef flat (particularly where an elevated platform is present), reef crest. A large series in the JCU comes from the fringing reefs of the Palm Islands and Lizard Island.

IDENTIFICATION DIFFICULTIES AND HISTORY

Although this species is poorly represented in my areas of study, evidence suggests it may be common (a) on windward outer reef flat platforms (as small round clumps) and (b) on reef edges of the fringing reefs of continental islands (as caespito-corymbose colonies). The series in JCU from Lizard Island and the Palm Island group is in the second category. An allied species is *A. valida* (Dana) (see Hoffmeister, 1925, p.60). This latter species may also occur on the Great Barrier Reef, but is not represented in the QM collections, except by two specimens collected in the Fiji Islands, and closely comparable with Dana's type.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Red Sea, Nicobar Islands, Cocos-Keeling, Philippines, Great Barrier Reef, Marshall Islands.

Acropora humilis (Dana, 1846)
(Plates 81, 82, 83)

Madrepora humilis Dana, 1846, p.483, pl.31, fig.4, pl.41, fig.4.

Acropora humilis: Wells, 1954, p.425, pl.100, fig.1, pl.126, figs.1–6, pl.127, figs.3, 4, pl.128, figs. 3–5 (synonymy); Rossi, 1954, p.50; Stephenson and Wells, 1956, p.15; Pillai and Scheer, 1976, p.32.

This species has been given extensive taxonomic treatment by Wells 1954. He combined 17 species (some with additional synonyms designated by earlier authors), and concluded that three broad forms could be recognised. These he considered to be characteristic of different reef localities and related, in particular, to water level. Although a large suite of specimens is on hand at the QM, their description is withheld until a further study concentrating on this complex species can be carried out. For general purposes, this species is probably the best known and most easily recognised *Acropora*. Some additional information is added below on Well's first facies, forma alpha *(A. samoensis, A. pelewensis).*

Acropora humilis (Dana, 1846) forma α Wells, 1954

MATERIAL EXAMINED

QM: Big Broadhurst Reef, SW. side, reef slope: 8·6 m, 14.x.1973, C.W., G1132, G1135; 8·6 m, 15.x.1973, C.W., G11131; 8·7 m, 15.x.1973, G11130; 9·8 m, 16.x.1973, G11134; 10·4 m, 16.x.1973, C.W., G11133; 12·5 m, 17.x.1973, C.W., G11137.

Bowden Reef, SW. side, upper reef slope, 26.vii.1972, C.W., G11189.

Darley Reef, patch reef in lagoon: 24.iii.1973, C.W., G11128; 3 m, 22.iii.1973, C.W., G11129; 22.iii.1973, 5 m, C.W., G11611.

FIELD DIAGNOSIS

Colonies may be low arborescent (with shrub-like growth) caespito-corymbose, or plate-like. Branches are terete (non tapering) or slightly tapering, with wide axial corallites, and large thick-walled radial corallites. Colours are cream-brown, sometimes with pale blue tips, or pale blue or lavender.

LABORATORY DIAGNOSIS

Branching pattern: Superimposed on the colony shape described above is usually a high degree of budding. The branches may be as broad as 20 mm, but in the plate like colonies (which occur on reef slopes) and particularly in deeper-water specimens, branches can be as narrow as 8 mm.

Axial corallites: About 2 mm exert. Outer diameter 3·0 to 5·0 mm; inner diameter 1·1 to 1·6 mm. Septation: both cycles present, primaries up to 3/4R, secondaries up to 1/2R.

Radial corallites: Tubular or appressed tubular, with round or oval openings, or nariform, the outer wall thickened. Primary septa are usually present, up to 1/3R; secondary septa not usually fully developed, but some present up to 1/4R.

Coenosteum: Costate to reticulate both on and between radial corallites, with spines that are laterally flattened and sometimes slightly elaborated at the tip.

WITHIN REEF DISTRIBUTION

This form extends down the reef slope and sloping surfaces of lagoonal patch reefs.

IDENTIFICATION DIFFICULTIES AND HISTORY

Deep water specimens, because of the narrow and proliferous branches, are barely recognisable as *A. humilis*, and begin to have a similar general appearance to *A. sarmentosa*.

GEOGRAPHIC DISTRIBUTION

A. humilis has a wide Indo-Pacific distribution.

Acropora digitifera (Dana, 1846)
(Plate 84)

Madrepora digitifera Dana, 1846, p.454; Brook, 1893, p.75.

Acropora digitifera: Verrill, 1902, p.228, pl.36, fig.12, pl.36B, fig.3; Vaughan, 1918, p.175, pl.13, fig.7; pl.76, figs.1, 1a, 2; Wells, 1954, p.427, pl.127, figs.1, 2; 1955, p.9; Stephenson and Wells, 1956, p.13 (synonymy).

Acropora fraterna Verrill, 1902, p.247, pl.36, fig.18, pl.36B, fig.9.

MATERIAL EXAMINED

YPM: *A. digitifera* type (fragment, ex. Boston Soc. Nat. History) 4192; Tahiti, U.S. Expl. Exped., *A. fraterna* holotype 2032.

QM: Big Broadhurst Reef, SW. side, outer reef flat: 11.x.1973, C.W., G11170; 18.x.1973, C.W., G11169, G11171, G11172; 22.x.1973, C.W., G11168, G11187.

Bushy-Redbill Reef, adjacent Redbill Is., reef flat, 18.xii.1972, C.W., G11176; 2.vi.1975, C.W. G11173, G11174; 5.vi.1975, C.W., G11175; 10.vi.1975, C.W., G11188; 11.vi.1975, C.W., G11177.

Heron Island, W. side, reef flat, July 1973, C.W., G11180.

Oyster Cay, C. Limpus, 1975, G11179.

Fiji Islands: Great Astrolabe Reefs, Yaucuve Levu fringing reef, Jan. 1974, C.W., G11183, G11184, G11186; Vaga Bay, Beqa, patch reefs, 15.i.1974, C. J. Wallace, G11182.

FIELD DIAGNOSIS

Colonies are corymbose, with central to lateral attachment, and tapering branches. Appearance is of a diminutive, 'neat' *A. humilis*. Colour is commonly cream to pale brown, with or without blue branch tips.

LABORATORY DIAGNOSIS

Branching pattern: From a growing area which may be central to lateral, and more or less stalk-like, main branches grow horizontally, and give off secondary branches or bundles of branches vertically to obliquely. These may taper to a point, or be terete, and are from 8 to 20 mm greatest width.

Axial corallites: Non exert. Outer diameter 2·8 to 3·8 mm; inner diameter 0·8 to 1·1 mm. Septation: both cycles developed, primaries up to 2/3R, secondaries up to 1/4R.

Radial corallites: A size gradation occurs from branch tip to proximal and small corallites are interspersed with large. Shape is dimidiate, or tubular with oval to dimidiate opening, radials spreading at 90° from branch. Outer wall is thickened.

Coenosteum: Costate or with regular lines of spines on corallites, spongy with spines in between.

WITHIN REEF DISTRIBUTION

Limited to the shallow middle reef and outer reef flat pavement *('A. digitifera'* from inner reef flat as interpreted by Wallace and Lovell 1977 is *A. tubicinaria.)*

IDENTIFICATION DIFFICULTIES AND HISTORY

On some reefs (e.g. Enewetak, Marshall Islands) this species is well marked and easily recognised. On the Great Barrier Reef, where *A. digitifera* occurs with *A. humilis*, some colonies cannot be definitely assigned to one or other species on morphological grounds. As Stephenson and Wells (1956) point out, the main difference is in dimensions. A further analysis of one must include the other.

GEOGRAPHIC DISTRIBUTION

Great Barrier Reef, Moreton Bay (Queensland), Fiji Islands, Marshall Islands, Tahiti.

Acropora multiacuta Nemenzo, 1967
(Plate 85)

Acropora multiacuta Nemenzo, 1967, p.133, pl.39, figs.1, 2, 3; Scheer and Pillai 1974, p.24, pl.6, fig.4.

MATERIAL EXAMINED

USNM: (donated): Darley Reef, shallow patch reefs in lagoon, 1 m, 24.iii.1973, C.W.

BM: (donated): Darley Reef, shallow patch reefs in lagoon, 1 m, 24.iii.1973, C.W.

JCU: Philippine Islands, 1975: 3 m, M. Pichon, 2509/75; 5 m, M. Pichon, 2525/75.

QM: Darley Reef, shallow patch reefs in lagoon: 1 m, 19.vii.1972, C.W., G6721, G6722; upper surface, 23.iii.1973, C.W., G10465, G10470, G10471; upper surface, 24.iii.1973, C.W., G10466, G10467, G10469; 1 m, 24.iii.1973, C.W., G10464; 3 m, 22.iii.1973, C.W., G10468.

FIELD DIAGNOSIS

Irregular caespitose to caespito-corymbose colonies from an encrusting central to lateral base, with axial corallites sturdy and prominent, sometimes to the extent of the entire branch or one side of the branch being naked of radial corallites. Colour is whitish blue with pale blue polyps. The largest colony seen to date is 19·5 cm diameter.

LABORATORY DIAGNOSIS

Only twelve Great Barrier Reef specimens have been examined and these show much variation, particularly in the extent of radial corallite presence on the branches, the amount of secondary branching, and the length of the main branches. Some dimensions such as the width of the branches are not included in the diagnosis for this reason.

Branching pattern: From the encrusting base, the main branches arise vertically to obliquely, and may be variously curved. The longest branch in the present collection is 10 cm. At the base of main branches smaller branches may occur. These do not always alter the colony shape, but in the side attached specimens it appears they would contribute to the development of a bracket shape as the colony matured. Some specimens have prolific incipient branching along the main and secondary branches.

Axial corallites: (On the main branches) outer diameter 3·5 to 6·5 mm; inner diameter 1·0 to 2·0 mm. Septation: both cycles present, occasionally a third cycle partially developed, primaries up to 1/3R, secondaries up to 1/4R. On the basal and incipient branches axials are narrower and sometimes compressed so that the opening is oval. These are described as radial corallites by Nemenzo.

Radial corallites: Scattered, nariform, tubo-nariform, or partly appressed tubular; often oriented with opening down or across the branch. Septa not developed at all, or primaries just visible.

Coenosteum: Densely echinulate on both radial corallites and inter-corallite areas; the spines laterally flattened, occasionally some pseudocostate development on the axial corallite.

WITHIN REEF DISTRIBUTION

The only populations seen have been on the upper surface and edges of patch reefs, just below low water. The colonies occur on the surface or in depressions in the irregular reef surface, and the main branches may be curved to maintain an overall vertical orientation. The naked areas of branches are always upwards.

IDENTIFICATION DIFFICULTIES AND NOTES

Nemenzo used the species grouping Alticyathus for this species and for his *A. fastigata* (1967, p.134). The latter may be a synonym, or may be *A. digitifera*. I have not been able to locate Nemenzo's types in the UP collections. On the Great Barrier Reef, the species has only been seen from the Darley Reef lagoon, and it cannot yet be fully categorised.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Nicobar Islands, Philippines, Great Barrier Reef.

Acropora clathrata (Brook, 1891)
(Plates 86, 64C).

Madrepora clathrata Brook, 1891, p.459; 1893, p.49, pl.5, pl.6, fig.A, B.
Madrepora orbicularis Brook, 1892, p.460; 1893, p.37, pl.2 (synonymy);
Madrepora vasiformis Brook, 1893, p.37, pl.26, fig. A (Synonymy).
Acropora vasiformis: Pillai and Scheer, 1976, p.27, pl.3, fig.4.
Acropora tutuilensis (part) Hoffmeister, 1925, p.71, plate 19, figs. 1a–1e.

MATERIAL EXAMINED

BM: Mauritius, *A. clathrata* holotype 1893.4.7.78; Ceylon, *A. orbicularis* holotype 1883.3.24.7; Rodriguez, *A. vasiformis* holotype 1876.5.5.92.

USNM: Pago Pago Harbour, Tutuila, Samoa, *A. tutuilensis* no. 1; ?nos. 2, 3. (Mayor collection) (mentioned Hoffmeister, 1925).

QM: Big Broadhurst Reef, SW. side, reef slope: 5 m, 25.iii.1973, C.W., G9753; 8 m, 26.iii.1973, C.W., G9752; 1 m, 27.iii.1973, C.W., G9748; 3 m, 27.iii.1973, C.W., G9749; 4 m, 27.iii.1973, C.W., G9751; 5 m, 27.iii.1973, C.W., G9750; 1 m, 13.x.1973, C.W., G9742, G9746; 6·3 m, 13.x.1973, C.W., G9735; 7 m, 13.x.1976, C.W., G9743; 7·1 m, 13.x.1973, C.W., G9740, G9741; 7·3 m, 14.x.1973, C.W., G9739; 8 m, 14.x.1973, C.W., G9744, 8·1 m, 14.x.1973, C.W., G9738; 19·7 m, 15.x.1973, C.W., G9737, 4 m, 20.x.1973, C.W., G9745; 10 m, 20.x.1973, C.W., G9759; 1·9 m, 22.x.1973, C.W., G9747; 3·3 m, 22.x.1973, C.W., G9736.

Bowden Reef: slope of opening in SW. side: 0·5 m, 26.vii.1972, C.W., G9760; 1 m, 26.vii.1972, C.W., G9761; SW. side, reef slope, 1 m, 15.vii.1972, C.W., G9762.

Bushy-Redbill Reef: NW. side, reef slope, Dec. 1972, C.W., G9754; NNE. end, 30.xii.1972, C.J.W., G9755; S. end, reef slope, 3 m, 3.vi.1975, C.W., G9756; reef

slope adjacent Redbill Is., 0·5 m, 1.vi.1975, C.W., G9758; 1 m, 2.v.1975, C.W., G9757.

Darley Reef: patch reef in lagoon, 3 m, 18.vii.1972, C.W., G9763.

Field Diagnosis

Horizontal plate (reaching approx. 1·2 m diameter), developing by unilateral expansion from a vasiform shape with a single attachment, which becomes lateral as the colony develops. The plate has a flat appearance, due to the orientation of the secondary branchlets in the plane of the plate or obliquely to it. Common colours are pinkish brown, apple green and yellowish green.

Laboratory Diagnosis

Branching pattern: From the attaching stalk, branching is oblique to horizontal. Secondary branches arise in the same plane as primary branches, or obliquely to them, forming a single layer or a series of interlacing layers. All branches, except those towards the edge zone, are of similar diameter. Anastomosis of branches varies, so that anything from an open network to a solid plate (with branches either fused to the plate or projecting obliquely from it) is possible.

Axial corallites: Outer diameter 1·5 to 2·2 mm, inner diameter 0·6 to 0·9 mm. Septation: primary septa present, up to 1/3R, secondaries usually not visible, or a few present to less than 1/4R.

Radial corallites: A number of shapes are possible, and specimens may possess all, some, or only one of the possible types, viz. tubular, with round, oval, or dimidiate openings, tubo-nariform, nariform, rostrato-nariform, dimidiate, sub-immersed or immersed. Immersed corallites usually only occur along lines of fusion of branches. The other types project from the branch, at from 90° to 45°, occasionally less. There is a tendency for differential thickening or extending of the longer wall sometimes with bizarre extensions such as long points on nariform and horns on dimidiate corallites. Plate 86 shows:

(D) all uniform size, nariform or dimidiate with differential outer wall development.

(B) mixed size, tubular with round, oval, and dimidiate openings, immersed and sub-immersed.

(F) similar to B, but corallites more appressed and scattered.

Septation: septa are never well developed; usually only the directive septa are visible, or a few other primaries present as small spines. As the corallites are rarely appressed, they appear well spaced and there is always some coenosteum between.

Coenosteum: On unthickened corallites this may be visibly porous and is usually costate, on thickened radials it is composed of compactly arranged flattened spines, sometimes pseudocostate. Between corallites it is reticulate.

Identification Difficulties and History

This coral occurs with the other large horizontal plate *Acropora (A. hyacinthus* and *A. cytherea),* from which it is easily separated by its flattened appearance and by the lack of scale-like corallite lips. Identification difficulties occur at the laboratory stage, where so many different combinations of colony features and corallite size and shape are seen. This variety is demonstrated in the synonymy: *A. clathrata s.s.* has narrow branches, openly reticulated, and radial corallites are tubular, with a variety of sizes and opening-shapes; *'A. orbicularis'* and *'A. vasiformis'* are almost solid plates, *'A. vasiformis'* with rostrate thickening of many radial corallites, *'A. orbicularis'* with unthickened radials in a variety of shapes. Hoffmeister's no. 1. specimen of *A. tutuilensis* is a partly fused plate of this species. His no.4 is probably *A. rotumana.* All the type specimens can be compared with specimens in the QM series. *A. stigmataria* (Milne Edwards and Haime) (see Brook 1893, p.50), may be a senior synonym but its type cannot be located for examination.

Within Reef Distribution

The species appears to be restricted to sloping surfaces or good water cover. Very large specimens can occur around low water mark on the edge of surge channels, on the upper reef slope, and on the floor of surge channel openings (see Plate 64C).

Geographic Distribution

Indo-Pacific: Mauritius, Rodriguez, la Reunion (G. Faure pers. comm.), Ceylon, Seychelles (?), Great Barrier Reef, Samoa.

Acropora divaricata (Dana, 1846)
(Plates 87, 88)

Madrepora divaricata Dana, 1846, p.477, pl.41, fig.2; Milne Edwards and Haime, 1860, p.140; Brook, 1893, p.64.

Madrepora tenuispicata Studer, 1880, p.20, figs.1a, 1b; Brook, 1893, p.96.

Acropora tenuispicata: Pillai and Scheer, 1974, p.455, fig.4b.

?*Madrepora complanata* Brook, 1891, p.459; 1893, p.70, pl.4, fig.C.

Acropora complanata: Pillai and Scheer, 1976, p.28, pl.7, fig.2.

?*Madrepora complanata* var. *informis* Brook, 1893, p.71.

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Exped., *A. divaricata* holotype 299.

YPM: Fiji Islands, U.S. Expl. Exped., *A. divaricata* fragment of type 2008.

BM: Seychelles, H.M.S. Alert, *A. complanata* syntypes 1882.10.17.140, .147, .148; Macclesfield Bank, 13 fathoms, *A. complanata* var. *informis* syntypes 1892.10.17.71, .72, .73.

Hessisches Landmuseum: *Acropora tenuispicata* (colour transparencies only) (mentioned Pillai and Scheer 1974).

QM: Big Broadhurst Reef: SW. side, reef slope: 12·4 m, 23.x.1973, C.W., G9162; 11 m, 16.x.1973, C.W., G9166; 9·8 m, 16.x.1973, C.W., G9167; 9·6 m, 15.x.1973, C.W., G9164; 8·7 m, 15.x.1973, C.W., G9170, G9173; 8·6 m, 15.x.1973, C.W., G9174, G9175; 8·3 m, 15.x.1973, C.W., G9163, G9172; 8·1 m, 14.x.1973, C.W., G9161, G9168; 8 m, 14.x.1973, C.W., G9160, G9165, G9178; 7·8 m, 14.x.1973, C.W., G9171, G9176, G9177; 7·6 m, 28.iii.1973, C.W., G9180; 7·1 m, 13.x.1973, C.W., G9169; 7 m, 28.iii.1973, C.W., G9181, G9188; 6 m, 26.iii.1963, C.W., G9179; 6 m, 25.iii.1973, C.W., G9184.

Bushy-Redbill Reef: W. side, reef slope: 8 m, 3.vi.1975, C.W., G9186; 2 m, 3.vi.1975, C.W., G9185; NW. side, reef patches, 12 m, 14.vi.1975, C.W., G9187.

Darley Reef: patch reefs in lagoon: 7 m, 22.iii.1973, C.W., G9182; 3 m, 18.vii.1972, C.W., G9184; 22.iii.1973, C.W., G10219.

Fiji Islands, Great Astrolabe Reefs (Kadavu), W. side of Yaukuve Levu, fringing reef, 1.ii.1974, C.W., G9781, G9782.

FIELD DIAGNOSIS

Occurs as bracket like colonies with central to lateral attachment, 'corymbose' in having all branches reaching up to a horizontal plane, and 'caespitose' in having divaricate branching within the boundaries of the colony shape. Reaches approximately 50 cm diameter. Branches appear rough because of projecting radial corallites. Colour is usually a drab dark brown or dark brown with blue tips.

LABORATORY DIAGNOSIS

Although the species is easily recognised in the field, skeletal fragments can be confusing. Branchlet dimensions and radial corallite shape are variable amongst colonies in a single population, and pieces taken from different parts of the same corallum may appear different because of their orientation.

Branching pattern: From a single area of attachment, branching is central to lateral. Periferal branches contribute to an oblique undersurface; inside these is a network of short branchlets at wide angles, the final branchlets being erect or nearly so, and ending in a horizontal plane. Branchlet widths vary from 7 mm to 15 mm.

Axial corallites: Outer diameter 2·3 to 3·0 mm; inner diameter 0·8 to 1·1 mm. Septation: primary septa present, up to 1/2R, secondary septa poorly developed, but usually some present, up to 1/4R.

Radial corallites: Shape and size of the radial corallites changes along the branches. On upper branchlets they are prominent (up to 3 mm long), usually extending at from 45° to 90°. They are usually tubular on branch tips, passing through tubo-nariform to nariform, then rounded to sub-immersed proximally. The prominent radials are sometimes extended by rostrate development (see Plate 88 C, D). Within the sequence from distal to proximal, radials are usually evenly graded and neatly arranged, but they can be unevenly graded, so that branches appear ragged (Plate 88 A), and downward directed radials can occur anywhere along the branch.

WITHIN REEF DISTRIBUTION

This coral occurs in the higher diversity (for *Acropora)* parts of the reef, where no particular colony shape predominates: middle reef slope, deeper outer reef flats, patch reefs in deep lagoons and leeward broken reef areas. The species, although common, has a drab appearance when alive, and is easily missed when subjective observation techniques are used.

IDENTIFICATION DIFFICULTIES AND HISTORY

The radial corallites of this species are similar to those of the flat plate species, *Acropora clathrata.* I have not found specimens of *Acropora divaricata* deep enough to form flat plates but am confident that *A. complanata* (Brook), a flat plate species dredged from deep water, represents deep water flattening of *A. divaricata.* For *A. tenuispicata* (Studer) I have drawn on Pillai and Scheer's (1974) interpretation of this species. The type is not in the MNB, where the remainder of the Studer types are located. The combination of a determinate bracket with divaricate branching

is unique in the *Acropora*. The shape has not been emphasised in previous descriptions. A series in the JCU from Lizard Island fringing reefs shows more rounded colony shape, with slender branches, often naked of radial corallites on their upper surface.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Seychelles, Singapore, Fiji Islands, Great Barrier Reef.

Acropora sarmentosa (Brook, 1892)
(Plate 89)

Madrepora sarmentosa Brook, 1892, p.462; 1893, p.127, pl.22
Acropora sarmentosa: Nemenzo, 1967, p.90, pl.26, fig.4.
non *Acropora sarmentosa:* Vaughan, 1918, p.174, pl.72, fig.4, pl.73, fig.1.
Acropora rosaria form 1: Crossland, 1952, p.224, pl.40, fig.3.

MATERIAL EXAMINED

BM: Port Denison, Saville Kent, *A. sarmentosa* syntype 1892.6.8.228.

UP: Little Balatero Cove, Puerto Gaelera, Oriental Mindoro, Nemenzo 259; Muelle, Puerto Gaelera, Oriental Mindoro, Nemenzo 324 (mentioned Nemenzo, 1967).

QM: Big Broadhurst Reef, SW. side, reef slope: 17m, 24.x.1973, C.W., G9064, G9065; 15·7m, 23.x.1973, C.W., G9062; 15·4m, 17.x.1973, C.W., G9056; 9·7m, 15.x.1973, C.W., G9059; 8·1m, 14.x.1973, C.W., G9055; 8m, 28.iii.1973, C.W., G9054; 7·6m, 13.x.1973, C.W., G9057; 6·8m, 20.x.1973, C.W., G9058; 4·1m, 22.x.1973, C.W., G9061.

Bowden Reef, slope of opening in SW. side, 1–2m, 23.viii.1972, C.W., G9066.

Bushy-Redbill Reef, NW. side, reef slope: 30.xii.1972, E. Lovell, G9071; 3–7m, 21.xii.1972, E. Lovell, G9073; NW. side, reef crest, 30.xii.1972, C.W., G9070; NW. side, patch reefs: 12m, 15.vi.1975, C.W., G9075; 12m, 14.vi.1975, C.W., G9060; SW. side, reef crest, 24.v.1975, C.W., G9063; outer reef flat adjacent Redbill Island: 1.vi.1975, C.W., G9072; 22.xii.1972, E. Lovell, G9074.

Darley Reef, patch reefs in lagoon: 6m, 22.iii.1973, C.W., G9067; 4m, 22.iii.1973, C.W., G9068; 2.5m, 24.iii.1973, C.W., G9069.

Heron Island, W. side, reef flat, 6.vii.1973, Y. Loya, G9704.

Ellison Reef: dredged 9 fathoms, 25.vii.1924, Dr Paradice, G9709; 24.vii.1924, C. Hedley, G9707.

Fiji Islands, Great Astrolabe Reefs: Qasilabe fringing reef, 4–6m, 4.ii.1974, C.W., G9710; Yaukuve Levu, W. side, fringing reefs, 8m, 1.ii.1974, C.W., G9705.

FIELD DIAGNOSIS

Colonies of this species usually have few (commonly 2 or 3) thick rounded branching units, consisting of a central horizontal to oblique branch or branches, with vertical branchlet bundles evenly distributed, but longer on the upper side. Colonies of more than 50 cm across are unusual, and attachment is usually from the side. The overall appearance is smooth — axial corallites are not exert, radial corallites are large, evenly distributed, uniformly sized and not projecting; secondary branching patterns are regular and branchlets terete. The usual colouration on the Barrier Reef is two-toned, and cryptic — most often a dull greenish-grey or -brown, with pale brown or pink tips to the branchlets. This colouration occurs also in the Fijian reefs. On patch reefs in deep lagoonal situations, the colony can assume a sturdy rounded shape with central attachment.

LABORATORY DIAGNOSIS

Branching pattern: From a side attachment, branching is horizontal or oblique, with two to several main branches. Vertical to acute branchlets occur at regular intervals along the main branches; these usually branch again, one to several times, and are shorter and narrower on the under surface. Upper surface branchlets are 5 to 9 mm wide.

Axial corallites: Outer diameter 3·0 to 4·0 mm, up to 7 mm in lagoonal specimens; inner diameter 1·0 to 2·0 mm. Septation: 12 septa or slightly less, usually well developed (primaries to 3/4R, secondaries to 1/2R).

Radial corallites: All of similar size, neatly and evenly arranged around the branchlet, appressed tubular. (Brook described them as 'swallow-nest shaped'). In shallow water specimens the wall is thick, and corallites are densely packed around the branchlet. With increasing depth, radial corallites become more scattered, thinner walled, and the wall may flare a little, and appear lip like.

Coenosteum: Spines which may be laterally flattened or slightly elaborated are arranged evenly both on radials and between: sometimes radial walls are costate.

WITHIN REEF DISTRIBUTION

Reef slope from crest to limits of depth of *Acropora* distribution (species no. 18 in Wallace 1975); deeper water diverse reef flats and lagoonal patch reefs; sporadically in shallow outer reef situations where there is space for outward growth; fringing reefs. The species is never very

abundant, but is usually present in most reef habitats.

IDENTIFICATION DIFFICULTIES AND HISTORY

In the field, lower reef slope specimens of this species and of *A. florida* may appear similar. The two-toned colouration, thicker branchlets and smoother general appearance of *A. sarmentosa* can distinguish it. Vaughan (1918) suggested that *A. sarmentosa* may be a growth form of *A. squamosa* (= *A. millepora*). His specimens were not *A. sarmentosa* but were indeed *'A. squamosa'*. His misidentification of this species may account for it being overlooked in much of the literature. Both Brook and Nemenzo describe their specimens well.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Philippines, Great Barrier Reef, Fiji Islands.

Acropora florida (Dana, 1846)
(Plates 90, 91, 92)

Madrepora florida Dana, 1846, p.466, pl.37, fig.1.
non *Madrepora florida:* Brook, 1893, p.53.
Madrepora gravida Dana, 1846, p.470; Brook, 1893, p.59 (synonymy).
Acropora gravida: Nemenzo, 1967, p.107, pl.31, fig.3; Scheer and Pillai, 1974, p.18, pl.5, fig.1; Pillai and Scheer, 1974, p.453.
Madrepora mirabilis Quelch, 1886, p.159, pl.10, fig.5; Brook, 1893, p.125.
Madrepora compressa Bassett-Smith, 1890, p.452; Brook, 1893, p.60, pl.33, fig.F.
Madrepora affinis Brook, 1893, p.60, pl.28, fig.F (synonymy).
Acropora affinis: Crossland, 1952, p.205, pl.34, fig.1; Nemenzo, 1967, p.77.
Acropora vermiculata Nemenzo, 1967, p.108, pl.31, fig.4.

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Exped., *A. florida* holotype 282.

YPM: Fiji Islands, U.S. Expl. Exped., *A. florida* fragment of type 2002.

BM: Tizard Bank, China Sea, 5 fthms, *A. compressa* holotype 1889.9.24.117; Darnley Island, J.B. Jukes, *A. affinis* syntype 1846.7.30.29; Banda, Challenger, *A. mirabilis* holotype 1885.2.1.14; Claremont Is., G.B.R., Saville Kent, *A. ornata* var. (id. Brook) 1892.6.8.112.

QM: Big Broadhurst Reef: S W. side, reef slope: 15·3m, 17.x.1973, C.W., G8649; 11·3m, 17.x.1973, C.W., G8653; 9·3m, 16.x.1973, C.W., G8647; 9·3m, 17.x.1973, C.W., G8646; 8·6m, 17.x.1973, C.W., G8648, G8654; 8·6m, 16.x.1973, C.W., G8661; 8m, 28.iii.1973, C.W., G8664; 7·9m, 15.x.1973, C.W., G8650; 7·4m, 15.x.1973, C.W., G8656, G8662; 6·6m, 14.x.1973, C.W., G8655, G8657, G8667; 6m, 27.iii.1973, C.W., G8665; 6m, 25.iii.1973, C.W., G8666; 5·8m, 13.x.1973, C.W., G8651; 5·2m, 13.x.1973, C.W., G8645; 3m, 25.iii.1973, C.W., G8669; 2·3m, 11.x.1975, C.W., G8644; 2m, 25.iii.1973, C.W., G8661, G8663, G8668, G8670; S W. side, surge channel, 8·5m, 20.x.1973, G8658, G8659; S W. side, outer reef flat, 18.x.1973, G8652.

Low Isles, June 1974, C. Limpus, G8672.

Murray Islands (Maer Is.), 18.vii.1974, G. Ingram, G8671.

Bowden Reef, S. end, reef slope, 3·3m, 15.vii.1972, C.W., G6726.

Darley Reef, lagoonal patch reef, 3–5m, 19.vii.1972, C.W., G6725.

Viper Reef, lagoonal patch reef, 1·5m, 16.vii.1972, C.W. G6724.

Fiji Islands, Makaluvau Reef, outer reef flat, 10.i.1974, C.W., G10273.

FIELD DIAGNOSIS

This is a sturdy open arborescent species, in which the surface of the branches is covered by short secondary branchlets. It is highly variable in two aspects, the shape of the colony and the density and prominence of the secondary branchlets. The colony shape changes with depth and slope of the attaching surface. In shallow water and flat substrate it forms a rounded, open colony with central attachment; on sloping surfaces the attachment is more lateral, and the branches tend to extend horizontally. With increasing depth the branches become flatter. The secondary branchlets vary from evenly distributed with even lengths to scattered and variously sized and may even be undeveloped on some branches. The most irregular colonies occur in fringing reef situations.

LABORATORY DIAGNOSIS

Branching pattern: Sturdy main branches divide sparsely to form an upright bush. The shape of the colony and the cross-sectional shape of the branch become flatter with increasing water depth. The branches usually proliferate towards the branch tips into shorter branches. The surface of the branches is covered with short branchlets. Except on completely vertical branches the branchlets are shorter on the under-surface (to absent on horizontal branches).

Axial corallites: Outer diameter 2·0 to 3·0 mm; inner diameter 0·8 to 1·4 mm. Septation: primary septa present, up to 2/3R; secondary septa usually all developed, or at least 3 present, up to 1/2R.

Radial corallites: Evenly sized and distributed, appressed tubular with round opening, with wall which may flare slightly. Septation: primary septa present, up to 1/2R, some to all secondaries present, up to 1/4R.

Coenosteum: Costate or reticulate on radial corallites, reticulate in between, with scattered simple spines.

WITHIN REEF DISTRIBUTION

Entire reef slope from reef crest to limits of *Acropora* growths; deep water lagoonal patch reefs, fringing reefs. Occasionally on middle or outer reef flat. It is well known as an early recolonizer on the fringing reefs near Townsville, N.Q. (D. Tarca, pers. comm.).

IDENTIFICATION DIFFICULTIES AND HISTORY

The variability of the species is expressed in the synonymy. Brook misunderstood *A. florida:* his specimens in the BM are possibly *A. rotumana. A. florida s.s.* is atypical of the species as it appears on the Great Barrier Reef in that the corallites are larger and the branchlets poorly developed: G6725 is closest to this. The species is best described by *A. affinis,* which has evenly sized and distributed branchlets; its similarity to *A. gravida* was apparent to Brook. *A. compressa* is named from a flat plate specimen of this species. *A. mirabilis* is named for a single aberrant specimen which is probably this species under some environmental stress.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Singapore, Celebes, Philippines, Strait of Malacca, Nicobar Islands, Great Barrier Reef, Fiji Islands, Enewetak Atoll (C.W.).

THE 'Acropora echinata' GROUP

The species *Acropora echinata, A. subglabra, A. carduus* and *A. longicyathus,* with their synonyms, have in common their shape, radial corallite structure and coenosteal structure.

The growth forms are comparable within the group, and nothing exactly similar is found outside the group. The branches are commonly labelled 'bottlebrush': secondary branchlets, or bundles of branchlets, are given off evenly around the main branches, giving a round brush like unit. The growth of a colony is indeterminate, the units being capable of openly branching or closely proliferating, giving a variety of form in collected specimens. The colonies tend to occur on rubble or sandy floors, and the bases of branch units are usually dead. If the colonies occur in deep sloping conditions, they are small and approach a flattened form.

The radial corallites are round tubular appressed or partly appressed, tending to develop into axial corallites. Their numbers relative to the number of axials are lower than in most other groups. In all species, the number of radial corallites per axial decreases distally on the branch unit, so that long naked axials may occur around the base.

The spines of the coenosteum have multiple tips, and the coenosteal appearance on and between radials is similar.

The main differences among the species are in the corallite dimensions and the amount of elaboration of the coenosteal spines.

These species occur only in the sheltered, deeper parts of reefs, where almost any *Acropora* species can survive. They appear to have poor differentiation of radial corallites from axials, and if this is accompanied by a similar lack of functional differentiation it may account for their lack of colonizing success.

Acropora echinata (Dana, 1846)

Madrepora echinata Dana, 1846, p.464, pl.36, fig.1, 1a; Brook, 1893, p.185 (synonymy).

Acropora echinata: Vaughan, 1907, p.158, pls.49, 50; Wells, 1954, p.423, pl.135, figs. 1–4, pl.136, figs 1–6 (synonymy); Nemenzo, 1967, p.126; Pillai and Scheer, 1976, p.33, pl.11, figs.1, 2.

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Exp., *A. echinata* syntype 275.

UP: Batangas Channel, Puerto Galera, Oriental Mindoro C1064 (mentioned Nemenzo, 1967).

I have not seen this species in the central and southern Great Barrier Reef. A single specimen in James Cook University was collected at Lizard Island on a sandy bottom. A large specimen in the Queensland Museum bearing no locality data has been presumed to be from the Great Barrier Reef. The species is well described and illustrated by other authors. Further notes are given with *A. subglabra.*

GEOGRAPHIC DISTRIBUTION

Philippines, Sulu Sea, Great Barrier Reef, Fiji Islands, Samoa, Marshall Islands.

Acropora subglabra (Brook, 1891) (Plate 94A, B)

Madrepora subglabra Brook, 1891, p.470; 1893, p.186, pl.29, fig.c (synonymy).

Acropora subglabra: Thiel, 1933, p.24.
M. subglabra var. *rugosa* Brook, 1893, p.187.
Acropora subglabra var. *rugosa:* Nemenzo, 1967, p.125, pl.35, fig.2.
Madrepora procumbens Brook, 1893, p.188, pl.29, fig.d.
Acropora procumbens: Thiel, 1932, p.130, pl.10, fig.2; Nemenzo, 1967, p.127–128, pl.35, fig.1.

MATERIAL EXAMINED

BM: *A. procumbens* syntype 1843.3.6.131; South Seas, *A. subglabra* syntype 1841.12.11.1.

UP: *A. subglabra* var. *rugosa* C731 (mentioned Nemenzo, 1967).

QM: Lizard Island fringing reef, June 1973, R. Pearson, G10713, G10714.

FIELD DIAGNOSIS

Sprawling, shrubby bottlebrush colonies, of very slender proportions, colour pale brown or pinkish brown.

LABORATORY DIAGNOSIS

Branching pattern: Main branches may have any orientation from vertical to horizontal. Secondary branchlets distributed evenly around main branches, up to 30 mm long, undersurface branchlets being shorter than upper surface branchlets in horizontal branches.

Axial corallites: Outer diameter 0·9 to 1·5 mm; inner diameter 0·5 to 0·8 mm. Septation: primaries complete, to 3/4 R, secondaries absent or some present to less than 1/4R.

Radial corallites: Scattered appressed tubular, tubo-nariform or nariform, up to 3 mm long. Non-appressed tubular radials are incipient axials.

Coenosteum: Lines of elaborate spines both on and between radial corallites.

WITHIN REEF DISTRIBUTION

The species apparently does not occur in the Central and Southern Great Barrier Reef province, but is present further north, in situations below the reef flat.

IDENTIFICATION DIFFICULTIES AND HISTORY

This species requires field study. Brook's description of *A. procumbens* was on the basis of 'contracted (axial corallite) apertures', but in fact the internal axial diameter of the type is only an average 0·1 mm less than that of the *A. subglabra* type. *A. echinata* (Dana) is a similar species of slightly larger dimensions, and it is probable that this is a (senior) synonym.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Singapore, Philippines, Banda, Great Barrier Reef.

Acropora carduus (Dana 1846)
(Plates 93A, 94C, D)

Madrepora carduus Dana, 1846, p.464, pl.36, fig. 2; Brook, 1893, p.178 (synonymy).
Acropora carduus: Faustino, 1927, p.277, pl.93, figs.1, 2; Nemenzo 1967, p.123–4, pl.34, fig.3.

MATERIAL EXAMINED

USNM: Sooloo Sea, U.S. Expl. Exped., *Acropora carduus* paratype? 277 (N.B. Rathbun (1887) records 278 from Fiji as type).

QM: Big Broadhurst Reef, S W. slope: 6 m, 25.iii.1973, C.W., G10729, G10730; 6·3 m, 23.x.1973, C.W., G10738; 7·8 m, 14.x.1973, C.W., G10733; 8 m, 26.iii.1973, C.W., G10731; 8 m, 14.x.1973, C.W., G10734; 9·6 m, 15.x.1973, C.W., G10736; 9·8 m, 16.x.1973, C.W., G10737; 12·4 m, 23.x.1973, C.W., G10732; 16·2 m, 23.x.1973, C.W., G10735.

Bowden Reef, SW. side, reef slope, 2 m, 26.vii.1972, R. Pearson, G10741, G10742.

Bushy-Redbill Reef: NW. side, sandy floor around patch reefs, 15 m, 15.vi.1975, C.W., G10739; W. side, reef crest, 2 m, 3.vi.1975, C.W., G10740.

Fiji Islands, Great Astrolabe Reefs, Jan. 1974, C.W., G10744.

FIELD DIAGNOSIS

Arborescent to shrubby, bottlebrush branched colonies of dimensions intermediate between those of *A. subglabra* and *A. longicyathus*. Colour: cream, pale brown, or pink-brown.

LABORATORY DIAGNOSIS

Branching pattern: Growth indeterminate, main branches covered by short branchlets, which are evenly distributed, more or less equal in size and extending at 45° to 90° from the branch. Total diameter of this 'bottlebrush' is 15 to 30 mm, with branchlets up to 12 mm long and 5 mm wide. Main branches may be proliferous, giving a shrubby appearance, or sparsely branching, giving an arborescent appearance: usually both types of branching occur within a colony. In deep water (e.g. specimen G10735) the branchlets develop on the upper surface of the colony only, and the colony is effectively reduced to a small plate.

Axial corallites: From non exert (budding at tip) to 7 mm exert. Outer diameter 1·0 to 2·0 mm; inner diameter 0·5 to 0·8 mm. Septation: primary

septa well developed, up to 3/4R, secondary septa absent, or some present, to 1/4R.

Radial corallites: On branchlets, scattered appressed tubular, sometimes approaching nariform, with round openings. On some colonies radials crowded, partly appressed tubular and extending out from branchlets. On the main branches radials are sub-immersed to immersed, or in some cases tubular appressed. Primary septa poorly to well developed to 1/2R, secondaries usually absent except in immersed corallites, where a few may be present. Radial corallites are best represented on distal parts of branches. At the bases of branches most have developed into long tubular axials.

Coenosteum: finely echinulate on radial corallites and between. Occasionally spines are arranged in rows or even joined as costae.

Within Reef Distribution

Reef slope, from below the area of rough water surge to about 20 m; deep water reef flat areas, sandy floors of lagoons and reef-edge patch reefs.

Identification Difficulties and History

Being a deeper water species, *A. carduus* is poorly represented in older collections, and hence presents few historical problems. It occurs with *A. longicyathus*, and they can be easily separated by obvious differences in corallite dimensions.

Geographic Distribution

Indo-Pacific: Philippines, Sulu Sea, Great Barrier Reef, Fiji Islands.

Acropora longicyathus (Milne Edwards and Haime, 1860)
(Plates 93B, 95)

Madrepora longicyathus Milne Edwards and Haime, 1860, p.148; Brook, 1893, p.187 (Synonymy).
Acropora longicyathus: Nemenzo, 1967, p.128, pl.35, figs. 3, 4.
Madrepora prolixa Verrill, 1866, p.22.
Acropora prolixa: Verrill, 1902, p.237, pl.36, figs. 3, 3a, pl.36A, Figs. 3, 3a; pl.36F, fig.14; Hoffmeister, 1925, p.65, pl.16; Crossland, 1952, p.226.

Material Examined:

PM: *A. longicyathus* type 303A.

USNM: Ousima, *A. prolixa* syntype 414.

QM: Big Broadhurst Reef, S W. side, reef slope: 6m, 25.iii.1973, C.W., G10763; 7m, 27.iii.1973, C.W., G10767; 8m, 26.iii.1973, C.W., G10762, G10764; 9m, 15.x.1973, C.W., G10751, G10752; 9·6m, 15.x.1973, C.W., G10753; 9·7m, 15.x.1973, C.W., G10754; 9·8m, 16.x.1973, C.W., G10755; 10·3m, 16.x.1973, C.W., G10756; 10·6m, 16.x.1973, C.W., G10757, G10758; 12m, 16.x.1973, C.W., G10759; 12·5m, 17.x.1973, C.W., G10760; surge channel, 10m, 20.x.1973, C.W., G10761.

Bushy-Redbil Reef: W. side, outer flat, 31.v.1975, C.W., G10745; reef slope near Redbill Is., 3m, 1.vi.1975, C.W., G10746; W. side, patch reefs (sandy floor), 8m, 3.vi.1975, C.W., G10747, G10748; N W. side, patch reefs (sandy floor) 12m, 14.vi.1975, C.W., G10749, G10750.

Field Diagnosis

Arborescent to shrubby, bottlebrush branched colonies of sturdy dimensions. Colour: cream, pale to dark brown, or blue-brown.

Laboratory Diagnosis

Branching pattern: Growth indeterminate, main branches covered by evenly distributed proliferous branchlets or bundles of branchlets. These are directed at 45° to 90° to the branch, and may be as short as 5 mm all over branch, or all several centimetres long and much branched. Greatest total branch width is 80 mm, smallest (except for branch tips) 40 mm. Deep-water colonies can have little undersurface development, and approach a plate like shape.

Axial corallites: Sometimes exert (to 10 mm) near base of branch, more often one side naked of radial corallites, other side with 3 or 4 from their outer rim. Outer diameter 2·1 to 2·8 mm; inner diameter 0·8 to 1·3 mm. Septation: primary cycle present to 3/4R, secondary cycle present, or at least partly developed up to 1/4R.

Radial corallites: On branchlets, appressed or partly appressed tubular with round openings. When fully appressed, radials are scattered, only a few to each axial corallite: however, branchlets can have radials touching. In the first case, radials on main branches are immersed or (more usually) sub-immersed; in the second, main branch radials are usually similar to those of branchlets.

Coenosteum: Neatly echinulate on and between corallites, the spines laterally flattened with simple to forked or more elaborate tips.

Within Reef Distribution

Reef slope, from below the area of rough water surge to about 20m; deep water reef flat areas, sandy floors of lagoons and leeward patch reefs.

Identification Difficulties and History

The two species *A. longicyathus* and *A. prolixa* have been combined by other authors: Verrill's

specimens were small branch tips. This species is not well represented in collections.

GEOGRAPHIC DISTRIBUTION

Philippines, Ousima, Samoa, New Guinea, Great Barrier Reef.

THE 'Acropora squarrosa' GROUP

The group of species *A. elseyi*, *A. rosaria*, *A. squarrosa* and *A. granulosa* has in common (1) dense echinulate coenosteum of elaborate spines, (2) large tubular to nariform radial corallites, and (3) a tendency for some branchlets to have an upper surface naked of radial corallites. The group is linked to the *'A. echinata'* group which has, however, less differentiated radial corallites.

The synonyms adopted here may be controversial. Most of the species involved seem to be well documented in the literature, but they still present extraordinary identification problems. The synonymies are presented as hypotheses requiring further testing.

The oldest name for the group, *A. squarrosa* (Ehrenberg) has been treated by a number of authors (e.g. von Marenzeller 1907, Vaughan 1918, Wells 1954), but the interpretations are various and sometimes confusing. *A. granulosa*, with its synonyms here listed, links this group to the *'A. echinata'* group.

A. microphthalma, as here interpreted, is included in the group because of its coenosteal structure.

Acropora microphthalma (Verrill, 1869) (Plate 96)

Madrepora microphthalma Verrill, 1869, pp.83, and 102.

Acropora microphthalma: Verrill, 1902, p.232, pl.36C, fig.1, 36F, fig.15.

?*Acropora microphthalma:* Wells, 1954, p.429, pl.126, figs. 7–9 (synonymy).

non *Acropora microphthalma:* Stephenson and Wells, 1956, p.10.

Acropora laevis (part) Crossland, 1952, p.230.

MATERIAL EXAMINED

YPM: Ryuku Islands, *A. microphthalma* holotype 774 (fragment).

QM: Big Broadhurst Reef, SW. side, reef slope: 3m, 28.iii.1973, C.W., G8684; 4m, 13.x.1973, C.W., G8688, G8689; 6m, 25.iii.1973, C.W., G8685; 6·4m, 14.x.1973, C.W., G8693; 7·8m, 15.x.1973, C.W., G8691; 8m, 26.iii.1973, C.W., G8683, G8686; 8m, 28.iii.1973, C.W., G8682; 9·1m, 16.x.1973, C.W., G8690; 9·4m, 16.x.1973, C.W., G8692.

Bowden Reef, SW. side, reef crest, 0·5m, 24.vii.1972, C.W., G8680.

FIELD DIAGNOSIS

An aborescent species forming small clumps (up to 100 cm across) the branches having slender dimensions, and radial corallites being small and crowded. Colour is most commonly a whitish-cream. Although because of its size it is not a conspicuous species, it is the most delicate arborescent coral in the Great Barrier Reef area, and is easily recognized.

LABORATORY DIAGNOSIS

Branching pattern: Branching is open arborescent, with many short branchlets being given off towards branch tips at 45° to 90° to the main branches. The greatest branch width measured in the collections is 14 mm, the smallest (excluding branchlets) 5 mm.

Axial corallites: Outer diameter 1·8 to 2·3 mm; inner diameter 0·8 to 1·00 mm. Septation: primary septa strongly developed, up to 3/4R, secondaries absent, to present up to 1/4R.

Radial corallites: Extend at about 45°, short tubular with round to oval opening to tubonariform, outer wall slightly thickened. First septal cycle well developed, up to 2/3R, second cycle usually partially represented. Radials are uniform in size and evenly distributed, giving a fine-grained appearance to the branches.

Coenosteum: When spines are well developed, they have elaborate tips and are distributed both on corallites and between. However, lightly calcified coralla may have simple pointed spines and a generally spongy appearance.

WITHIN REEF DISTRIBUTION

Middle reef flat, deeper reef flat areas, sandy floors around patch reefs, reef slope to surge channel floor.

IDENTIFICATION DIFFICULTIES AND HISTORY

Interpretation of *A. microphthalma* from Verrill's poor series is difficult and previous identifications have linked it with *A. exilis*. The *A. microphthalma* of Stephenson and Wells (1956) (no. G2697, QM) is in my opinion *A. nasuta*.

The species as here interpreted is distinctive, particularly in the field, and the fragment I have seen of Verrill's type compares well with the tips of the larger dimensioned specimens. At least one specimen of Crossland's *A. laevis* series (BM 1934.5.14.67) is this species.

GEOGRAPHIC DISTRIBUTION

Ryuku Islands, Great Barrier Reef, Fiji Islands (C.W.), Enewetak Atoll (C.W.).

Acropora elseyi (Brook, 1892)
(Plate 97 A, B.)

Madrepora elseyi Brook, 1892, p.456; 1893, p.172, pl.11, figs. E, F.
Acropora elseyi: Crossland, 1952, p.223; Pillai and Scheer, 1976, p.31, pl.9, fig.1.
Madrepora exilis Brook, 1892, p.457; 1893, p.172, pl.10, figs. C, D.
Acropora exilis: Crossland, 1952 (part), p.223, pl.39, fig.4; Stephenson and Wells, 1956, p.13, pl.1(b) (synonymy).

MATERIAL EXAMINED

BM: N. Australia, J. Elsey, *A. elseyi* syntypes 1857.11.18.214, 215, 216, 217, 218; Thursday Is., Saville-Kent, *A. elseyi* 1892.6.8.241–4, 6; Rocky Is. Saville-Kent, *A. elseyi* 1892.6.8.247 (mentioned Brook, 1893). Port Denison, Saville-Kent, *A. exilis* syntypes, 1892.6.8.103, 104, 106.

QM: Big Broadhurst Reef, E. side, side of reef flat channel, 21.x.1973, C.W., G10802.

Bushy-Redbill Reef: W. side, middle reef flat, 1m, 27.v.1975, C.W., G10793; G10794; W. side, outer reef flat, 8.vi.1975, C.W., G10797; N W. side, first reef crest, 23.xii.1972, C.W., G10798; adjacent Redbill Is., reef crest, 19.xii.1972, C.W., G10795; adjacent Redbill Is., reef slope, 19.xii.1972, C.W., G10796.

FIELD DIAGNOSIS

Low bushy to caespitose colonies with bottlebrush-type branches. Colour usually bright yellow, yellow-brown or lime green-brown.

LABORATORY DIAGNOSIS

Branching pattern: Main branches surrounded by regularly placed short branchlets which may be of equal or unequal length. Main branches up to 15 mm wide, branching units up to 100 mm wide, branchlets up to 8 mm wide.

Axial corallites: From non-exert to 2 mm exert. Outer diameter 1·6 to 3·2 mm; inner dimaeter 0·6 to 1·0 mm. Septation: primary septa well developed, up to 3/4R, secondary septa absent or few present to less than 1/4R.

Radial corallites: On both main branches and branchlets, radials are tubular with round openings, becoming round tubular distally. Radials are usually evenly distributed on branches, and almost touching, sometimes upper surface of small branchlets is naked of corallites. Septation: primaries well developed, up to 1/2R, secondaries absent or a few just visible.

Coenosteum: Neatly and densely costate both on and between corallites.

WITHIN REEF DISTRIBUTION

This is one of the few *Acropora* occurring in the shallow longitudinal patch reefs perpendicular to the reef edge, forming the windward edge of lagoons, and is characteristic of these areas. It also occurs in deeper reef flat areas, and reef crest and upper reef slope on some leeward reef areas. It is a common species of fringing reefs of continental islands.

IDENTIFICATION DIFFICULTIES AND HISTORY

Both species in synonymy were described from the Barrier Reef, *A. elseyi* being slightly sturdier than *'A. exilis'*. The species will be better understood when studied on fringing reefs.

GEOGRAPHIC DISTRIBUTION

Indo-Pacific: Maldive Archipelago, Great Barrier Reef.

Acropora rosaria (Dana 1846)
(Plate 97 C, D)

Madrepora rosaria Dana, 1846, p.465, pl.36, fig.3.
Madrepora rosaria var. *diffusa* Brook, 1893, p.180.
Acropora rosaria: Vaughan, 1918, p.184, pl.82, figs.2, 2a, 2b; Wells, 1954, p.428, pl.130, figs.3, 4; Stephenson and Wells, 1956, p.18.
Acropora rosaria (part): Crossland, 1952, p.224, pl.40, figs.1, 4.
?*Madrepora syringodes* (part) Brook, 1892, p.463; 1893, p.177, pl.33, fig.E.

MATERIAL EXAMINED

USNM: Fiji Islands, U.S. Expl. Exped., *A. rosaria* holotype 281; paratype 933.

QM: Palm Islands, 1939, T. C. Marshall, G9192, G9193, G9194, G9195, G9196, G9197, G9200, G9202.

FIELD DIAGNOSIS

Not determined.

LABORATORY DIAGNOSIS

Branching pattern: Usually 'bottlebrush' branching units are formed, a central branch of up to 20 mm diameter bearing branchlets at even intervals all around.

Axial corallites: Exert 1·0 to 2·0 mm. Outer diameter 2·5 to 3·8 mm; inner diameter: 0·8 to 2·4 mm. Septation: first cycle well developed, up to 3/4R, second cycle usually present, or most septa present, up to 1/3R.

Radial corallites: Tubular, partly or fully appressed, or nariform. Walls thick, primary septa developed up to 1/3R and secondary septa partly developed, up to 1/2R.

Coenosteum: Densely arranged spines, sometimes laterally flattened, both on and between corallites.

Within Reef Distribution

The specimens described were collected on the fringing reefs of the Palm Island group.

Identification Difficulties and History

This species requires further study. The only material easily identifiable with *A. rosaria* available to me was collected in habitats not comparable with those I have studied. I am thus unable to pursue the possibility of a close relationship between this species and *A. squarrosa*. I consider it probable that the figured syntype of Brook's *A. syringodes* (BM 1892.6.8.209 from Palm Islands) is *A. rosaria*. Interpretations of *A. syringodes* are difficult to follow and seem to span a number of species, and it is likely that the latter species, as described, is a mixture.

Geographic Distribution

Great Barrier Reef, Fiji Islands, Samoa, Marshall Islands.

Acropora squarrosa (Ehrenberg, 1834) (Plates 98, 99, 100)

Heteropora squarrosa Ehrenberg, 1834, p.112.
Madrepora squarrosa: Brook, 1893, p.65 (synonymy).
Acropora squarrosa: von Marenzeller, 1907, p.46, pl.14, figs.36-39; Vaughan, 1918, p.184, pl.83, figs. 2, 2a, 2b; Wells, 1954, p.427, pl.129, figs. 1, 2; Rossi, 1954, 1954, p.52; Nemenzo, 1967, p.69, pl.21, fig.4; Pillai and Scheer 1976, p.31.
Acropora murrayensis Vaughan, 1918, p.183, pl.82, figs.1, 1a, 1b; Nemenzo, 1967, p.71, pl.23, fig.2.
Madrepora syringodes (part) Brook, 1892, p.463; Brook, 1893, p.177 (not illus.).
Madrepora cancellata Brook, 1893, p.166, pl.32, fig.C.
Acropora cancellata: Crossland, 1952, p.225, pl.41, figs.3, 4.

Material Examined

USNM: Murray Islands, *A. murrayensis* holotype.

BM: *A. syringodes* 1893.4.7.163 (mentioned Brook, 1893); Louisade Archipelago, 15 fathoms, *A. cancellata* holotype 1851.9.29.39.

QM: Big Broadhurst Reef, SW. side, reef slope: 1·3 m, 23.x.1973, C.W., G10839; 1·9 m, 23.x.1973, C.W., G10840; 6·3 m, 13.x.1973, C.W., G10826, G10827; 6·3 m, 23.x.1973, C.W., G10841; 7 m, 13.x.1973, C.W., G10825; 7·8 m, 14.x.1973, C.W., G10828, G10830; 8 m, 14.x.1973, C.W., G10829; 8·1 m, 14.x.1973, C.W., G10824; 8·2 m, 14.x.1973, C.W., G10831; 8·7 m, 15.x.1973, C.W., G10832; 9 m, 15.x.1973, C.W., G10833, G10834; 9·2 m, 25.x.1973, C.W., G10842; 10·6 m, 16.x.1973, C.W., G10836; 11·4 m, 25.x.1973, C.W., G10843; 12·9 m, 23.x.1973, C.W., G10845; 13·4 m, 17.x.1976, C.W., G10837; 30 m, 18.x.1973, C.W., G10838; E. side, reef slope, 4 m, 21.x.1973, C.W., G10844.

Bushy-Redbill Reef: Reef crest adjacent Redbill Is.: 18.xii.1972, C.W., G10768, G10770; 19.xii.1972, C.W., G10769; 1.vi.1975, C.W., G10771; reef slope adjacent Redbill Is.: 20.xii.1972, E. Lovell, G10772, G10773; 20.xii.1972, C.W., G9189; W. side, middle reef flat; 1 m, 8.vi.1975, C.W., G10774, G10775; 14.vi.1975, C.W., G10776; NW. side, first reef crest: 22.xii.1972, E. Lovell, G10777; 22.xii.1972, C.W., G10778, G10779; NE. side, D. Hadley, 1.i.1973, G10780.

Bowden Reef, SW. side, reef slope: 24.vii.1972, C.W., G10789; 26.vii.1972, C.W., G10788.

Darley Reef, patch reef in lagoon: 1m, 18.vii.1972, R. Pearson, G10782, G10785; 1 m, 22.iii.1973, C.W., G10783, G10784, G10786, G10787, G10790; 3 m, 18.vii.1972, C.W., G10846; 3 m, 24.iii.1973, C.W., G10791; 4 m, 22.iii.1973, C.W., G10792; 6 m, 22.iii.1973, C.W., G10847; 7 m, 22.iii.1973, C.W., G10846.

Viper Reef, patch reef in lagoon, 2 m, 16.vii.1972, C.W., G10781.

Field Diagnosis

Colonies can be bottlebrush branching, caespitose to plate like, some of the variation being due to depth gradients. The surface of the branches has a general 'globular' appearance due to rounded, thickened corallites, and a whitish glow behind the general colouration due to dense coenosteum showing through semi-transparent tissue. Common colours are pale blue, lavendar, cream-brown and yellow-brown.

Laboratory Diagnosis

Branching pattern: Bottlebrush branching colonies have tapering branching units, and the branchlets extend widely from the main branch (90° or just less). In caespitose colonies there is a tendency towards development of a bottlebrush unit (incipient branchlets developed evenly around the branches) and even in plate-like colonies the short upright branches bear indications of incipient branchlets along their length. In most specimens of this species branchlets which are naked of radial corallites on their upper surface can be seen.

Axial corallites: From barely exert to 2·5 mm exert. Outer diameter 2·6 to 3·8 mm; inner diameter 0·7 to 1·4 mm. Septation: primaries usually well developed (up to 3/4R), secondaries completely absent to fully present, up to 1/3R.

Radial corallites: Tubular appressed to nariform, with round to oval openings at 90° or less to branch. Wall is thickened so that corallite

may appear round tubular, or distorted rostrate hooks or horns may be developed. Septa are usually poorly developed: primaries can usually be just detected, and sometimes a few secondaries.

Coenosteum: Laterally flattened spines with elaborated tips are arranged densely and evenly over both the corallites and the inter-corallite region.

Identification Difficulties and History

The material examined shows extraordinary variation in colony shape, branch size, and radial corallite distribution. However, I am unable to separate the collection into units on any of these characters. The evidence suggests a species where the role of the radial corallite is very flexible. The 'easiest' identification in this group is *A. murrayensis s.s.*, which was well described by Vaughan. This occurs particularly on sandy floor situations in lagoons and deep water reef flat areas. On the reef crest and upper reef slope it can also occur, but with shortened 'bottlebrush' branches. The caespitose to plate-like forms occur mainly on sloping surfaces, and on deep parts of the reef slope small flat plates approaching *A. granulosa* are formed, these being identifiable with *A. cancellata s.s.* At least one of Brook's syntypes of *A. syringodes* (BM 1893.4.7.163) from unknown locality, compares closely with caespitose specimens in the present collection. The biggest problem is in interpreting *A. squarrosa s.s.* which I have taken (following Vaughan 1918) to be caespitose, approaching corymbose, with very regularly arranged radial corallites and relatively thick branches. I suspect *A. austera* specimens are sometimes identified to this species.

Geographic Distribution

Indo-Pacific: Red Sea, Seychelles, Maldives, Minicoy, Philippines, Louisade Archipelago, Great Barrier Reef, Marshall Islands.

Acropora granulosa (Milne Edwards and Haime, 1860)
(Plates 101, 102)

Madrepora granulosa Milne Edwards and Haime, 1860, p.156; Brook, 1893, p.189 (synonymy).
Madrepora speciosa Quelch, 1886, p.163, pl.10, fig.1; Brook, 1893, p.191.
Madrepora clavigera Brook, 1892, p.455; 1893, p.183, pl.9, figs. A, A[1].
Acropora clavigera: Crossland, 1952, p.226, pl.40, fig. 2, pl.42, fig.3.
Madrepora rayneri Brook, 1892, p.461; 1893, p.191, pl.8, fig.A.
Acropora rayneri: Wells, 1954, p.431, pl.134, fig.6, pl.137, figs.1, 2, pl.139, figs.1, 2.

Material Examined

PM: *Acropora granulosa* holotype 328a.

BM: *Acropora clavigera* holotype 1851.11.14.28. Fiji, *Acropora rayneri* syntypes, 1862.2.4.30, 1862.2.4.44.

QM: Big Broadhurst Reef, SW. slope: Oct., 1973, C.W., G11483; 5 m, 27.iii.1973, C.W., G11476; 7 m, 26.iii.1973, C.W., G11474; 7 m, 27.iii.1973, C.W., G11477, G11493; 8 m, 28.iii.1973, C.W., G11492; 8 m, 24.x.1973, C.W., G11481; 10 m, 23.x.1973, C.W., G11494; 10·4 m, 16.x.1973, C.W., G11487; 17·2 m, 17.x.1973, C.W., G11480; 25 m, 17.x.1973, C.W., G11485.

Bushy-Redbill Reef: adjacent Redbill Is., reef crest, 1 m, 1.vi.1975, C.W., G11490; 20.xii.1972, E. Lovell, G11491; NW. side, patch reefs, 15.vi.1975, 12 m, C.W., G11488.

Darley Reef, patch reef in lagoon, 2·5 m, 19.vii.1972, C.W., G6723.

Feather Reef, reef slope, 10 m, 24.x.1972, R. Pearson, G11479, G11482.

Field Diagnosis

Colonies are side-attached thin plates, with anastomosing horizontal branches and short vertical branchlets or groups of branchlets. Axial corallites are long, tapering or rounded, and may be sinuous. Radials are relatively few and scattered.

Laboratory Diagnosis

Branching pattern: described above.

Axial corallites: From barely exert to as long as 10 mm bare of radials. Outer diameter 1·2 to 2·5 mm; inner diameter: 0·6 to 2·2 mm. Septation: primaries well developed, up to 3/4R, secondaries absent or poorly represented, to less than 1/4R.

Radial corallites: Appressed tubular to nariform with round to slightly oval opening, directed at 90° or less to branch. Radials, except at growing edge of colony, are few, and inconspicuous, the appearance of the colony being dominated by the axial corallites.

Coenosteum: Spines with pointed or laterally flattened tips are densely and evenly arranged on and between corallites.

Within Reef Distribution

Reef slope and sides of lagoonal patch reefs, usually at depths greater than 20 m, but can be much shallower on very steeply sloping surfaces, for example G11490 is a specimen from 1 m on the side of a steep and narrow surge channel opening.

Identification Difficulties and History

The combination of the various species in synonymy seems barely possible from the type material, and also from much of my own material which identifies strongly with one or another species. A more acceptable combination would be two species, *A. speciosa* = *A. rayneri* and *A. granulosa* = *A. clavigera*. However some large specimens show a mixture of characteristics of all four species. The differences amongst the described species are in dimensions and the degree of tapering of the axial corallite: *'A. rayneri'* is very slight, and *'A. speciosa'* sturdier, both with tapering axials, *A. granulosa s.s.* and *'A. clavigera'* both have thick, rounded, non-tapering axials. In all the material there is little difference in inner axial diameter, axial septation, radial corallite shape and coenosteal spines. The locations of the specimens give no clue to the morphological differences. All categories except *'A. speciosa'* (one lagoonal specimen) co-occur on the reef slope. Their different appearances (whether genotypically or phenotypically determined) cannot be explained by reef slope gradients, and are probably related to microhabitat features.

Despite the variety in the species, extreme care must be taken in assigning a specimen to this species, as deeper water specimens of many other species appear (as cleaned specimens) similar to this species.

Geographic Distribution

Indo-Pacific: Mascarene Archipeligo (G. Faure, pers. comm.), Louisade Archipelago, Great Barrier Reef, Fiji Islands, Marshall Islands.

Acropora austera (Dana, 1846)
(Plates 103, 65C)

Madrepora austera Dana, 1846, p.478; Brook, 1893, p.56 (synonymy); Verrill, 1902, p.266, pl 36, fig. 10, pl. 36B, fig. 1.

Material Exmained

YPM: *Acropora austera* (fragment of type) 4190.

QM: Big Broadhurst Reef, S W. side, reef slope: 7·8 m, 14.x.1973, C.W., G10813, G10828; 8·0 m, 14.x.1973, C.W., G10814; 8·2 m, 14.x.1973, C.W., G10815; 9·0 m, 15.x.1973, C.W., G10816.

Bowden Reef, SW. end, reef slope, 26.vii.1972, C.W., G10817.

Bushy-Redbill Reef: adjacent Redbill Is., reef crest: 2.vi.1975, C.W., G10806, G10807; 4.vi.1975, C.W., G10808; S. side, reef slope, 3 m, 27.xii.1972, C.W., G10809, G10810; W. side, patch reef, 8 m, 15.vi.1975, C.W., G10811; N W. side, patch reef, 19.xii.1972, E. Lovell, G10812.

Darley Reef, patch reef in lagoon, 24.iii.1973, C.W., G10818, G10819.

Viper Reef, patch reef in lagoon, 16.vii.1972, C.W., G10820.

Fiji Islands, Great Astrolabe Reefs, Jan. 1974, C.W., G10821, G10822.

Field Diagnosis

Patchy, irregularly branching colonies of bushy, bottlebrush or caespitose appearance; large, irregular-length rounded radial corallites with very large openings. Colour cream to pale brown or dirty yellow. Extended polyps may be bright orange (axials) and purple (radials).

Laboratory Diagnosis

Branching pattern: Main branches are up to 40 mm width. These give off secondary branches of such irregular spacing, angle, and length, that the colony may appear caespitose, bottlebrush, or low arborescent. Although growth is apparently indeterminate, colonies do not often reach more than about 1 m across, occurring usually in areas of high density cover.

Axial corallites: From barely exert to 3 mm exert. Outer diameter 2·4 to 3·8 mm; inner diameter 1·0 to 1·5 mm. Septation: all septa usually present, primaries up to 2/3R, secondaries up to 1/2R.

Radial corallites: On secondary branches radials are tubular, nariform or tubo-nariform, of mixed length. Similar corallites on main branches tend to become appressed, then rounded, distally. The shape of the opening approaches a square, and the lower (or outer) wall is sometimes thickened accentuating the angularity of the opening. Primary and most or all secondary septa are developed and, as Dana comments, these usually slope towards the centre deep in the corallite.

Coenosteum: Reticulate with elaborated spines on and between radial corallites.

Within Reef Distribution

Reef crest and upper slope, top and sides of lagoonal patch reefs. This species seems to occur particularly where there is a bend or edge on the reef surface (see plate 65C).

Identification Difficulties and History

This species is neglected in the literature, although my experience has shown it to be widely distributed.

Geographic Distribution

Indo-Pacific: Singapore, Philippines, Great Barrier Reef, Fiji (C.W.), Enewetak Atoll (C.W.).

Acropora brueggemanni (Brook, 1893)
(Plate 50C, D)

Madrepora brueggemanni Brook, 1893, p.145, pl. 24. (synonymy).
Acropora brueggemanni: Crossland, 1952, p.221.
Madrepora brueggemanni var. uncinata Brook, 1893, p.146, pl. 35, fig. E.
Acropora brueggemanni var. *uncinata:* Nemenzo, 1967, p.55.

MATERIAL EXAMINED

BM: Singapore, *A. brueggemanni* syntype 1878.4.1.1.

JCU: Palm Island Group, T. Done, 4 specimens; Lizard Island Group, M. Pichon and T. Done, 6 specimens.

QM: Big Broadhurst Reef, SW. side, reef slope, 5 m, 27.iii.1973, C.W., G11495; 6 m, 27.iii.1973, C.W., G11496–8.
Palfrey Islet, Lizard Island group, 30.vii.1977, P. Hutchings, G11499–506.

FIELD DIAGNOSIS

Sturdy arborescently branching colonies occur as either small clumps or extensive thickets. Axial corallites are obviously large and bulbous and there may be several axials at or near the branch tip. General appearance approaches that of *A. palifera* (see Wells 1954, p.430), but a definite branching pattern is achieved. Colour is pale brown to pale apple green.

LABORATORY DIAGNOSIS

Branching pattern: The branches may be round or irregular in cross section, from 15 to 30 mm diameter, and either tapering or truncate. The angle of branching is usually wide.

Axial corallites: Outer diameter 2·0 to 8·0 mm; inner diameter 0·8 to 1·4 mm. In general, when there is a single axial corallite, this is wider than the members of a bundle of axials. Septation: Both septal cycles usually developed, the primaries up to 3/4R, secondaries up to 1/3R.

Radial corallites: From short (barely emergent) to appressed tubular, with round openings. Primary septal cycle usually well developed, up to 1/2R; secondary cycle poorly developed, up to 1/4R.

Coenosteum: Dense arrangement of elaborated spines both on and between radials.

WITHIN REEF DISTRIBUTION

In my work, I have encountered this species only as a rare member of the upper reef slope assemblage. It is very common on the fringing reefs of the Lizard Island and Palm Island Groups, usually on sandy or poorly consolidated substrates.

IDENTIFICATION DIFFICULTIES AND HISTORY

Both Brook and Crossland note an approach to the characteristics of subgenus *Isopora* in this species. Strong affinities with *A. palifera* can be seen in the radial corallite structure, coenosteal texture, and tendency to multiple axial corallites. It is considered in the present paper in order to avoid field-identification problems.

GEOGRAPHIC DISTRIBUTION

Singapore, Philippines, Great Barrier Reef.

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INDEX TO SPECIES

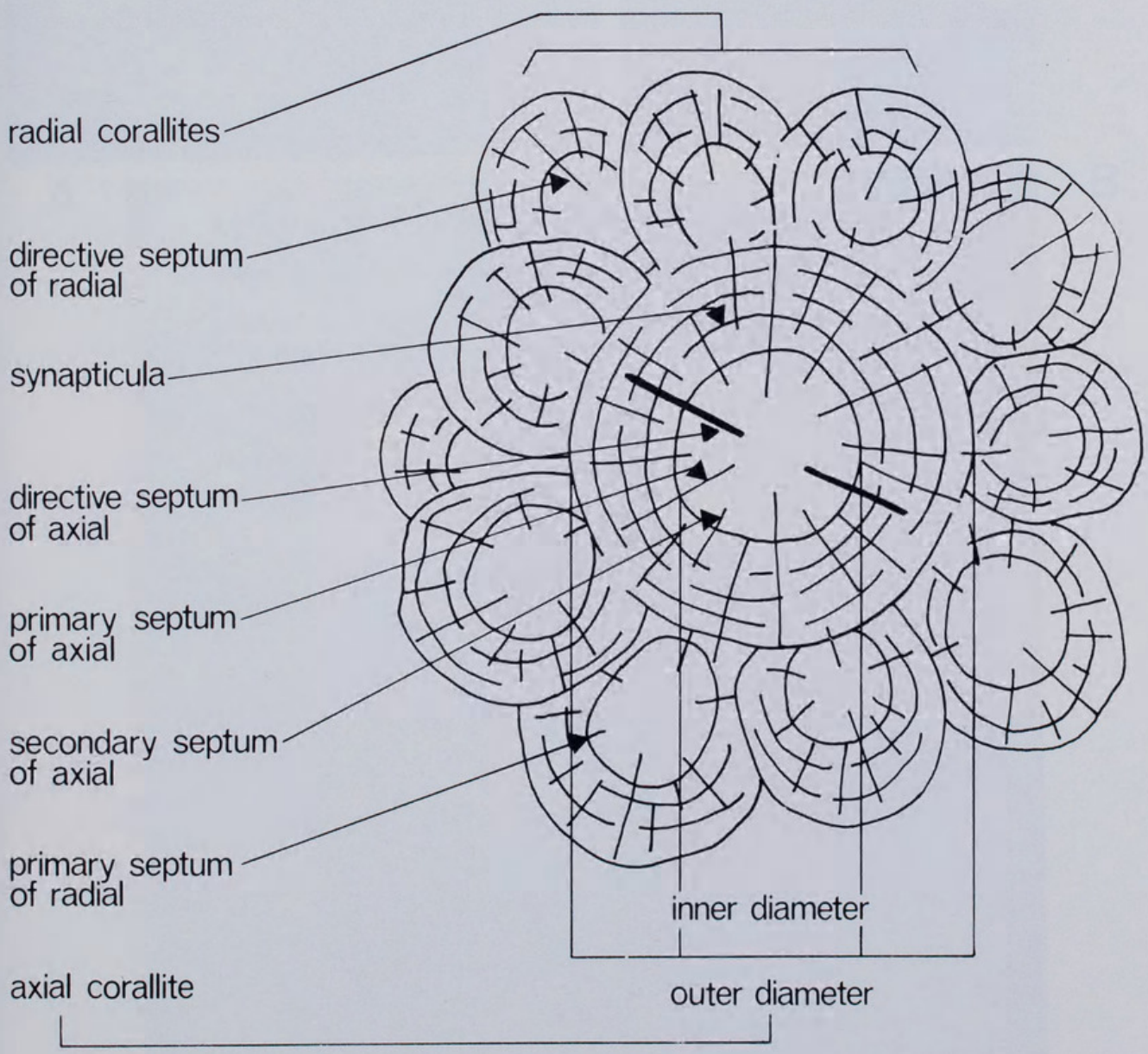

FIG. 3: Diagrammatic representation of Plate 43C indicating features used in the description of species.