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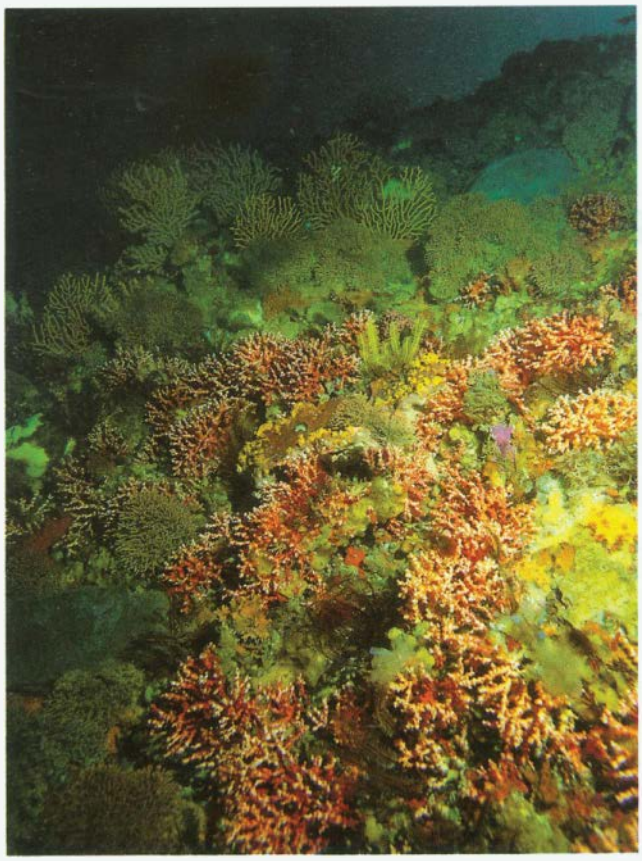
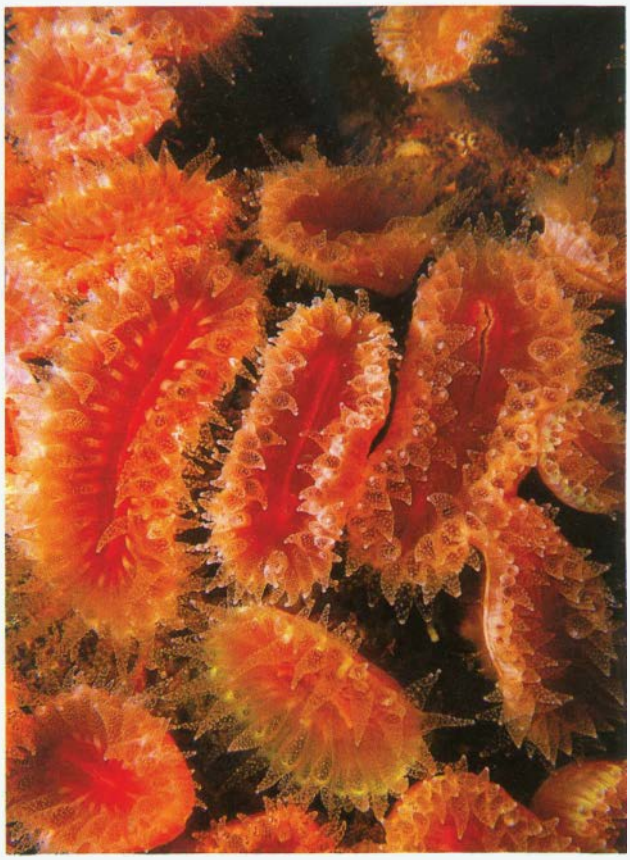
The Marine Fauna of New Zealand:

Scleractinia (Cnidaria : Anthozoa)

Stephen D. Cairns

New Zealand Oceanographic Institute Memoir 103





FRONTISPIECE:
Top left: Habitat of *Oculina virgosa* Squires, Three Kings Islands. Photo: Roger V. Grace
Top right: *Monomyces rubrum* (Quoy & Gaimard), Poor Knights Islands. Photo: Linda Grace
Bottom: *Culicia rubeola* (Quoy & Gaimard), Mimiwhangata. Photo: Roger V. Grace

COVER PHOTO: *Oculina virgosa* Squires, Three Kings Islands. Photo: Roger V. Grace.

NATIONAL INSTITUTE OF
WATER AND ATMOSPHERIC RESEARCH (NIWA)

The Marine Fauna of New Zealand: Scleractinia (Cnidaria : Anthozoa)

by

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Washington, D.C.

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"The living coral fauna of New Zealand is of the poorest kind as far as we know it. One species of *Flabellum* and one or two *Astrangiaceae* are all that are known."
(Tenison-Woods 1880: 1–2)

"The scleractinian corals of New Zealand have received so little attention that they have remained one of the larger unknown quantities of modern coral faunas."
(Ralph & Squires 1962: 1)

The Marine Fauna of New Zealand: Scleractinia (Cnidaria : Anthozoa)

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ABSTRACT

A total of 105 species of azooxanthellate Scleractinia are reported from the New Zealand region, defined as 24° to 57°30'S and 157°E to 167°W. Three new genera (*Pedicellocyathus*, *Temnotrochus*, *Falcatoflabellum*), 21 new species, and one new subspecies are described, and 71 new records for this region are reported. This revision is based on an examination of previously unexamined corals from approximately 804 stations, derived primarily from the collections of the New Zealand Oceanographic Institute and the Museum of New Zealand.

The New Zealand azooxanthellate Scleractinia are primarily (57%) tropical Indo-West Pacific in affinity, the species having varying degrees of southward extension into the region; 33°S is the southern limit for many species and is chosen herein to be the southern limit of the tropical/subtropical azooxanthellate province. There also appears to be a small, relatively shallow-water, warm-temperate (Auckland Province) group of endemic species; a group that is restricted to cold-temperate latitudes; and one species, *Flabellum impensum*, that has its northern limit in the New Zealand region in an otherwise Antarctic distribution. Six azooxanthellate species are reported from off Lord Howe Island, 18 from off Norfolk Island, and 10 from the Colville Ridge, all three regions containing primarily tropical and eurythermic tropical species. Most (82%) of the 56 azooxanthellate species known from off the Kermadec Islands are also tropical or eurythermic tropical; the remaining 10 species are found in warm- to cold-temperate regions to the south. Although 41 of the 105 species occur at shelf depths (0–200 m), most (80%) of the New Zealand azooxanthellate Scleractinia occur on the upper slope (200–1000 m), the deepest record being that of *Fungiacyathus marenzelleri* at 4954 m.

Keywords: Scleractinia, classification, distribution, new species, new genera, marine fauna, New Zealand, zoogeography.

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INTRODUCTION

Despite the impression given in the epigraph of a sparse and poorly known coral fauna, the New Zealand region fauna is now known to be quite a diverse one with at least 105 azooxanthellate species, which includes about 15% of the known azooxanthellate species worldwide. The paucity of shallow-water corals off New Zealand led to the statement (*see* Epigraph) of Tenison-Woods (1880) that corals are rare off New Zealand, but azooxanthellate corals abound in deeper waters, especially the upper slope, a fact only gradually revealed by deep-sea exploration: viz. *Gazelle* (Studer 1878); *Challenger* (Moseley 1881); *Terra Nova* (Gardiner 1929); and *Discovery* (Gardiner 1939) expeditions.

Only the azooxanthellate Scleractinia of the New Zealand region are discussed in this account, i.e., those species that lack algal symbionts. Being ecologically defined, the azooxanthellate corals are a polyphyletic group occurring in four of the five scleractinian suborders, but include all of the species that occur off New Zealand; however, the zooxanthellate (hermatypic or reef) corals that occur in the northern New Zealand region off Lord Howe, Norfolk, and the Kermadec Islands are not included in this account.

Azooxanthellate Scleractinia occur from the Arctic Circle to off continental Antarctica, and, although often referred to as "deep-water corals", occur from 0–6328 m, being commonest on the upper slope (200–1000 m). Scleractinia are exclusively sessile, benthic organisms, with an aragonitic calcium carbonate corallum that is usually white, but may be mottled or streaked with black, brown, or pink pigment. Most azooxanthellate corals are solitary in growth mode (e.g., 83% of New Zealand species), but colonial azooxanthellate species also occur, both in shallow and deep water.

Previous Studies

Squires (1958), Ralph and Squires (1962), and Squires and Keyes (1967) all presented brief historical resumés of scleractinian species and their distribution in the New Zealand region. Table 1 also briefly summarises all reports of scleractinian corals from this region, including first occurrences of all species, senior synonyms, and, in some cases, names of the vessels from which the specimens were collected. Only the significant publications are discussed below, and those requiring clarification.

Not surprisingly, the first two species of Scleractinia reported from the New Zealand region were the common, colourful, shallow-water *Monomyces rubrum* and *Culicia rubeola* by Quoy and Gaimard (1833).

Milne Edwards and Haime (1848b) reported three species of *Coenopsammia* from "Nouvelle-Zélande (Quoy et Gaimard)": *C. coccinea*, *C. gaimardi*, and *C. urvillii*, which, according to Wells (1983), are all synonyms of *Tubastraea coccinea* Lesson, 1829. These records were perpetuated by Milne Edwards and Haime (1857) and Duncan (1870), but not by Hutton (1904) in his list of corals known from New Zealand. In a revealing paragraph, Tenison Woods (1878: 340) cited Captain Hutton, "the well known naturalist at Dunedin", as saying that these three species did not occur off New Zealand. Tenison Woods went on to say that many of the specimens collected by the *Astrolabe* were mixed and that "many tropical corals quoted by Messrs. Quoy and Gaimard as from Australia and New Zealand, really came from the Pacific Islands within the tropics. Certain it is that very few of the Australian or New Zealand habitats can be verified." Later, Squires (1958) and Ralph and Squires (1962) listed these records as erroneous for the New Zealand region. In fact, *Tubastraea* had never been collected subsequent to the 1848 report until Squires (1960b) reported *T. aurea* (another junior synonym of *T. coccinea*) from the Norfolk Island cable. But even this record is false — the two specimens in question have well-developed Pourtalès Plans and thus are more consistent with the genus *Cladopsammia* than *Tubastraea*, although the species identity is unknown.

Six species (Table 1) were added to the inventory of New Zealand corals by three dredge stations of the *Terra Nova*, as reported by Gardiner (1929). Not all of these records were originally identified to species level, but examination of Gardiner's specimens (now deposited at The Natural History Museum, London, formerly the BM(NH), British Museum (Natural History)) confirm the identification of six well-known species for this region.

In his thorough revision of the fossil corals of

Table 1. Chronology of knowledge of recent azooxanthellate Scleractinia of the New Zealand region (* denotes a significant paper).

*1833	Quoy & Gaimard	*Astrolabe*: first records of *Turbinolia (= Monomyces) rubra* n. sp. and *Dendrophyllia (= Culicia) rubeola* n.sp.
1848b	Milne Edwards & Haime	Erroneous reports of three species of *Coenopsammia (= Tubastraea)* from New Zealand.
1849	Milne Edwards & Haime	*Culicia smithii* n.sp. from New Zealand (doubtful record).
1862	Holdsworth	*Flabellum nobile* n.sp. (= *Monomyces rubrum*) from New Zealand.
1870	Duncan	Uncritical listing of 7 recent species from New Zealand.
1876	Duncan	*Conocyathus zelandiae* n.sp. from Cook Strait; not since recollected off New Zealand, but known elsewhere.
1878	Studer	S.M.S. *Gazelle*: *Flabellum latum* n. sp. and *F. gracile* n.sp. (both considered to be forms of *Monomyces rubrum*).
1879	Tenison Woods	*Cylicia huttoni* n. sp. (= *Culicia rubeola*) and *C. vacua* n.sp. (= *Monomyces rubrum*) from off New Zealand.
1881	Moseley	H.M.S. *Challenger*: dubious record of *Caryophyllia maculata (= Rhizosmilia maculata)* and *C. lamellifera* n.sp. from off the Kermadec Islands.
1904	Hutton	Uncritical list of 8 recent and 1 fossil species from New Zealand.
1906	Dennant	*Kionotrochus suteri* n. sp. from off Great Barrier Island.
*1929	Gardiner	*Terra Nova*: Seven deep-water species reported off Three Kings Islands: *Flabellum harmeri* n.sp (= *Monomyces rubrum*); *Gardineria* sp. (= *Crispatotrochus curvatus*); *Desmophyllum cristagalli (= D. dianthus); Caryophyllia profunda; Trochocyathus* sp. (= *Tethocyathus cylindraceus*); *Thecopsammia* sp. (= *Balanophyllia chnous*); and *Dendrophyllia (= Eguchipsammia) japonica.*
1937	Wells	Additional record of *Kionotrochus suteri* from Cuvier Island.
1939	Gardiner	*Discovery*: *Deltocyathus lens (= Peponocyathus dawsoni)* and *Sphenotrochus intermedius (= S. squiresi)* from off New Zealand.
1947	Powell	Two species listed in "Native Animals of New Zealand".
1948	Ralph	Additional records of *Caryophyllia profunda* and *Flabellum rugulosum (= Monomyces rubrum).*
*1958	Squires	Uncritical listing of all recent corals reported from New Zealand coasts.
1958	Wells	*Stephanophyllia formosissima (= Letepsammia fissilis)* from off New Zealand.
1960a	Squires	Additional notes on *Kionotrochus suteri*, endemic to New Zealand.
1960b	Squires	First record of *Goniocorella dumosa* from New Zealand (off Norfolk Island).
1960c	Squires	Notes on fossil and Recent *Culicia rubeola.*
1962	Ralph & Squires	Five new records: *Oculina virgosa; Sphenotrochus* sp. B (= *S. ralphae*); *Stenocyathus decamera* n.sp. (= *S. vermiformis*); *Flabellum deludens (= F. apertum);* and *F. knoxi* n.sp.
*1963	Squires	Monograph of *Flabellum (= Monomyces) rubrum.*
1964a	Squires	Additional records of *Caryophyllia profunda, Goniocorella dumosa,* and *Flabellum knoxi* from off Chatham Islands.
1964b	Squires	Seven species reported off northeastern New Zealand, including new records of: *Ceratotrochus (= Labyrinthocyathus) limatulus* n.sp. and *Flabellum aotearoa.*
1965	Squires	Deep-water coral coppices reported from Campbell Plateau and Chatham Rise.
1965	Squires & Ralph	New records of *Flabellum lowekeyesi* n.sp. and *Stephanocyathus* sp. (= *S. platypus*).
*1967	Squires & Keyes	NZOI: New records of *Madrepora vitiae (= M. oculata), Dendrophyllia palita* n.sp. (= *D. alcocki*), and *Notocyathus orientalis (= Peponocyathus dawsoni).*
1968	Morton & Miller	Colour illustrations of *Culicia rubeola* and *Flabellum (= Monomyces) rubrum.*
1969	Squires	Nine species mapped and discussed from the New Zealand region, including new records of *Solenosmilia variabilis* and *Flabellum impensum.*

1974c	Zibrowius	Notes on *Dendrophyllia palita* (= *D. alcocki).*
1976	Grace & Grace	*Culicia rubeola* and *Flabellum* (= *Monomyces) rubrum* off Great Mercury Island.
1982	Brook *et al.*	*Sphenotrochus ralphae* off Rakitu Island.
1982	Brook	Four shallow-water species off Rakitu Island.
*1982	Cairns	R.V. *Eltanin*: 13 species reported from Subantarctic New Zealand, including 4 new records: *Aulocyathus recidivus*, *Enallopsammia marenzelleri*, *E. rostrata*, and *Fungiacyathus fragilis*.
1984	Hayward *et al.*	*Sphenotrochus ralphae* off Chickens Islands.
1985	Hayward *et al.*	Three shallow-water species off Broken Islands.
1988	Cairns	Notes on *Kionotrochus suteri.*
1989a	Cairns	*Javania* sp. (= *J. pachytheca*) and *Truncatoguynia* sp. (= *T. irregularis*) reported from off Kermadec Islands.
1992	Stolarski	Notes on *Kionotrochus suteri.*

New Zealand, Squires (1958) also listed all previous records of recent Scleractinia in an appendix, listing 26 taxa, 18 of which he considered valid. No new records of recent Scleractinia were included in his paper, but he did provide a brief history of recent corals known from New Zealand waters. Except for an addendum by Squires (1962a), the fossil corals have not been subsequently revised and thus Squires' (1958) revision serves as the fossil counterpart to this paper.

The revision of the extant scleractinian corals of New Zealand by Ralph and Squires (1962) was the first of two revisions of the recent corals of this region. They included three new species and five new records for the region (*see* Table 1). Their material drew from many sources, most now deposited at the Auckland Institute and Museum, and some at the Museum of New Zealand (MoNZ).

Although it deals with only one species, Squires' (1963) monograph of the New Zealand endemic *Flabellum (=Monomyces) rubrum* is a classic for the New Zealand region, including an extensive, annotated synonymy; a description of morphological variation of corallum and polyp; and a discussion of its ecology, distribution, and fossil record.

The second major revision of the scleractinian fauna of the New Zealand region was that of Squires and Keyes (1967), who based their paper primarily on the NZOI collections (station series A–C). They reported, illustrated, and keyed 25 recent species and discussed three other records that they considered of doubtful authenticity: *Trochocyathus* sp. of Gardiner (1929); *Gardineria* sp. of Gardiner (1929); and *Conocyathus zelandiae* Duncan, 1876. Of this number, three were new species, and three were new records for the region (*see* Table 1), *F. raukawaensis* n. sp. having previously been reported as *F. deludens* by Ralph and Squires (1962). Most of their specimens are deposited at NZOI but some are at MoNZ.

In a revision of the Antarctic and Subantarctic fauna, I reported 13 species from Subantarctic New Zealand waters, including four new records for the region (Cairns 1982) .

A tabulation of all species previously reported from the New Zealand region (Table 2) yields 34 species of azooxanthellate Scleractinia. Seventy-one additional species are included herein, resulting in a total of 105 species for this region.

Table 2. Distribution patterns and depth ranges of New Zealand azooxanthellate Scleractinia.

Species	TROPICAL 1	WARM TEMPERATE 2	Cold Temperate 3	4	5	6	7	SUBANTARCTIC 8	Elsewhere	PATTERN OF DISTRIBUTION	Depth (m) in the region
Fungiacyathus (F.) stephanus	K	x	x						Indo-West Pacific	1C	1442–1705
F. (F.) fragilis		x	x					x	N. Atlantic, C. Pacific	1D	1029–1693
F. (F.) pusillus pacificus	NTC									2C	350–988
F. (B.) marenzelleri		x	x						Cosmopolitan	1C	1760–4954
F. (B.) margaretae	C									2C	635–673
F. (B.) turbinolioides		x							W. Pacific	1B	600–751
Letepsammia superstes	K								Japan	3B	200–710
L. fissilis		x								2A	106–206
L. formosissima	NK								Indo-West Pacific	1A	290–378
Stephanophyllia complicata	NT	x							Indo-West Pacific	1A	319–1137
Culicia rubeola		x	x							2D	0–82
Oculina virgosa		x								2A	29–388
Madrepora oculata	TK	x	x					x	Cosmopolitan	1D	*149–946
Anthemiphyllia dentata	NTK								Indo-West Pacific	1A	280–570
Caryophyllia (C.) rugosa	LNK								Indo-West Pacific	1A	142-508
C. (C.) hawaiiensis	LNK								C. and W. Pacific	1A	126-279
C. (C.) quadragenaria		x	x			x			W. Pacific	1D	77-198
C. (C.) profunda		x	x	x		x		x	S. Indian Ocean	3A	*20-1300
C. (C.) atlantica	T			x		x	x		E. Atlantic, W. Pacific	1D	1004-1474
C. (C.) ralphae	L								Chesterfield Is.	2C	315-360
C. (C.) diomedeae	CK	x	x			x			Widespread	1C	660-1200
C. (C.) japonica		x	x	x			x		NW Pacific	3B	106-946
C. (C.) lamellifera	LNK								?SW Indian Ocean	2C	89-1152
C. (C.) elongata	TK	x							Indo-West Pacific	1B	165-590
C. (C.) scobinosa	LC								Indo-West Pacific	1A	784-1276
C. (C.) ambrosia	C	x	x						Widespread	1C	701-1180
C. (P.) compressa	K	x							Off Japan	3B	402-757
Coenocyathus brooki	K									2C	7-95
Crispatotrochus curvatus		x	x							2D	1373-2505
C. rugosa	LK									2C	142-508
Labyrinthocyathus limatulus	LNK	x								2B	20-508
L. sp.			x		x					2E	665-1000
Polycyathus norfolkensis	N									2C	10-20
Trochocyathus rhombo-columna	LTK								Indo-West Pacific	1A	419-530
T. maculatus	LK									2C	100-183
T. gordoni	K									2C	398-710
T. cepulla	NK								New Caledonia	2C	398-449
T. hastatus	K								Tuvalu	1A	460-710
Tethocyathus cylindraceus		x	?						W. Atlantic	1B	5-327

Species	TROPICAL 1	WARM TEMPERATE 2	Cold Temperate 3	4	5	6	7	SUBANTARCTIC 8	Elsewhere	PATTERN OF DISTRIBUTION	Depth (m) in the region
T. virgatus	TCK								W. Pacific	1A	142-530
Stephanocyathus (S.) platypus		x	x	x			x		Temp. SW Pacific	3A	561-1168
S. (A.) spiniger	LNK	x							Indo-West Pacific	1B	174-590
S. (O.) weberianus	L								W. Pacific	1A	1045
S. (O.) coronatus	NTC								W. Atlantic	1A	646-1276
Vaughnella oreophila	NC								W. Pacific	1A	646-757
V. multipalifera	K	x								2B	1357-1450
Bourneotrochus stellulatus	LNK								W. Pacific	1A	326-710
Deltocyathus ornatus	N								W. Pacific	1A	280-390
D. formosus	NK									2C	142-565
Conotrochus brunneus	LTK								Indo-West Pacific	1A	486-1051
Aulocyathus recidivus	TK	x	x		x			x	Temp. Indo-West Pacific	3B	245-1137
Dasmosmilia lymani		x							Atlantic	1B	633-1002
Desmophyllum dianthus	NTK	x	x	x	x	x	x	x	Cosmopolitan	1D	25-1750
Thalamophyllia tenuescens	LK								W. Pacific	1A	200-315
Hoplangia durotrix		x							E. Atlantic	3B	7-110
Goniocorella dumosa	N	x	x	x		x	x		Indo-West Pacific	1D	88-1488
Anomocora cf.*fecunda*	NK	x							Central Pacific	1B	145-388
Solenosmilia variabilis	TK	x	x	x		x	x	x	Cosmopolitan	1D	509-1260
Conocyathus zelandiae			?						Indian Ocean, Australia	-	?
Alatotrochus rubescens	N								W. Pacific	1A	449-751
Sphenotrochus ralphae		x								2A	7-104
S. squiresi		x								2A	66-318
Kionotrochus suteri		x								2A	46-622
Cryptotrochus venustus	T								W. Pacific	1A	1137
Peponocyathus dawsoni	T	x	x	x		x				2D	87-988
Tropidocyathus pileus	N								Indo-West Pacific	1A	319
Notocyathus conicus	NK								W. Pacific	1A	402-710
Thrypticotrochus multilobatus	NK	x							Indo-West Pacific	1B	95-440
Pedicellocyathus keyesi		x								2A	70-194
Truncatoguynia irregularis	NK								W. Pacific	1A	133-248
Stenocyathus vermiformis	TK	x	x	x	x	x	x	x	Cosmopolitan	1D	*30-805
Temnotrochus kermadecensis	K									2C	366-402
Flabellum (F.) knoxi			x	x		x	x	x		2E	160-1167
F. (F.) angiostomum	NT								W. Australia	1A	540-640
F. (F.) impensum							x		Off Antarctica	4	1165-2100
F. (U.) lowekeyesi	LK	x	x	x		x	x		SWIndian Ocean, Tasmania	3A	381-1064
F. (U.) messum	K								Indo-West Pacific	1A	800-1035
F. (U.) aotearoa	LNK	x							Chesterfield Is	2B	130-565
F. (U.) hoffmeisteri	CK								Temp. SE Australia	3A	440-646
F. (U.) apertum apertum			x	x	x	x	x	x	Subantarctic	3A	322-1575

Species	TROPICAL	WARM TEMPERATE	Cold Temperate					SUBANTARCTIC	Elsewhere	PATTERN OF DISTRIBUTION	Depth (m) in the region
	1	2	3	4	5	6	7	8			
Monomyces rubrum		x	x							2D	
- typical form											0-201
- forma *nobile*											70-410
- forma *latum*											1-163
Polymyces wellsi	K	x	x						Pacific	1B	355-1165
Rhizotrochus flabelliformis	LNK	x							W. Pacific	1B	228-419
Gardineria hawaiiensis	NTK	x							W. Pacific	1B	142-602
G. sp.	LN								Chesterfield Is	2C	291-378
Javania lamprotichum	K								Central Pacific	1A	465-710
J. pachytheca	LK	x							Chesterfield Is	2B	360-1045
Truncatoflabellum pari-pavoninum	K								Indo-West Pacific	1A	1035-1450
T. dens	NK								W. Pacific	1A	320-555
T. phoenix	K								off Japan	3B	145-179
T. arcuatum		x								2B	350-364
Placotrochides scaphula			x						Indo-West Pacific	1C	665
Falcatoflabellum raoulensis	K									2C	366-402
Balanophyllia chnous		x								2A	140-549
B. gigas		x	x						W. Pacific	1C	148-640
B. crassitheca	LNK	x								2B	190-508
Endopachys grayi	NK	x							Indo-Pacific	1B	95-143
Eguchipsammia gaditana	NTK	x							Cosmopolitan	1B	57-988
E. fistula	K								IndoWest Pacific	1A	325
E. japonica	NTK	x	x	x					W. Pacific	1C	142-785
Cladopsammia eguchii	K								Pacific	1A	7
Dendrophyllia arbuscula	NK								W. Pacific	1A	202-259
D. alcocki	LNTK	x	x		x				Indo-West Pacific	1C	*118-570
Enallopsammia rostrata	NTCK	x	x	x			x	x	Cosmopolitan	1D	110-1276
E. cf. *marenzelleri*								x	Indo-West Pacific, NE Atlantic	1D	333-371
	76	52	31	14	6	12	12	11			

1 Tropical/Subtropical Region: Lord Howe Island and Seamount Chain (L); Norfolk Island and Ridge north of 33°S (N); Three Kings Ridge north of 33°S (T); Colville Ridge (C); Kermadec Islands and Ridge north of 33°S (K)
2 Warm Temperate Region: Auckland province
3 Cold Temperate Cookian Province: southern North Island and South Island
4 Cold Temperate Cookian Province: Chatham Islands and Chatham Rise
5 Cold Temperate Antipodean Province: Macquarie Ridge north of 50°S
6 Cold Temperate Antipodean Province: Campbell Plateau
7 Cold Temperate Antipodean Province: Bounty Plateau
8 Subantarctic Region: southern Macquarie Ridge south of 50°S and Hjort Seamount
* Shallow depths occur only in fiord localities

MATERIALS AND METHODS

Material

This study is based on the examination of previously unstudied material from eight institutional sources, herein listed in order of decreasing size of the contribution: NZOI* (a rich source of thousands of specimens from 557 stations primarily from the collections made using the R.V. *Tangaroa*, cruise series D–Z; MoNZ (numerous specimens from 118 stations from R.V. *Tangaroa* cruise series O, P, and R (1978–1981) and earlier collections made by the R.V. *Alert* (1957) and R.V. *Acheron* (1972–1978); AIM (several hundred specimens from throughout the New Zealand region, including collections of Fred Brook from Kermadec, Norfolk, and Three Kings Islands); AUM (deep-water corals from 24 New Zealand localities); AMS (deep-sea corals from nine stations of the R.V. *Franklin* from seamounts in the Tasman Sea and Lord Howe Seamount Chain); Institute of Geological and Nuclear Sciences (IGNS), formerly the N.Z. Geological Survey (NZGS) (15 lots of relatively shallow-water corals from coastal New Zealand); Portobello Marine Biological Station of the University of Otago (nine lots of deep-water corals from canyons off Dunedin); Otago University Department of Geology (three lots of deep-water coral). Based on these specimens, additional records of 103 of the 105 azooxanthellate New Zealand species are reported and illustrated. *Conocyathus zelandiae* has never been collected from New Zealand subsequent to its original description in 1876, but is described and illustrated based on Australian specimens. Likewise, *Enallopsammia marenzelleri* has not been recollected since it was reported from the Macquarie Ridge by Cairns (1982).

In addition to these unstudied collections, previously reported specimens from the following museums were re-examined: AIM (Squires 1960b, 1964b; Ralph & Squires 1962), AMS (Bourne 1903), BM(NH) (Duncan 1876; Moseley 1881; Gardiner 1929, 1939; Gardiner & Waugh 1938; Squires 1962b); MoNZ (Ralph & Squires 1962 (part); Squires & Ralph 1965 (part)); NZGS (Tenison Woods 1880; Squires 1958, 1965; Squires & Keyes 1967); USNM (Squires 1958 (part), 1964a (part), 1969; Squires & Ralph 1962 (part); Cairns 1982, 1988, 1989a); ZMA (Alcock 1902b, c); ZMB (Studer 1878). Type material of 78 of the 105 New Zealand species was examined, as well as the types of at least seven junior synonyms.

Methods

It was attempted to provide complete species synonymies, at least regarding records from the New Zealand region, but it is acknowledged that various checklists and smaller publications may have been overlooked. The original description and other significant references outside the New Zealand region are also included in the synonymies, the latter often being a key to the extended synonymy (chresonomy) (*sensu* Smith & Smith 1972) of the species. Efforts were made to examine as many types as possible and to verify as many of the previously published records as possible (*see* Material), but when specimens were unavailable for study and the published accounts unclear, the synonymic entries and corresponding distribution records are queried.

Most of the 105 species included in the revision are described or diagnosed, all but two based on new materal (*see* Material); however, if a species has recently been described and/or the new records do not add to a previous description, then only a reference to a complete description is given. Conventional scleractinian terminology is used in describing coralla (*see* Wells 1956; Cairns 1981, 1989a). One new term introduced in this paper is the **calicular lancet**, which is a group of three or more septa that project well beyond the calicular edge as rectangular or triangular apices, producing a serrate to lacerate calicular edge.

It is important to document which specimens were actually seen by the author of a systematic paper and where those specimens are deposited. Therefore, I have segregated the Material Examined sections into New Records and Previous Records: the former lists previously unreported specimens, the latter lists specimens that have been cited in previous publications. A third category is added

* For explanation of abbreviations, see p. 15

some species named Reference Material, for specimens examined of closely related but not conspecific species. Each Material Examined section begins with a station number, followed by the number of specimens in the lot, and finally the catalogue number and/or museum of deposition.

A detailed map of the geographic range and a bathymetric range within the New Zealand region is given for most species, as well as its extended geographic and bathymetric ranges outside the region.

Holotypes and paratypes of all new species described herein are deposited at the USNM, NZOI, MoNZ, AMS, or AIM, as indicated in the text. An effort was made to list the museums of deposition and type localities for all senior and junior synonyms of all species.

The scanning electron photomicrographs were taken by the author on a Cambridge Stereoscan 100. In some cases in which specimens lacked sufficient contrast for conventional photography, the speci-men was dyed dark red and coated with a thin layer of sublimed ammonium chloride.

The following abbreviations are used in the text.

Museums

AIM Auckland Institute and Museum, Auckland (coral catalog numbers prefaced with "AK").

AMS Australian Museum, Sydney.

AUM Auckland University Museum, Geology Department; prefix for specimens held in that collection is AU.

BM(NH) British Museum (Natural History), London; now The Natural History Museum.

IGNS Institute of Geological and Nuclear Sciences

IOM Institute of Oceanology, Moscow.

MCZ Museum of Comparative Zoology, Harvard University, Cambridge.

MNHNP Muséum National d'Histoire Naturelle, Paris.

MNW Naturhistorisches Museum, Wien.

MoNZ Museum of New Zealand Te Papa Tonga-rewa (coral catalogue numbers pre-faced with "CO").

NMV National Museum of Victoria, Melbourne.

NZGS New Zealand Geological Survey (now Institute of Geological and Nuclear Sciences, IGNS).

NZOI New Zealand Oceanographic Institute, Wellington.

SAM South Australian Museum, Adelaide.

TIUS Institute of Geology and Paleontology, Tohoku (Imperial) University, Sendai, Japan.

USNM United States National Museum, Washington, DC; now the National Museum of Natural History.

ZMA Zoologische Museum, Amsterdam.

ZMB Zoologisches Museum, Berlin.

Other Abbreviations

GCD Greater calicular diameter of corallum.

GCD:LCD Ratio of greater calicular diameter to lesser calicular diameter of corallum.

D:H Ratio of diameter to height of corallum.

H:D Ratio of height to diameter of corallum.

LCD Lesser calicular diameter of corallum.

LEL:H Ratio of lateral edge length to height of corallum (*see* Cairns 1989b).

PD:GCD Ratio of pedicel diameter to greater calicular diameter.

SCI Septal concavity index: ratio of distance from thecal edge to point of greatest septal inflection to length of thecal face along that septum.

SSI Septal sinuosity index: ratio of amplitude of lower inner edge of a major septum to thickness of that septum (*see* Cairns 1989b).

Sx, Cx, Px, CSx Cycle of septa, costae, pali, or costosepta, respectively, designated by numerical subscript.

Sx > Sy In the context of a septal formula, septa of cycle x are wider than those of cycle y.

LIST OF STATIONS
NZOI (New Zealand Oceanographic Institute)

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
A502	41°30.0'	174°32.8'E	457	14.10.59
A904	44°15.2'	179°35.4'E	1108	12.9.63
A910	43°04.0'	178°39.0'W	549	13.9.63
B152	39°26.8'	176°56.7'W	4	25.7.57
B473	43°20.0'	169°47.0'E	215	3–4.6.61
B476	43°59.7'	168°17.2'E	144	4.6.61
B482	46°08.8'	166°06.0'E	88	5–6.6.61
B487	46°16.0'	166°03.0'E	196	6.6.61
B489	46°39.0'	166°09.5'E	198	7.6.61
B490	45°44.3'	166°44.8'E	148	8.6.61
B544	42°40.0'	173°39.0'E	128	4.10.62
B554	44°00.0'	172°58.2'E	81	6.10.62
B653	39°20.0'	173°42.0'E	79	23.10.62
B808	39°29.5'	173°48.0'E	55	18.3.63
C344	37°58.6'	174°34.4'E	55	26.10.59
C399	41°35.0'	174°45.7'E	468	3.5.60
C509	40°39.0'	177°03.5'E	201	20.6.60
C510	40°36.0'	177°02.0'E	384	"
C527	32°30.0'	179°12.0'W	508	18.9.60
C530	30°38.0'	178°31.0'W	183	19.9.60
C531	29°14.4'	178°02.0'W	179	"
C640	39°17.0'	171°53.0'E	364	28.5.61
C642	39°15.5'	171°52.5'E	354	"
C690	42°33.2'	173°33.8'E	119	18.6.61
C703	42°42.0'	173°37.8'E	184	19.6.61
C748	36°00.0'	173°32.2'E	135	16.2.62
C752	35°19.0'	172°57.5'E	131	17.2.62
C758	34°40.0'	172°14.5'E	203	"
C764	34°08.5'	172°08.5'E	66	19.2.62
C766	34°18.2'	172°48.8'E	75	"
C769	34°40.1'	173°11.2'E	77	20.2.62
C771	34°40.0'	173°27.0'E	192	"
C774	35°09.8'	174°14.4'E	78	"
C776	35°20.0'	174°25.8'E	77	"
C778	35°19.8'	174°47.6'E	187	"
C780	35°59.8'	174°47.4'E	75	21.2.62
C781	36.00'0'	175°20.8'E	93	"
C782	35°59.7'	175°36.7'E	134	"
C793	36°39.9'	175°02.0'E	132	23.2.62
C804	37°39.8'	177°43.6'E	77	24.2.62
C814	37°40.0'	178°56.4'E	194	25.2.62
C821	38°40.0'	178°21.5'E	32	26.2.62
C910	41°13.0'	173°52.7'E	24	8.2.63
D5	56°40.6'	158°45.5'E	1280	19.4.63
D6	55°29.0'	158°31.5'E	415	20.4.63
D39	50°58.0'	165°45.0'E	549	7.5.63
D74	50°55.7'	165°54.8'E	168	12.8.63
D87	49°56.0'	171°50.0'E	483	14.5.63

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
D136	48°33.5'	169°10.0'E	713	12.1.64
D149	49°10.5'	166°51.0'E	454	14.1.64
D159	49°01.0'	164°30.0'E	741	17.1.64
D166	49°49.0'	163°51.0'E	668	19.1.64
D173	50°53.0'	166°32.0'E	141	21.1.64
D224	40°47.0'	169°41.0'E	903	27.9.64
D225	40°27.0'	169°05.0'E	940	"
D226	39°54.0'	168°40.0'E	823	27–28.9.64
D227	39°50.0'	169°43.0'E	752	28.9.64
D228	39°08.0'	170°19.0'E	662	"
D230	38°10.0'	170°21.0'E	861	29.9.64
D231	37°53.0'	169°45.0'E	774	"
D235	39°43.0'	167°56.0'E	792	30.9.64
D242	38°00.0'	169°03.0'E	337	2.10.64
D244	39°31.0'	171°00.0'E	838	3.10.64
D424	41°05.0'	178°00.0'E	1558	14.3.65
D836	37°34.0'	179°22.0'E	1395	6.3.69
D871	43°20.0'	178°40.0'W	420	24.3.69
D876	43°20.0'	176°50.0'W	148	25.3.69
D888	44°15.0'	176°45.0'W	98	27.3.69
D899	44°23.0'	176°49.0'W	345	29.3.69
D904	43°58.5'	78°40.0'W	459	30.3.69
E74	44°00.0'	176°40.0'E	547	23.3.64
E75	44°00.0'	177°25.0'E	715	"
E79	43°05.0'	178°00.0'E	371	24.3.64
E121	43°15.0'	175°40.0'W	693	14.10.64
E123	43°45.0'	175°30.0'W	492	"
E148	44°30.0'	177°45.0'W	880	17.10.64
E254	34°35.0'	172°25.0'E	126	6.4.65
E255	34°39.0'	172°25.0'E	154	"
E256	34°39.0'	172°20.0'E	157	"
E258	34°39.0'	172°10.0'E	380	"
E261	34°35.0'	172°15.0'E	161	"
E274	34°30.0'	172°05.0'E	318	7.4.65
E275	34°25.0'	171°45.0'E	600	"
E278	34°25.0'	172°15.0'E	141	"
E283	34°25.0'	172°35.0'E	79	8.4.65
E291	34°15.0'	171°50.0'E	410	"
E302	34°06.7'	172°10.0'E	132	9.4.65
E313	34°05.0'	171°55.0'E	732	10.4.65
E319	33°56.0'	172°17.0'E	104	11.4.65
E340	34°05.0'	172°40.0'E	102	12.4.65
E348	34°37.0'	173°20.0'E	150	13.4.65
E349	34°37.0'	173°15.0'E	121	"
E351	34°37.0'	173°06.0'E	62	"
E356	34°34.0'	173°05.0'E	68	14.4.65
E358	34°34.0'	173°15.0'E	143	"
E359	34°34.0'	173°20.0'E	172	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
E364	34°30.0'	173°05.0'E	73	14.4.65
E368	34°25.0'	173°07.5'E	126	"
E370	34°25.0'	173°10.0'E	146	15.4.65
E374	34°20.0'	173°00.0'E	117	"
E378	34°20.0'	172°55.0'E	102	"
E387	34°15.5'	172°47.5'E	88	16.4.65
E389	34°01.5'	172°43.5'E	155	"
E390	34°07.6'	172°45.0'E	102	"
E391	34°12.6'	172°45.0'E	95	"
E393	34°20.0'	172°45.0'E	70	"
E399	46°00.0'	171°33.0'E	1222	6.10.65
E400	46°00.0'	171°02.0'E	622–768	7.10.65
E405	47°20.0'	169°55.0'E	1004	9.10.65
E410	46°40.0'	170°44.6'E	1086	10.10.65
E413	45°12.0'	171°44.0'E	594	11.10.65
E421	44°00.0'	175°00.0'E	494	15.10.65
E422	44°15.0'	175°00.0'E	615	"
E423	44°18.0'	174°31.0'E	640	"
E424	44°40.0'	172°38.0'E	293	16.10.65
E428	44°16.0'	174°00.0'E	646	17.10.65
E434	43°30.0'	174°30.0'E	556	18.10.65
E436	43°15.0'	174°00.0'E	695	"
E636	37°28.5'	177°13.0'E	190	10.10.66
E707	40°10.3'	177°18.3'E	951–834	21.3.67
E712	39°20.0'	178°15.8'E	772–717	22.3.67
E713	39°20.8'	178°17.0'E	935–858	"
E714	39°19.6'	178°21.2'E	1284–1249	"
E715	38°40.0'	178°29.3'E	322	23.3.67
E717	38°42.0'	178°33.3'E	828–839	"
E718	38°41.0'	178°40.0'E	1041–1019	"
E719	38°46.0'	178°48.0'E	913–750	"
E720	37°33.0'	178°35.0'E	256–252	24.3.67
E725	37°20.5'	178.00.5'E	1004–942	"
E731	37°23.5'	177°12.0'E	602–503	25.3.67
E749	40°47.0'	176°57.0'E	913–997	29.3.67
E751	41°39.7'	175°15.0'E	300–399	30.3.67
E752	41°40.7'	175°15.4'E	618–596	"
E753	41°46.2'	175°15.0'E	1074–1227	"
E755	42°00.5'	174°25.4'E	247–276	"
E756	42°01.8'	174°26.5'E	885–969	"
E757	42°03.2'	174°27.2'E	1081–1125	"
E772	42°00.0'	170°16.0'E	748	14–15.10.67
E773	42°00.0'	169°54.0'E	968	15.10.67
E774	42°00.0'	169°15.0'E	1168	"
E783	43°23.0'	168°36.5'E	966	16–17.10.67
E784	43°23.0'	168°05.0'E	1221–1213	17.10.67
E792	44°40.0'	167°33.5'E	213–123	19.10.67
E793	44°40.0'	167°32.0'E	243–253	"
E796	45°20.0'	166°45.5'E	251–226	20.10.67
E797	45°20.0'	166°44.7'E	471–421	"
E800	45°20.5'	166°41.5'E	1003–993	"
E801	45°53.5'	166°07.0'E	983–888	"
E803	45°57.0'	166°09.0'E	534–514	21.10.67
E804	45°58.5'	166°18.5'E	183	"
E821	46°43.5'	165°46.5'E	549	23.10.67

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
E825	46°39.5'	166°40.5'E	914	24.10.67
E826	46°37.5'	166°44.2'E	823	"
E830	47°21.0'	167°00.0'E	682–619	25.10.67
E840	33°52.0'	172°16.0'E	757–729	16.3.68
E841	33°53.0'	172°17.0'E	479–428	"
E846	34°96.5'	171°57.5'E	417–343	"
E848	33°59.0'	171°40.0'E	250	17.3.68
E849	33°55.0'	171°32.0'E	216	"
E850	33°49.0'	171°19.0'E	509–515	"
E852	33°38.0'	170°55.0'E	1024–1049	"
E855	33°10.0'	169°56.0'E	736–710	"
E859	32°01.0'	168°03.0'E	484–486	18.3.68
E860	32°21.0'	167°41.0'E	1246–1258	"
E864	32°36.0'	167°36.0'E	130	19.3.68
E865	32°41.0'	167°36.0'E	168	"
E868	33°51.0'	167°20.0'E	751–762	"
E869	33°58.0'	167°45.0'E	1705–1685	"
E870	34°05.0'	168°10.0'E	1488–1556	20.3.68
E873	34°37.0'	171°52.0'E	974–961	21.3.68
E876	34°39.0'	172°14.0'E	216–247	"
E879	35°19.0'	172°25.0'E	768–786	22.3.68
E880	35°20.0'	172°20.0'E	1029–1074	"
E883	36°00.0'	172°52.0'E	999–1046	23.3.68
E884	35°59.0'	173°10.0'E	701–689	"
E889	36°48.0'	173°40.0'E	727–729	"
E890	36°40.0'	173°34.0'E	1014	23–24.3.68
E894	37°20.0'	173°57.0'E	728–708	24.3.68
E899	38°00.0'	173°47.0'E	729–715	25.3.68
E902	37°34.0'	172°05.0'E	1064–1066	26.3.68
E908	38°38.0'	172°41.0'E	256–336	28.3.68
F10	38°43.0'	172°35.0'E	333	30.10.64
F75	35°30.0'	174°43.0'E	121	12.11.64
F81	49°32.0'	167°01.0'E	401	14.1.65
F90	49°30.5'	167°40.0'E	601	16.1.65
F100	49°02.0'	168°53.5'E	733–746	18.1.65
F110	48°07.0'	174°02.0'E	1167	21.1.65
F112	48°08.0'	175°56.0'E	1427–1481	22.1.65
F123	47°38.0'	178°57.0'W	1280	27.1.65
F128	49°09.0'	177°18.0'E	978	28.1.65
F135	50°58.0'	173°57.0'E	832	30.1.65
F136	51°20.0'	172°42.0'E	547	"
F143	53°05.5'	170°13.0'E	380	1.2.65
F144	53°29.0'	178°56.0'E	596	"
F146	53°00.0'	172°45.0'E	435	"
F147	52°21.0'	173°09.0'E	611	"
F319	19°51.0'	157°43.8'W	847–940	27.5.65
F750	44°15.0'	175°26.0'E	594	17.8.66
F753	44°45.0'	174°30.0'E	763–854	18.8.66
F762	41°00.0'	176°30.0'E	304–326	21.8.66
F764	41°05.0'	176°37.5'E	999–1030	"
F767	41°30.8'	176°07.0'E	1205–1293	"
F797	37°25.7'	177°11.0'E	348	7.9.66
F868	37°28.5'	179°03.5'E	808–924	2.10.68
F872	37°20.6'	178°11.2'E	878–832	3.10.68
F873	37°19.5'	178°11.0'E	1050–1053	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
F874	37°18.0'	178°11.0'E	1357	3.10.68
F877	37°31.0'	177°32.0'E	783–728	"
F878	37°28.5'	177°31.5'E	997–942	"
F896	36°40.5'	176°19.2'E	909–814	6.10.68
F898	36°13.0'	176°10.0'E	263–260	8.10.68
F900	36°13.0'	176°23.0'E	754–721	9.10.68
F909	35°06.4'	175°11.0'E	1002–1030	10.10.68
F911	34°38.0'	174°36.0'E	1295–1412	11.10.68
F913	34°43.5'	174°31.5'E	743	"
F915	34°58.7'	174°18.0'E	251–265	"
F916	34°38.5'	173°28.0'E	249–241	12.10.68
F923	34°07.5'	172°46.7'E	143–216	13.10.68
F924	34°07.5'	172°47.0'E	315–439	"
F928	34°06.2'	172°06.8'E	388–406	14.10.68
F933	34°24.0'	173°10.3'E	252–249	15.10.68
G1	32°35.0'	167°23.0'E	138	14.9.66
G3	26°25.0'	167°15.0'E	710	27.9.66
G32	43°44.0'	176°29.0'E	402	23.2.67
G33	43°40.0'	177°00.0'E	457	"
G38	43°37.0'	179°29.5'E	415	24.2.67
G172	43°39.0'	179°28.0'W	373	17.1.68
G177	43°47.0'	179°28.0'W	315	"
G184	44°06.0'	179°25.0'W	344	"
G197	43°46.0'	179°44.0'W	377	18.1.68
G198	43°48.0'	179°44.0'W	366	19.1.68
G200	43°54.0'	179°44.0'W	395	"
G208	43°30.0'	179°56.0'E	413	"
G223	43°44.0'	179°50.0'E	421	21.1.68
G230	43°33.0'	179°43.0'E	410	"
G233	43°32.0'	179°36.0'E	412	"
G240	43°40.0'	179°36.0'E	424	22.1.68
G244	43°36.0'	179°30.0'E	406	"
G245	43°35.0'	179°31.0'E	421	"
G254	43°35.0'	179°29.0'E	417	23.1.68
G255	43°39.0'	179°29.0'E	424	"
G258	43°34.0'	179°22.0'E	402	"
G259	43°33.0'	179°22.0'E	419	"
G262	43°30.0'	179°22.0'E	412	"
G273	43°30.0'	179°15.0'E	410	24.1.68
G276	43°35.0'	179°15.0'E	413	"
G278	43°40.0'	179°15.0'E	413	"
G279	43°39.0'	179°07.0'E	426	"
G291	43°42.0'	179°01.0'E	402	25.1.68
G292	43°42.0'	179°48.0'E	454	"
G293	43°40.0'	179°28.0'E	421	"
G303	43°04.0'	179°20.0'W	311	26.1.68
G329	44°06.0'	179°00.0'W	417	1.2.68
G344	43°44.0'	178°52.0'W	402	2.2.68
G371	43°33.0'	177°50.0'W	388	5.2.68
G398	43°25.0'	178°17.0'W	424	7.2.68
G651	44°00.0'	174°31.0'E	572	17.1.70
G665	44°43.0'	172°40.0'E	934	18.1.70
G666	44°52.2'	172°20.2'E	1015	18–19.1.70
G667	44°57.0'	172°05.0'E	872	19.1.70
G688	46°10.0'	171°00.2'E	731	20.1.70
G697	46°19.5'	170°42.0'E	528	21.1.70
G701	46°20.0'	171°30.0'E	1400	22.1.70
G703	46°20.0'	172°04.0'E	1480	23.1.70
G817	33°00.9'	162°56.6'E	815	14.2.71
G818	33°00.0'	162°48.5'E	791	"
G819	32°57.6'	162°35.3'E	782	"
G820	33°09.0'	162°36.0'E	793	15.2.71
G821	33°18.5'	162°35.5'E	791	"
G822	33°20.4'	162°49.2'E	815	"
G823	33°10.4'	162°59.2'E	798	"
G824	33°10.4'	162°59.2'E	807	"
G825	33°20.9'	162°59.5'E	829	15–16.2.71
G885	47°54.3'	179°53.1'E	210–240	13.12.70
G888	48°16.0'	177°50.4'E	1020	14.12.70
G893	49°37.0'	178°19.0'E	570	16.12.70
G937	49°41.3'	167°16.5'E	520	16.1.71
G938	49°33.9'	166°44.5'E	490	17.1.71
G941	39.59.7'	178°08.0'E	665–690	17.5.73
G947	40°13.8'	177°20.0'E	1491–1423	30.5.73
G955	42°40.5'	174°45.5'E	1195–1147	3.6.73
H636	43°26.4'	179°34.9'E	395	10.3.75
H914	43°29.4'	177°55.5'W	358	11.8.75
H923	43°29.0'	179°32.2'E	395	13.8.75
H939	43°40.9'	179°29.8'E	431	14.8.75
H942	43°43.8'	179°28.2'E	46	"
H945	43°19.4'	179°29.2'E	405	15.8.75
I14	35°35.9'	174°40.0'E	103	4.5.75
I15	35°24.6	174°28.0'E	68–71	"
I19	35°25.2'	175°00.4'E	270–276	5.5.75
I21	35°24.2'	175°25.8'E	690	"
I25	35°11.1'	175°06.1'E	675	6.5.75
I34	35°00.0'	175°13.0'E	578	7.5.75
I47	36°00.0'	174°39.9'E	48–46	9.5.75
I50	36.00.2'	175°13.2'E	92	10.5.75
I52	36°11.2'	75°13.5'E	63–66	"
I53	36°12.1'	174°55.0'E	56–54	11.5.75
I56	36°23.0'	175°13.1'E	50–46	"
I63	36°11.3'	176°23.0'E	585–400	12.5.75
I64	36°12.0'	176°11.8'E	335–247	"
I71	29°09.8'	168°02.1'E	57	20.7.75
I76	28°45.0'	167°45.1'E	259–190	"
I86	29°29.9'	167°50.5'E	280–350	23.7.75
I87	29°25.0'	167°50.0'E	89–170	"
I91	29°24.8'	168°10.0'E	342–360	"
I92	29°24.8'	168°13.2'E	570–578	"
I94	29°20.2'	168°10.8'E	308	"
I96	32°10.8'	167°21.2'E	356	25.7.75
I97	32°22.9'	167°28.2'E	540–544	"
I343	34°46.4'	173°23.7'E	< 30	17.11.77
I345	34°40.4'	173°31.0'E	182–227	"
I352	34°39.0'	174°04.2'E	840–815	19.11.77
I353	34°45.4'	174°04.1'E	530	"
I356	34°52.4'	174°05.7'E	269–275	"
I363	34°50.2'	174°00.2'E	227–224	20.11.77
I366	34°42.3'	174°17.6'E	705–684	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
I370	34°10.6'	172°46.5'E	94	23.11.77
I371	34°11.6'	72°49.5'E	118–120	"
I374	34°32.3'	173°30.3'E	232–240	"
I375	34.32.7'	173°30.9'E	-	"
I661	43°50.2'	179°05.8'W	375	11.3.79
I664	47°39.8'	179°27.8'W	595	12.3.79
I666	47°47.5'	178°59.5'W	1165	13.3.79
I667	47°45.6'	179°17.0'W	648	"
I669	47°49.0'	179°45.7'W	355	"
I671	48°00.0'	180°00.0'E	280	"
I674	48°00.4'	179°10.5'W	750	14.3.79
I676	48°09.8'	179°20.0'W	810	"
I684	48°20.0'	179°29.0'W	705	15–16.3.79
I685	48°19.5'	179°29.5'W	722	16.3.79
I686	48°30.5'	179°45.0'W	710	"
I689	48°51.5'	178°41.5'E	808	17.3.79
I694	49°30.0'	178°45.0'E	1004	18.3.79
I698	48°20.0'	178°30.0'E	726	19.3.79
I699	48°16.0'	179°00.0'E	532	"
I702	48°10.0'	178°44.5'E	545	20–21.3.79
I703	48°10.9'	178°15.9'E	875	21.3.79
I704	48°00.0'	178°29.0'E	475	"
I707	47°20.0'	179°30.0'E	552	22.3.79
I715	47°05.0'	178°15.0'E	623	23.3.79
I716	44°00.0'	176°13.9'E	500	25.3.79
I721	44°07.4'	175°46.2'E	540	26.3.79
I735	24°42.0'	159°34.8'E	360	11.5.79
I741	22°43.0'	159°16.0'E	328	12.5.79
I743	22°34.2'	159°09.4'E	291–298	"
I745	22°06.8'	159°06.3'E	1300–1560	"
J55	44°05.5'	176°12.0'E	198	17.5.70
J58	43°31.0'	179°09.5'E	512	20.5.70
J59	43°51.0'	179°25.0'E	309	"
J362	32°32.7'	166°26.5'E	1030	25.8.73
J485	50°38.0'	167°38.0'E	320–365	7.12.73
J657	37°28.2'	179°03.2'E	695–726	4.9.74
J658	36°00.6'	179°12.8'E	2515–2505	"
J659	35°00.6'	179°15.1'E	695–689	5.9.74
J660	35°02.0'	179°15.9'E	803–788	"
J667	36°37.5'	178°19.3'E	2431	5–6.9.74
J672	36°26.5'	175°46.0'E	25–32	7.9.74
J674	36°41.8'	175°55.2'E	3–33	"
J676	37°22.5'	177°11.7'E	341–333	8.9.74
J678	37°24.7'	177°12.0'E	352–350	"
J679	37°21.1'	177°11.8'E	316–328	"
J680	37°25.8'	177°11.8'E	328–352	"
J683	37°20.7'	177°06.8'E	388–400	"
J686	37°16.2'	176°51.2'E	194–219	"
J699	37°33.2'	176°59.2'E	174–248	10.9.74
J705	37°16.0'	176°51.0'E	190	11.9.74
J709	37°15.2'	176°50.0'E	328–406	"
J710	37°15.1'	176°50.1'E	195–208	"
J711	37°15.0'	176°50.0'E	366–472	"
J715	36°04.3'	178°00.8'E	683–693	12.9.74
J716	36°04.2'	178°00.6'E	785–990	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
J951	35°02.0'	172°52.7'E	52	18.6.81
J953	34°39.6'	172°13.1'E	270–260	"
J954	34°38.0'	172°13.5'E	204–192	"
J959	34°25.3'	173°08.8'E	140–210	19.6.81
J966	34°51.9'	173°51.7'E	120	20 6.81
J969	35°08.8'	174°21.1'E	70–106	21.6.81
J970	35°08.6'	174°21.1'E	86–91	"
J971	35°25.3'	174°58.9'E	246	22.6.81
J976	35°44.7'	175°29.6'E	155–225	"
K527	41°10.4'	173°10.0'E	-	24.7.72
K795	33°02.6'	179°34.6'W	350	18.7.74
K800	29°11.9'	177°50.8'W	670–778	22.7.74
K803	29°16.0'	177°50.3'W	190–140	"
K804	29°14.8'	177°49.6'W	590–490	"
K805	29°10.7'	177°47.4'W	1142–1156	22–23.7.74
K806	28°30.7'	177°49.3'W	1165–1185	23.7.74
K818	29°13.3'	177°56.4'W	95–116	24.7.74
K819	29°13.2'	177°56.3'W	100–140	"
K820	29°13.3'	177°59.8'W	95–122	"
K823	29°18.5'	177°56.2'W	202–131	25.7.74
K825	28°47.8'	177°47.8'W	145	"
K826	28°48.0'	177°48.0'W	142	"
K828	28°35.4'	177°50.7'W	440	26.7.74
K828A	28°35.4'	177°50.7'W	508–510	"
K829	29°13.0'	177°52.4'W	565–635	"
K830	29°11.5'	177°53.0'W	545–590	26–27.7.74
K838	30°15.8'	178°23.7'W	200	28.7.74
K839	30°15.4'	178°24.0'W	290	"
K840	30°17.6'	178°25.3'W	398–412	"
K842	30°10.2'	178°35.9'W	325–370	29.7.74
K843	30°10.5'	178°34.5'W	254–260	"
K844	30°11.2'	178°33.8'W	290	"
K846	30°13.1'	178°32.0'W	610–640	"
K851	30°33.3'	178°31.8'W	106–104	30.7.74
K857	30.33.8'	178°30.6'W	165–180	"
K858	30°34.2'	178°29.8'W	465–501	"
K859	30°34.9'	178°28.2'W	405–443	"
K860	30°35.8'	178°25.7'W	605–720	"
K867	31°21.4'	178°50.6'W	190–240	1.8.74
K868	31°21.5'	178°51.4'W	335	"
K870	31°21.2'	178°44.5'W	510–610	2.8.74
K872	31°20.4'	178°49.2'W	280–235	"
K873	37°34.0'	179°22.0'W	1270–1280	3.8.74
M763	44°36.2'	167°49.7'E	27	29.3.81
M773	44°37.1'	167°51.5'E	25	30.3.81
M774	44°40.0'	167°54.6'E	30	"
M775	44°38.9'	67°55.2'E	20	"
M776	44°39.5'	167°54.2'E	15	"
M779	44°36.0'	167°49.4'E	30	31.3.81
M782	44°40.0'	167°55.0'E	22	1.4.81
M793	44°36.0'	167°49.4'E	30	7.4.81
N369	34°24.6'	172°26.3'E	101	10.12.74
N897	32°20.7'	179°03.8'W	424–426	22.2.77
O841	45°20.8'	167°02.4'E	0–35	26.2.85
O849	45°16.0'	167°00.1'E	0–35	28.2.85

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
O852	45°15.6'	167°09.4'E	0–35	1.3.85
P1	32°35.4'	167°32.0'E	122	24.1.77
P2	32°35.7'	167°31.7'E	122	"
P5	32°36.4'	167°30.6'E	126	25.1.77
P8	32°40.8'	167°26.8'E	757–660	"
P10	32°40.0'	167°28.4'E	378–352	"
P13	32°10.5'	167°21.2'E	449–442	"
P14	31°47.2'	167°51.6'E	319–316	"
P16	29°36.3'	168°05.0'E	310	26.1.77
P17	9°35.5'	168°04.0'E	248–225	"
P27	28°54.6'	167°44.2'E	390–402	27.1.77
P34	28°57.8'	167°45.8'E	370	28.1.77
P35	28°57.9'	167°45.5'E	392–423	"
P48	28°42.8'	167°54.6'E	279–186	30.1.77
P57	33°15.0'	169°59.0'E	563–614	4.2.77
P64	34°52.5'	172°34.4'E	155–163	7.2.77
P68	38°39.0'	172°38.2'E	313–557	9.2.77
P85	31°38.4'	159°09.5'E	430–465	28.5.77
P115	31°25.9'	159°02.2'E	183–179	31.5.77
P120	35°45.7'	165°04.1'E	950	3.6.77
P842	32°34.4'	156°17.3'E	285–290	28.11.79
P846	31°00.1'	153°18.3'E	350–375	3.12.79
P925	27°59.6'	155°37.5'E	420	11.12.79
P939	41°20.4'	166°54.8'E	1760–1799	22.4.80
P942	41°00.6'	169°06.0'E	914	24.4.80
P944	27°20.8'	179°20.9'W	673–670	31.5.80
P945	26°42.9'	179°20.0'W	1276–1384	1.6.80
P946	25°59.1'	179°18.1'W	660	"
P947	25°13.7'	179°04.1'W	646–547	"
P966	23°29.8'	176°34.6'W	635–695	10.6.80
Q1	43°49.7'	179°00.0'W	470	12.3.78
Q2	43°36.8'	178°43.7'W	400	"
Q6	44°09.4'	179°35.6'W	468	14.3.78
Q7	44°06.2'	179°33.8'W	408	14–15.3.78
Q8	44°02.2'	179°20.3'W	305	15.3.78
Q11	43°44.1'	179°31.6'W	300	"
Q13	43°27.6'	179°46.9'W	415	"
Q16	43°59.4'	179°15.6'W	215	16.3.78
Q19B	44°02.0'	179°17.2'W	285	"
Q20	44°09.6'	179°14.2'W	320	17–18.3.78
Q24	44°29.7'	176°33.7'W	320–300	22.3.78
Q25	44°26.2'	176°38.4'W	360	"
Q31	44°15.8'	176°54.8'W	340–315	23.3.78
Q38	44°24.8'	176°43.6'W	345	23–24.3.78
Q39	44°26.0'	176°37.0'W	255	24.3.78
Q40	44°29.5'	176°32.5'W	345–380	"
Q46	33°07.4'	156°10.1'E	148	24.5.78
Q68	29°14.0'	159°00.0'E	1045–1212	1.6.78
Q70	26°59.7'	159°18.9'E	376–427	2.6.78
Q83	33°00.2'	163°01.2'E	816–841	7.6.78
Q84	32°59.4'	163°08.7'E	830	"
Q102	45°38.8'	166°53.3'E	0–40	8.11.78
Q105	44°38.1'	167°52.8'E	0–30	9.11.78
Q174	41°37.9'	175°12.8'E	44	17.12.78
Q338	44°00.7'	176°04.9'E	480	13.11.79
Q340	44°06.1'	176°11.7'E	435	13.11.79
Q341	44°07.1'	176°19.2'E	264	14.11.79
Q343	44°07.8'	175°47.8'E	500	"
Q738	44°37.3'	167°51.7'E	30	11.7.82
Q741	44°37.8'	167°51.7'E	30	13.7.82
Q743	44°57.6'	167°27.0'E	37	14.7.82
Q874	12°22.3'	178°32.5'W	1000	23.10.83
R437	39°35.1'	178°25.1'E	800	16.6.90
R438	39°26.0'	78°20.3'E	1010	"
R439	39°26.8'	178°20.0'E	1000	"
S6	42°35.9'	170°39.7'E	201	11.9.78
S8	42°38.0'	170°36.0'E	120	"
S22	50°39.0'	167°39.6'E	400	17.9.78
S25	50°41.8'	167°40.6'E	339	"
S27	50°41.3'	167°37.5'E	335	18.9.78
S28	50°41.1'	167°44.0'E	375	"
S29	50°40.7'	167°41.1'E	300	"
S30	50°41.0'	167°40.8'E	265	"
S42	53°15.6'	169°30.5'E	480	21.9.78
S43	53°29.1'	170°04.2'E	693	"
S46	53°59.8'	171°13.2'E	1075	"
S48	53°30.6'	172°24.0'E	625	22.9.78
S52	52°47.0'	172°54.0'E	494	23.9.78
S53	53°00.7'	172°59.9'E	450	"
S67	48°05.9'	179°55.2'E	380	26.9.78
S72	48°06.5'	178°46.8'E	420	27.9.78
S99	51°57.8'	174°48.0'E	1750–1800	27.11.78
S122	43°35.5'	175°57.3'E	322	20.10.79
S125	43°32.1'	175°58.5'E	365	"
S126	43°33.4'	175°58.6'E	322	"
S127	43°35.4'	175°57.3'E	322	"
S130	43°34.0'	175°57.7'E	335	21.10.79
S142	44°30.9'	174°52.5'E	715	24.10.79
S152	45°52.3'	174°04.9'E	1676	26.10.79
S154	45°24.2'	173°59.8'E	1373	27.10.79
S157	44°10.5'	173°29.9'E	160	28.10.79
S159	44°19.3'	173°35.5'E	525	"
S160	44°13.9'	173°39.5'E	550	"
S166	44°25.4'	174°07.4'E	720	29.10.79
S168	44°10.6'	174°23.3'E	594	"
S173	43°59.4'	174°02.0'E	486	30.10.79
S174	44°06.5'	173°54.1'E	518	"
S181	43°26.7'	173°30.0'E	392–260	31.10.79
S216	42°40.9'	173°39.2'E	200	4.11.79
S222	42°28.3'	173°40.2'E	600–180	5.11.79
S248	44°36.1'	167°49.2'E	30	19.2.80
S251	45°10.9'	167°07.4'E	20	20.2.80
S257	45°17.0'	167°00.6'E	37	21.2.80
S260	45°29.4'	167°05.1'E	33	22.2.80
S562	35°49.2'	172°54.0'E	600–505	5.8.83
S565	29°18.5'	169°46.7'E	1350–830	12.8.83
S571	30°47.3'	172°45.2'E	509–480	15.8.83
S572	30°45.5'	172°47.7'E	530–403	"
S573	30°29.7'	172°42.3'E	975–840	"
T7	44°06.5'	176°06.5'E	315	7.3.81

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
T8	44°19.4'	176°14.0'E	480–520	7.3.81
T32	48°23.6'	179°42.6'W	668	13.3.81
T38	49°04.6'	178°58.2'E	740	13–14.3.81
T48	49°18.6'	177°54.7'E	990	15.3.81
T88	44°02.0'	174°46.6'E	500	31.3.81
T109	39°45.8'	178°14.1'E	288–350	24.4.81
T182	18°57.9'	159°44.0'W	375–672	14.9.81
T214	30°40.9'	178°25.5'W	565	18.3.82
T217	30°44.0'	178°38.1'W	492	"
T225	29°13.1'	177°53.5'W	472	21.3.82
T226	28°33.0'	177°50.0'W	800–930	22.3.82
T233	29°13.0'	178°00.0'W	100	"
T235	30°19.3'	178°21.0'W	510–445	23.3.82
T241	30.05.0'	178°25.1'W	1087	23–24.3.82
T243	30.05'0'	178°15.0'W	1035	24.3.82
T244	30.05.2'	178°10.2'W	1450	"
T247	30°14.0'	178°27.0'W	15	"
T256	30°31.0'	178°39.0'W	710–725	27.3.82
T257	31°09.7'	178°40.0'W	890	28.3.82
T259	31°09.8'	178°30.0'W	1310–1254	"
U197	34°09.8'	163°36.7'E	1186	25.9.82
U198	34°59.3'	162°11.2'E	1573	26.9.82
U203	35°33.2'	159°05.8'E	4919–4912	29.9.82
U204	35°29.7'	157°28.0'E	4570–4675	30.9.82
U208	34°13.8'	151°29.1'E	498–466	5.10.82
U224	36°55.7'	159°31.5'E	4954–4961	15.10.82
U325	10°52.4'	165°58.6'W	1585–1446	21.4.86
U345	14°56.1'	172°15.3'W	1972–2166	26.4.86
U351	18°39.1'	172°12.2'W	996–976	29.4.86
U568	35°08.4'	169°28.4'E	867–865	3.2.88
U573	33°33.1'	170°06.4'E	1260	4.2.88
U574	33°19.6'	170°06.9'E	570–580	"
U582	31°52.0'	172°26.0'E	1058–988	5.2.88
U584	31°26.3'	172°35.6'E	1137–1150	6.2.88
U591	30°51.0'	172°48.0'E	486	7.2.88
U592	30°41.3'	172°54.0'E	1067–1058	"
U594	30°20.1'	172°59.6'E	406	"
U595	30°21.5'	173°08.7'E	1474–1365	"
U599	30°43.0'	173°16.0'E	640–590	8.2.88
U602	31°30.6'	172°50.9'E	1216–1385	9.2.88
V365	43°44.9'	179°00.4'W	399	8.9.89
V372	43°20.2'	178°58.8'E	415–409	13.9.89
V373	43°35.5'	178°59.5'E	385	"
V386	44°05.3'	177°00.1'E	665	16.9.89
V387	43°49.6'	176°59.8'E	498–497	"
V388	43°34.8'	176°59.9'E	331–328	"
X121	37°24.7'	177°11.7'E	340	23.11.89
X122	37°25.1'	177°11.1'E	365	24.11.89
X138	37°15.0'	176°50.4'E	355–265	27.11.89
X152	36°09.7'	176°48.4'E	940–820	28.11.89
X182	36°48.2'	177°28.3'E	1035–925	3.12.89
X221	37°20.2'	177°06.0'E	405–300	7.12.89
Z2098	28°39.5'	173°01.0'E	850	4.9.67
Z2997	26°57.0'	168°10.2'E	1329	"
Z3907	43°41.8'	179°55.1'E	387	"
Z3909	43°42.2'	179°58.0'E	388	"
Z3911	43°38.1'	178°09.2'E	376	"
Z3924	43°33.0'	179°39.0'E	402	"
Z3925	43°24.0'	179°22.5'E	394	"
Z3928	43°34.3'	179°37.6'E	399	"
Z3934	43°33.3'	179°39.4'E	400	"
Z3936	43°33.2'	179°40.1'E	389	"
Z3939	43°32.2'	179°40.0'E	391	"
Z3943	43°33.4'	179°40.1'E	388	"
Z3947	43°33.1'	179°39.9'E	389	"
Z3948	43°33.2'	179°39.9'E	390	"
Z3950	43°32.9'	179°43.6'E	393	"

MoNZ Stations (BS)

BS208	37°22.5'	176°22'E	207-219	27.2.57
BS300	41°30'	174°54'E	603	6.9.72
BS302	Antipodes Is		81	21.11.72
BS307	Raoul I., Kermadecs		110-146	4.4.73
BS309	Raoul I., Kermadecs		165-220	"
BS310	Raoul I., Kermadecs		155-165	"
BS313	NW end of Raoul I.		146-201	5.4.73
BS314	39°22'	171°50'E	236	
BS327	Bay of Islands		7	7.12.73
BS329	off Moturoa, Bay of Islands		31	8.12.273
BS335	Bay of Islands		37-40	10.12.73
BS342	Bay of Islands		46-55	14.12.73
BS346	off Motuwhekeke I., Bay of Islands		22-31	"
BS353	37°30'	179°22'E	1134-1207	7.2.74
BS362	36°01'	174°43'E	59	13.2.74
BS363	35°58.5'	174°44'E	62	"
BS369	35°32'	174°41'E	110-113	15.2.74
BS370	35°29'	174°44'E	110	15.2.74
BS372	35°22'	174°43'E	146	"
BS380	35°10.5'	174°10'E	37	16.2.74
BS391	34°01'	172°07'E	622	18.2.74
BS392	34°08'	172°11'E	102	"
BS394	34°11'	172°10'E	91	19.2.74
BS395	34°10'	172°12'E	252	"
BS396	34°13'	172°11.5'E	256	"
BS401	34°22'	173°03'E	121	"
BS402	34°26'	173°14'E	146	20.2.74
BS415	Bay in Stephenson's I., opposite Whangaroa Heads		22-24	23.2.74
BS434	4.1 km off Fleetwood Bluff, Raoul I.		135	25.10.75
BS437	5.6 km off Fleetwood Bluff, Raoul		154	"
BS438	3.9 km off Nugent I., Raoul I.		146-165	28.10.75
BS441	3.7 km off Nugent I., Raoul I.		366-402	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
BS442	5.0 km off Nugent I., Raoul I.		512-549	28.10.75
BS480	41°26'	174°47'E	99-106	29.2.76
BS559	43°14'	173°39'E	512-1006	27.9.76
BS560	42°35'	173°41'E	640	28.9.76
BS570	29°14'	177°50'W	135-146	10.9.76
BS571	29°19'	177°54'W	219-274	"
BS581	29°14'	177°53'W	530-567	13.9.76
BS630	42°36'	170°40'E	300	13.4.78
BS631(P441)	34°24.0'	172°16.8'E	120	20.6.78
BS632(P449)	34°20.0'	172°30.0'E	100	"
BS633(P461)	34°20'	171°48'E	440	21.6.78
BS634(P465)	34°17'	171°45'E	427	"
BS635(P475)	33°59.2'	172°13.6'E	155	23.6.78
BS636(P476)	34°01.8'	172°12.9'E	508	"
BS637(P485)	4°05.5'	172°24.6'E	200	24.6.78
BS638(P487)	34°14.2'	172°32.4'E	100	"
BS639(P515)	33°58.0'	172°30.6'E	550	25.6.78
BS641(P571)	34°02.0'	171°48.4'E	188	29.6.78
BS642(P574)	34°06.5'	172°04.7'E	310	"
BS649(R7)	42°29.2'	176°06.3'E	1262	11.1.79
BS654(R12)	43°02.6'	175°24.2'E	253	12.1.79
BS665(R23)	42°16.3'	174°20.8'E	860	14.1.79
BS668(R26)	41°52.1'	174°43.2'E	454	"
BS672(R30)	41°31.4'	174°52.6'E	533	15.1.79
BS682(R40)	37°35.0'	178°43.0'E	129	17.1.79
BS697(R55)	37°25.2'	177°11.8'E	318	19.1.79
BS707(R65)	37°24.0'	177°06.5'E	740	"
BS709(R67)	37°21.5'	177°06.0'E	283	"
BS715(R73)	37°17.0'	176°51.0'E	251	20.1.79
BS718(R76)	37°29.1'	176°54.7'E	248	"
BS723(R81)	37°35.9'	176°59.5'E	179	"
BS724(R82)	37°37.5'	176°59.9'E	129	20.1.79
BS732(R90)	37°46.5'	176°38.5'E	39	21.1.79
BS733(R91)	37°43.4'	176°38.5'E	59	"
BS734(R92)	37°39.4'	176°34.4'E	82	"
BS742(R100)	37°22.0'	176°28.5'E	448	22.1.79
BS744(R102)	37°18.9'	176°16.2'E	59	"
BS747(R105)	37°16.7'	176°17.5'E	104	"
BS748(R106)	37°15.2'	176°14.5'E	188	"
BS753(R111)	37°07.8'	176°18.7'E	463	23.1.79
BS756(R114)	37°00.8'	176°12.3'E	178	"
BS757(R115)	37°00.2'	176°14.8'E	304	"
BS761(R119)	37.22.0'	176°40.0'E	616	24.1.79
BS762(R120)	37°29.0'	176°32.0'E	818	"
BS763(R121)	37°30.8'	176°32.3'E	755	"
BS768(R126)	37°33.1'	178°49.5'E	94	25.1.79
BS770(R128)	37°33.4'	178°48.3'E	106	"
BS771(R129)	39°15.4'	178°19.3'E	413	26.1.79
BS806(O550)	35°54'	172°12'E	543-597	11.1.81
BS807(O551)	35°10.4'	172°35.4'E	110-146	"
BS812(O556)	35°37.6'	172°36.5'E	657	"
BS819(O564)	37°06.6'	173°54.1'E	952	12.1.81
BS830(O575)	39°52.8'	177°36.5'	785-882	21.1.81
BS831(O576)	38°39'	178°41'E	725-755	"
BS833(O578)	37°38'	178°56'E	143-153	22.1.81
BS842(O588)	37°17.4'	176°53.6'E	292-337	23.1.81
BS843(O589)	37°15'	176°51'E	163-407	"
BS844(O590)	37°11'	176°39'E	685-705	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
BS846(O592)				
	37°04'	176°27'E	807-872	23.1.81
BS849(O595)				
	37°00'	176°13'E	202-207	24.1.81
BS856(O602)				
	35°35'	175°46'E	327-329	"
BS866(O612)				
	34°43'	173°32'E	163-168	27.1.81
BS878(O624)				
	34°25.7'	173°12.8'E	207-221	"
BS881(O627)				
	34°20'	173°06'E	163-168	"
BS882(O628)				
	32°32'	167°30'E	113-118	29.1.81
BS883(O629)				
	32°32'	167°31'E	113	"
BS884(O630)				
	32°33'	167°29'E	133	"
BS888(O634)				
	32°39'	167°40'E	357-487	"
BS889(O635)				
	32°41'	167°38'E	206-296	30.1.81
BS891(O637)				
	32°39'	167°32'E	133	"
BS893(O639)				
	33°59.9'	171°45.3'E	186-196	31.1.81
BS895(O641)				
	34°02'	171°44'E	246-291	"
BS896(O642)				
	34°01'	171°45'E	201-216	"
BS897(O643)				
	34°02'	171°46'E	206-221	"
BS898(O644)				
	34°01'	171°44'E	206-211	"
BS899(O645)				
	34°00'	171°47'E	143-163	"
BS902(O648)				
	34°10.5'	172°11.4'E	153	1.2.81
BS904(O650)				
	33°57.0'	172°19.0'E	128	"
BS905(O651)				
	33°57.4'	172°19.4'E	123-128	"
BS906(O652)				
	34°15'	172°14'E	173-178	2.2.81
BS907(O653)				
	43°17'	172°16'E	123-133	"
BS909(O655)				
	34°16'	172°15'E	138-143	"
BS910(O656)				
	34°19'	172°18'E	88-93	"
BS911(O657)				
	34°20.2'	172°21.8'E	121	"
BS912(O658)				
	34°22.8'	172°24.6'E	121	"
BS913(O659)				
	34°25.0'	172°27.8'E	78	2.2.81

Miscellaneous Vessels

(AIM, AMS, AUM, BM, MoNZ, Portobello, USNM)

Albatross :				
3708	35°02'N	138°46'E	110-128	8.5.1900
4894	32°33'N	128°32'E	174	9.8.1906
Alexander Nesmeyanov:				
N17-6	32°15'	179°10'E	900-950	Dec 1989
N17-15	32°15'	179°10'E	760-830	Dec 1989
Alpha Helix:				
79-M14	11°33.5'	135°52.5'E	22	-
79-M15	11°31.5'	135°48.8'E	24	-
Azuchi Maru:				
96	44°17.8'	177°30.6'W	512	-
Belinda:				
	44°10.6'	147°10.1'E	1051-1100	-
Challenger:				
170	29°55'	178°14'W	?1152	14.7.1874
Chatham:				
4	43°14'	176°11'W	366	23.1.54
34	44°04'	175°23.5'W	238	1954
Cordilla:				
	42°50'	177°41'W	763-775	13.8.89
Eltanin:				
370	53°54'	64°36'W	104-115	12.12.62
1403	41°42'	175°29'E	946-951	31.1.65
1712	38°24'	178°53'W	1354-1995	28.5.66
1718	38°27'	168°07'W	531-659	13.7.66
1850	49°40'	178°53'E	103	2.1.67
1983	47°11'	147°47'E	1028-1034	24.2.67
Franklin:				
6/88/4	10°34'	144°13'E	815-825	20.8.88
6/88/5	10°37.2'	144°22.0'E	990-1053	21.8.88
5/89/4	36°43.1'	156°13.3'E	143	1.5.89
5/89/5	33°14'	156°10'E	132	"
5/89/10	30°48'	156°13'E	288	2.5.89
5/89/25	28°05.8'	163°06'E	1051	5.5.89
5/89/32	27°12.0'	160°37.8'E	1960	7.5.89
5/89/40	26°45.3'	159°31.0'E	315-360	8 .6.89
5/89/41	27°08.4'	158°15.2'E	2860	"
5/89/47	28°17.5'	158°37.9'E	419	10.5.89
Ikatere:				
B26	35°04'	174°23'E	185	-
J1/56/71	35°05'	172°27'E	274	-
J15/9/76	39°40'	169°45'E	712-740	-
J9/15/77	44°13.1'	173°51'E	610	-
JC10/57/71	47°09'	169°28.4'E	429-456	-

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
JC11/2/71				
	43°56'	174°35.8'E	585	-
JC19/9/84				
	40°06'	167°57.9'E	919-922	13.11.84
JC19/19/84				
	39°42.4'	168°07'E	748-780	15 .11.84
K1/24/81				
	40°46.1'	176°59.0'E	1010-1035	25.11.84
K1/25/81				
	40°13.3'	177°11.8'	555-585	25.11.81
KTN17/82				
	42°46.2	176°32.5'W	1100	-
KTN26/82				
	42°50'	176°08'W	1050	-
Private Collection:				
L892	N. of Curtis I., Kermadecs		30	13.10.85
L999	W. of Esperance Rock		22	1.9.88
L1050	W. of N. Meyer I., Raoul I.		12	1 .1.91
L1051	SW of Napier I., Raoul I.		36	1.6.91
L1056	34°11'	172°03.3'E	20	18.1.85
L1057	34°10.5'	172°02'E	37	1.2.85
L1413	N. of Macauley I., Kermadecs		20	1.6.92
L1630	W. side Meyer I., Raoul I.		7	1.1.91
L2633	34°08.2'	172°10.4'E	15	19 .1.85
L2641	34°11'	172°03.3'E	15-18	18.1.85
L2680	37°33.5'	178°18'E	10	25.1.85
L2712	36°37'	175°48'E	20	25.10.84
L2715	36°08'	175°30'E	53	2.1.81
L2925	35°54'	175°07'E	23	28 .10.84
L2926	36°15.5'	175°19.6'E	16	23.10.84
L2929	35°54'	175°07'E'E	30	3 .1.84
L3069	35°28.4'	174°43.5'E	5-7	27.8.84
L3071	35°28.4'	174°43.5'E	5-22	"
L4620	Duncombe Bay, Norfolk I.		10-12	1.11.89
L4621	Duncombe Bay, Norfolk I.		20	"
L4622	W. of Nepean, Norfolk I.		15	22.3.92
L4623	Organ Rock, Norfolk I.		15	1.11.89
L4721	W. of Cheeseman I., Kermadecs		26	1.9.88
L4722	W. of Esperance Rock Kermadecs		22	1.9.88
Lachlan :				
	37°39'	178°34'E	183	-
Matai :				
	36°47.4'	173°53.4'E	732	-
Munida:				
MU67/81	Sander's Canyon, Otago		512-533	-
MU73/124	Papanui Canyon, Otago		420	-
MU76/139				
	45°46'	171°03'E	660	-
Paterson :				
	36°18'	164°51'E	1000	July 1993
Poong San-1:				
	40°02'	168°58.4'E	795-887	-
San Manukau-1:				
	44°46'	176°15'W	1272-1322	20 .12.89
Slope:				
33	38°19.6'	149°24.3'E	930	-
Soela:				
1/82/59				
	33°09'	156°13'E	138-142	28.1.82
Terra Nova:				
91	off Great King, Three Kings Is.		549	26.7.1911
96	11 km east of North Cape		128	3.8.1911
TM (KT9292)YT1				
	30°14.8'N	130°46.1'E	80-88	16.2.92
Trinity II				
	37°05'	176°17'E	470-700	-
Tui:				
Rumble II				
	35°25'	178°48'E	1050	-
Rumble IV				
	36°06'	178°01'E	640	-
AU2/53				
	34°00'	171°55'E	805	-
AUZ40	29°24'	168°10'E	326	-
Volcanolog:				
64	35°26.3'	175°43'E	445	-
B30/20/1				
	Barrier Bank, N of Great Barrier Is		300-500	-
B30/28				
	Knight's Terrace, off Poor Knights Is		300-500	-

LIST OF SPECIES

Order SCLERACTINIA
Suborder FUNGIINA
Superfamily FUNGIOIDEA
Family FUNGIACYATHIDAE

Fungiacyathus (Fungiacyathus) stephanus (Alcock)
Fungiacyathus (Fungiacyathus) fragilis G.O. Sars
Fungiacyathus (Fungiacyathus) pusillus pacificus n.ssp.
Fungiacyathus (Bathyactis) marenzelleri (Vaughan)
Fungiacyathus (Bathyactis) margaretae n.sp.
Fungiacyathus (Bathyactis) turbinolioides Cairns

Family MICRABACIIDAE

Letepsammia superstes (Ortmann)
Letepsammia fissilis n.sp.
Letepsammia formosissima (Moseley)
Stephanophyllia complicata Moseley

Suborder FAVIINA
Superfamily FAVIOIDEA
Family RHIZANGIIDAE

Culicia rubeola (Quoy & Gaimard)

Family OCULINIDAE

Oculina virgosa Squires
Madrepora oculata Linnaeus

Family ANTHEMIPHYLLIIDAE

Anthemiphyllia dentata (Alcock)

Suborder CARYOPHYLLIINA
Superfamily CARYOPHYLLIOIDEA
Family CARYOPHYLLIIDAE

Caryophyllia (Caryophyllia) rugosa Moseley
Caryophyllia (Caryophyllia) hawaiiensis Vaughan
Caryophyllia (Caryophyllia) quadragenaria Alcock
Caryophyllia (Caryophyllia) profunda Moseley
Caryophyllia (Caryophyllia) atlantica (Duncan)
Caryophyllia (Caryophyllia) ralphae n.sp.
Caryophyllia (Caryophyllia) diomedeae Marenzeller
Caryophyllia (Caryophyllia) japonica Marenzeller
Caryophyllia (Caryophyllia) lamellifera Moseley
Caryophyllia (Caryophyllia) elongata Cairns
Caryophyllia (Caryophyllia) scobinosa Alcock
Caryophyllia (Caryophyllia) ambrosia Alcock
Caryophyllia (Premocyathus) compressa Yabe & Eguchi
Coenocyathus brooki n.sp.
Crispatotrochus curvatus n.sp.
Crispatotrochus rugosus n.sp.
Labyrinthocyathus limatulus (Squires)
Labyrinthocyathus sp.
Polycyathus norfolkensis n.sp.
Trochocyathus (Trochocyathus) rhombocolumna Alcock
Trochocyathus (Trochocyathus) maculatus n.sp.
Trochocyathus (Trochocyathus) gordoni n.sp.
Trochocyathus (Trochocyathus) cepulla n.sp.
Trochocyathus (Aplocyathus) hastatus Bourne
Tethocyathus cylindraceus (Pourtalès)
Tethocyathus virgatus (Alcock)
Stephanocyathus (Stephanocyathus) platypus (Moseley)
Stephanocyathus (Acinocyathus) spiniger (Marenzeller)
Stephanocyathus (Odontocyathus) weberianus (Alcock)
Stephanocyathus (Odontocyathus) coronatus (Pourtalès)
Vaughanella oreophila Keller
Vaughanella multipalifera n.sp.
Bourneotrochus stellulatus (Cairns)
Deltocyathus ornatus Gardiner
Deltocyathus formosus n.sp.
Conotrochus brunneus (Moseley)
Aulocyathus recidivus (Dennant)
Dasmosmilia lymani (Pourtalès)
Desmophyllum dianthus (Esper)
Thalamophyllia tenuescens (Gardiner)
Hoplangia durotrix Gosse
Goniocorella dumosa (Alcock)
Anomocora cf. *fecunda* (Pourtalès)
Solenosmilia variabilis Duncan

Family TURBINOLIIDAE

Conocyathus zelandiae Duncan
Alatotrochus rubescens (Moseley)
Sphenotrochus (Sphenotrochus) ralphae Squires
Sphenotrochus (Sphenotrochus) squiresi n.sp.
Kionotrochus suteri Dennant

Cryptotrochus venustus (Alcock)
Peponocyathus dawsoni n.sp.
Tropidocyathus pileus (Alcock)
Notocyathus conicus (Alcock)
Thrypticotrochus multilobatus Cairns

Superfamily FLABELLOIDEA
Family GUYNIIDAE

Pedicellocyathus keyesi n.gen., n.sp.
Truncatoguynia irregularis Cairns
Stenocyathus vermiformis (Pourtalès)
Temnotrochus kermadecensis n.gen., n.sp.

Family FLABELLIDAE

Flabellum (Flabellum) knoxi Ralph & Squires
Flabellum (Flabellum) angiostomum Folkeson
Flabellum (Flabellum) impensum Squires
Flabellum (Ulocyathus) lowekeyesi Squires & Ralph
Flabellum (Ulocyathus) messum Alcock
Flabellum (Ulocyathus) aotearoa Squires
Flabellum (Ulocyathus) hoffmeisteri Cairns & Parker
Flabellum (Ulocyathus) apertum apertum Moseley
Monomyces rubrum (Quoy & Gaimard)
Polymyces wellsi Cairns
Rhizotrochus flabelliformis Cairns
Gardineria hawaiiensis Vaughan
Gardineria sp.
Javania lamprotichum (Moseley)
Javania pachytheca n.sp.
Truncatoflabellum paripavoninum (Alcock)
Truncatoflabellum dens (Alcock)
Truncatoflabellum phoenix n.sp.
Truncatoflabellum arcuatum n.sp.
Placotrochides scaphula Alcock
Falcatoflabellum raoulensis n.gen., n.sp.

Suborder DENDROPHYLLIINA
Family DENDROPHYLLIIDAE

Balanophyllia chnous Squires
Balanophyllia gigas Moseley
Balanophyllia crassitheca n.sp.
Endopachys grayi Milne Edwards & Haime
Eguchipsammia gaditana (Duncan)
Eguchipsammia fistula (Alcock)
Eguchipsammia japonica (Rehberg)
Cladopsammia eguchii Wells
Dendrophyllia arbuscula Van der Horst
Dendrophyllia alcocki (Wells)
Enallopsammia rostrata (Pourtalès)
Enallopsammia cf. *marenzelleri* Zibrowius

ZOOGEOGRAPHY

Vaughan and Wells (1943: 88) made the brief statement that 10 (56%) of the 18 species of New Zealand Scleractinia then known were endemic, the other eight being related to a South Pacific fauna. Based on the slightly larger number of 21 species, Ralph and Squires (1962) suggested that the New Zealand coral fauna originated from pre-Pliocene relicts and a more recent invasion from the Indo-Pacific, and minimised the endemic nature of the fauna. Finally, based on 25 species, Squires and Keyes (1967) stated that 12 species (48%) were endemic, seven were autochthonous (traceable to forms from the New Zealand Neogene), and the remainder shared a relationship with South Pacific and Antarctic faunas, including two species with affinities to the Australian region. They also discussed five general patterns of distribution based on 17 of these 25 species. Their first general pattern (New Zealand endemic) corresponds to pattern 2D discussed below; their second pattern (warm-temperate shelf) corresponds to pattern 2A discussed below; their third pattern includes a miscellaneous group of three species; the fourth pattern groups four eurythermic tropical species (patterns 1B, C, D discussed below), and their fifth pattern also corresponds to two eurythermic tropical species (pattern 1D) and one widespread temperate species (pattern 3A).

The following analysis is based on 104 species, one species *(Conocyathus zelandiae)* remaining unclassified. It includes a much larger area than previous studies of the New Zealand region, defined as having latitudinal boundaries of 24° S and 57°30′ S and longitudinal borders of 157° E to 167° W (the New Zealand region as defined and mapped by Carter (1980)).

Patterns of Distribution

Four general patterns of distribution (Tables 2 and 3) emerge from a study of the distribution patterns of the 104 azooxanthellate species in the New Zealand region, these patterns being in general

Table 3. Patterns of scleractinian distribution within the New Zealand region.

I. Cosmopolitan, Indo-West Pacific, or widespread in Pacific, with a southern range in New Zealand region extending to:	
A. Subtropics (no farther south than 33°S), including Wanganella Bank, Norfolk Ridge; Lord Howe Islands; northern Three Kings Ridge; Colville Ridge; Kermadec Islands	29 species
B. Warm-temperate Auckland Province (eurythermic tropical)	12 species
C. Cold-temperate region (southern North Island, South Island, Chatham Rise, Campbell and Bounty Plateaus, northern Macquarie Ridge), broad eurythermic tropical	8 species
D. Subantarctic (Macquarie Ridge south of 50°S, Hjort Seamount)	10 species
II. "Endemic", or thus far known only from:	
A. Warm-temperate Auckland Province	7 species
B. Auckland Province and subtropical ridges and islands to north of New Zealand	6 species
C. Subtropical ridges and islands north of 33°S (Lord Howe Island, Norfolk Ridge, Three Kings Ridge, Colville Ridge, and Kermadec Islands)	14 species
D. Temperate (warm and cold) New Zealand	4 species
E. Cold-temperate region	2 species
III. Widespread temperate species	
A. Restricted to southern temperate latitudes	5 species
B. Disjunct distribution off Japan or northeast Atlantic and New Zealand	6 species
IV. Antarctic	1 species

agreement with the horizontal distribution of shelf fauna proposed by Briggs (1974).

The commonest pattern of azooxanthellate coral distribution in the New Zealand region is that of species that are widespread in the tropical Indo-West Pacific (or even cosmopolitan) that have their southern limit in the Southwest Pacific in the New Zealand region. Also included in this group are four species (*Tethocyathus cylindraceus, Stephanocyathus coronatus, Dasmosmilia lymani, and Hoplangia duro-trix*) that are thus far known to occur only in the Atlantic Ocean and New Zealand region. This group (pattern 1 of Tables 2–3) consists of 59 species (57% of regional fauna) and can be further subdivided based on the degree of southward extension into the New Zealand region. For instance, 29 of these 59 species are found no farther south than 33°S (pattern 1A). Zooxanthellate corals are known from Lord Howe Island (Veron & Done 1979; Veron 1993: 65 species), Norfolk Island (Veron 1986; Veron, pers. comm., 1993: 5 species), and the Kermadec Islands (Vaughan 1917: 8 species), the latter assumed by some (e.g., Schiel, Kingsford & Choat 1986) to be subtropical. However, there are no islands or shallow banks in the New Zealand region between Esperance Rock (the southern limit of zooxanthellate corals, about 31°20'S) and Three Kings Islands (about 34°), where no zooxanthellate corals are known to occur. But, because 13 of the 29 species having pattern 1A have their southernmost occurrences at 33°S, often at Wanganella Bank on the southern Norfolk Ridge, this latitude was chosen as the boundary between the subtropics and warm-temperate upper slope (200-1000 m) region of New Zealand. It is interesting to note that the northern limit of reef corals in the northwest Atlantic is 34–35°N (MacIntyre 1970) and the northern limit of reef corals in the northwest Pacific is 34°30'N (Veron 1992). Latitude 33°S is also considered to be the northern limit of the warm-temperate upper-slope Auckland Province.

A second distributional pattern (pattern 1B) consists of 12 species that are widespread in the tropics but also extend into the warm-temperate region of New Zealand — the Auckland Province. Briggs (1974) defined this region to include the northern half of North Island from East Cape and 38–39° S on the west coast. He referred to species having this kind of distribution as eurythermic tropical.

A third distributional pattern (pattern 1C) consists of eight species termed "broad eurythermic tropical" by Briggs (1974), including species that are widespread in the tropics but also extend into cold-temperate regions. In New Zealand, the cold-temperate region is defined by Briggs (1974) to include the North Island south of the warm-temperate boundary, South Island, Chatham Rise, Bounty and Campbell Plateaus, and northern Macquarie Ridge north of 50°S. Three of these eight species are cosmopolitan in distribution.

A final, fourth category of widespread species (pattern 1D) is a derivative of the third, consisting of ten species that extend even farther south into Subantarctic waters of the Macquarie Ridge (south of 50°S) and Hjort Seamount. Seven of these ten species have cosmopolitan or near-cosmopolitan distributions. Squires and Keyes' (1967: fig. 4) fourth general pattern of distribution corresponds to patterns 1C–D discussed above.

A second group of distributional patterns comprises those species that are "endemic" or at least so far known only from a restricted geographic range. Seven species (pattern 2A) occur only in the warm-temperate Auckland Province. Because the bathymetric ranges of these species are fairly shallow (i.e., mostly 50–300 m), most of these species may in fact be endemic to this province. This pattern corresponds to Squires and Keyes' (1967: fig. 2) second general pattern of distribution.

A second pattern of "endemics" (pattern 2B) consists of six species that are known only from the warm-temperate region of New Zealand and the subtropical ridges and islands to the north, of which two species also occur as far north as the Chesterfield Islands. The depth ranges of these species are considerably deeper than those of pattern 2A, i.e., none shallower than 130 m, and most ranging from 500–1000 m. For this reason it is likely that these species may eventually be found to be eurythermic tropical species with broader distributions in the upper-slope tropical region (i.e., pattern 1A).

A third category of "endemics" (pattern 2C) consists of 14 species known only from the subtropical ridges (Norfolk, Colville, Kermadec, and Three Kings north of 33°S) and islands (Lord Howe, Norfolk, and Kermadecs) north of New Zealand, of which two species also extend to the Chesterfield Islands. Like pattern 2B, the bathymetric ranges of these species are relatively deep (primarily 300–800 m) and it is likely that at least some of these species will be found to occur more widely in tropical regions (i.e., pattern 1A).

A fourth category of "endemics" (pattern 2D) consists of four species known only from off both warm- and cold-temperate New Zealand. Whereas the two shallow-water species, *Culicia rubeola* and

Monomyces rubrum, are probably endemic to New Zealand, the two other species, *Crispatotrochus curvatus* (1375–2505 m) and *Peponocyathus dawsoni* (87–988 m) are predicted to be found either to the north of New Zealand or in other temperate areas. *Monomyces rubrum* characterised Squires and Keyes' (1967: fig. 1) first general pattern of distribution, that species apparently being the only species in their group.

Two species are known only from the cold-temperate region of New Zealand (pattern 2E): *Flabellum knoxi* and *Labyrinthocyathus* sp. A. *Flabellum knoxi* is widespread and common in this region and serves as a reliable indicator of the cold-temperate upper slope New Zealand region.

A third group of distributional patterns includes widespread temperate patterns. Pattern 3A consists of five upper-slope species that occur in the temperate region of the southern Indian Ocean and/or Australia as well as in the temperate region of New Zealand. Two species (*Flabellum hoffmeisteri* and *Stephanocyathus platypus*) are known only off Australia and New Zealand, and constitute the only (1.9%) unique affinity between the species of these two regions.

Pattern 3B consists of five species known from off temperate Japan as well as temperate to subtropical New Zealand, and one species (*Hoplangia durotrix*) is known only from the temperate northeastern Atlantic and warm-temperate New Zealand. These unusual disjunct distributions may eventually be found to be artefacts of collecting or, possibly the result of species introductions (e.g., *H. durotrix*). If found to be more widely distributed, these patterns might change to 1A, B, C or even 1D.

Category 4 consists of only one species, *Flabellum impensum*, that is Antarctic in distribution with an apparent northern range in the deep water of the cold-temperate Bounty Plateau.

To summarise, a majority (57%) of the 104 azooxanthellate coral species that occur in the New Zealand region represent the southern limit of more widespread tropical or eurythermic tropical species. Some endemic species do seem to occur in the warm-temperate Auckland province (pattern 2A), off New Zealand (pattern 2D), and in the cold-temperate region (pattern 2E), but those known only from the subtropical islands and ridges north of New Zealand (pattern 2C) may well have extended distributions into the tropics. Eleven species (11%) are known from more widespread temperate regions (patterns 3A–B) and one species is Antarctic in affinity (pattern 4).

Briggs (1974: 373) suggested that the horizontal distribution of upper slope (200–1000 m) faunas "closely follows that of the shelf". Azooxanthellate Scleractinia (and Stylasteridae) are good tests for this theory in that most (i.e., 80%) New Zealand azooxanthellate Scleractinia occur in the upper-slope realm (see below). In general, the distribution of deep-water azooxanthellate Scleractinia (Cairns, 1979, 1982, 1994) have been found to be consistent with the generally accepted shallow-water regions and provinces, the New Zealand region being no exception. Consistent with Briggs' (1974) shelf regions and provinces, the corals of New Zealand show tropical, eurythermic tropical, and broad eurythermic tropical components, warm-temperate endemics, and cold-temperate endemics. I diverge from Briggs only in the interpretation of the Kermadec Islands (*see* below).

Regional Affinities

Although 22 azooxanthellate species are known from the Lord Howe Seamount Chain (Table 2), only six are known from off Lord Howe Island or Balls Pyramid. Half of these six species are tropical or eurythermic tropical species (patterns 1A–C), two are known only from the subtropical ridges and islands north of New Zealand (pattern 2C), and one species, *Balanophyllia crassitheca*, is known from the subtropical New Zealand region as well as the warm-temperate Auckland Province (pattern 2B).

Seventeen of the 36 (Table 2) azooxanthellate species that occur on the Norfolk Ridge also occur off Norfolk Island. Their affinities are primarily tropical (pattern 1A, 9 species) to eurythermic tropical (patterns 1B–D, 5 species). Also, two species are thus far known only from the New Zealand subtropics (pattern 2C) and two species are known from the subtropics and warm-temperate Auckland Province (pattern 2B).

Of the ten species that occur on the Colville Ridge, seven are widespread tropical (pattern 1A) or eurythermic tropical (patterns 1C–D), two are known only from the subtropical ridges north of New Zealand (pattern 2C), and one species, *Flabellum hoffmeisteri*, occurs off cold-temperate south-eastern Australia and Tasmania (pattern 3A).

The zoogeographic affinities of the Kermadec Islands/Ridge have been debated with mixed opinion, perhaps depending on the animal group being analysed and the depth range being considered. Briggs (1974) considered the Kermadecs as a separate province in the warm-temperate region; from fish distributions Shiel *et al.*, (1986) considered the chain

to be subtropical; and Gordon (1985), based on Bryozoa, suggested that they were transitional between the northern tropical and temperate neozelanic elements. The 56 species of azooxanthellate Scleractinia (Table 2) known from the Kermadec Ridge show a decided correlation with the tropical region — 19 species are widespread tropical species with their southern range in the Kermadecs (pattern 1A), another 18 species are eurythermic tropical (patterns 1B–D), and nine are known only from the subtropical region (north of 33°S) to the north of New Zealand (pattern 2C), of which three of the latter are known only from the Kermadec Islands. Thus, a total of 46 (82%) of the 56 Kermadec species have tropical or subtropical affinities. Four species (7%) occur in the warm-temperate Auckland Province as well as the subtropical ridges north of New Zealand (pattern 2B), giving support to Briggs' hypothesis of a warm-temperate affinity, and six species are widespread in cold-temperate regions having their northern extension or disjunct distribution in the Kermadec Islands (patterns 3A–B).

Of the 13 species that are known from the Chatham Rise (Table 2), eight are broad eurythermic tropical species (patterns 1C–D), one is endemic to the cold-temperate region of New Zealand, and four are more widely distributed primarily in the southern temperate regions (patterns 3A–B).

In summary, the ridges and islands north of New Zealand (Lord Howe and Norfolk Islands and ridges north of 33°S, Colville Ridge, Kermadec Islands and Ridge) show a strong tropical affinity (patterns 1A–D, 2C) and a very weak affinity to the warm-temperate Auckland province, the latter evidenced by a low number of species sharing pattern 2B.

Bathymetric Distribution

Forty-one (39%) of the 104 New Zealand species occur at shelf depths (0–200 m) within the New Zealand region (Table 2), 14 of which are accessible by scuba (0–50 m), viz. *Culicia rubeola*, *Oculina virgosa*, *Coenocyathus brooki*, *Labyrinthocyathus limatulus*, *Polycyathus norfolkensis*, *Tethocyathus cylindraceus*, *Hoplangia durotrix*, *Sphenotrochus ralphae*, *Kionotrochus suteri*, *Monomyces rubrum*, *Cladopsammia eguchii*, *Caryophyllia profunda*, *Desmophyllum dianthus*, and *Stenocyathus vermiformis*. The last three species, however, as well as *Madrepora oculata*, *Aulocyathus recidivus*, and *Dendrophyllia alcocki* (Table 2), are found more commonly at upper-slope depths (200– 1000 m), occurring in shallow water only in the cool upwelled waters of Fiordland. Most (82 species or 80%) of the New Zealand species occur in the upper slope (200–1000 m) and 30 species (39%) occur in the lower-slope region (1000–3000 m). Only one species, *Fungiacyathus marenzelleri*, is known from the abyssal region, as deep as 4954 m west of the Lord Howe Rise. The percentages above exceed 100 because many species occur in more than one bathymetric region. *Conocyathus zelandiae* was not included in the bathymetric analysis, but would probably occur in the 0–100 m zone.

The 104 species (all but *Conocyathus zelandiae*) were scored for their occurrences in eight bathymetric zones: 0–100 m, 100–200 m, 200–400 m, 400–600 m, 600–800 m, 800–1000 m, 1000–2000 m, and 2000–5000 m. These zones were then clustered by UPGMA using NTSYS-PC, version 1.60 (1991). The most obvious result of this cluster analysis was the faunistic break between the species occurring from 0–400 m and those occurring deeper than 400 m, the similarity coefficient between these two clusters being only 0.265. Within the three shallower-water zones, those species occurring at 100–200 m have a strong affinity with those occurring at 200-400 m, whereas the species that occur at 0–100 m are somewhat independent, joining the 100-400 m cluster only at the 0.347 level. This faunistic break at 100 m was also noted by Squires and Keyes (1967: 36) in their bathymetric analysis of 23 New Zealand species.

MINERALOGY

In the context of a more comprehensive analysis of the mineralogy of the Scleractinia, the coralla of eight New Zealand species were analysed by X-ray diffraction to determine their calcium carbonate polymorph. All species consisted of 100% aragonite. The species tested were *Caryophyllia elongata*, *C. diomedeae*, *Flabellum aotearoa*, *Truncatoflabellum dens*, *Javania pachytheca*, *Falcatoflabellum raoulensis*, *Truncatoguynia irregularis*, and *Polymyces wellsi*. All recent Scleractinia thus far analysed have proven to be aragonitic (Filkorn, in press).

CLASSIFICATION

Order SCLERACTINIA
Suborder FUNGIINA
Superfamily FUNGIOIDEA Dana, 1846
Family FUNGIACYATHIDAE Chevalier, 1987

Fungiacyathus Sars, 1872

Corallum solitary, cupolate, and free; septotheca horizontal and usually quite fragile. Costae either thin serrate ridges or rounded and granular. Four or five cycles of septa; septal faces carinate, reflecting underlying trabeculae. All septa attached to their adjacent septa with synapticular plates. Pali may be present; columella spongy.

Key to the six species of *Fungiacyathus* known from the New Zealand Region

1 Five cycles of septa (96 septa) *F. (Fungiacyathus)* 2
Four cycles of septa (48 septa) *F. (Bathyactis)* 4

2 Septal and costal edges straight; numerous trabecular spines on inner septal edges ..... *F. pusillus pacificus*
Septal and costal edges sinuous (corrugated); no trabecular spines 3

3 Small P2 present; septal lobes quite tall ..... *F. stephanus*
P2 absent; septal lobes not tall ..... *F. fragilis*

4 Costae rounded and granular; intercostal furrows deep near calicular edges (as in a turbinoliid); coralla small (≤ 11 mm GCD) ..... *F. turbinolioides*
Costae ridged and serrate or granular; intercostal regions shallow; adult coralla 18–40 mm in diameter 3

5 Base flat; all costae serrate ridges; trabecular ridges sparse and widely spaced (about 1.0–1.75 mm apart); diameter up to 40 mm ..... *F. marenzelleri*
Base highly concave; C1–3 rounded and granular; trabecular ridges numerous and closely spaced (about every 0.4 mm apart); diameter up to 18 mm ..... *F. margaretae*

Fungiacyathus (Fungiacyathus) Sars, 1872

Fungiacyathus having 96 septa (5 cycles).

TYPE SPECIES: *Fungiacyathus fragilis* Sars, 1872, by monotypy.

REMARKS: Six species are known in the nominate subgenus, including one exclusively fossil species (*F. euaensis* Wells, 1977, Eocene of Tonga) and one as yet undescribed species (*F.* sp. A of Cairns, 1994, North Pacific). The other four are *F. pusillus* (Pourtalès, 1868; *F. fragilis* Sars, 1872, *F. stephanus* (Alcock, 1893), and *F. paliferus* (Alcock, 1902). The recent species occur worldwide at 99–2200 m.

Fungiacyathus (F.) stephanus (Alcock, 1893)
(Plate 1, a-c)

Bathyactis stephanus Alcock, 1893: 149, pl. 5, figs 12, 12a.
Bathyactis stephana: Alcock 1898: 28–29, pl. 3, figs 5, 5a.
Fungiacyathus (F.) stephanus: Cairns 1989a: 7–9, pl. 1, figs a-k, pl. 2, figs a-b (synonymy); Cairns & Keller 1993: 230; Cairns 1994: 37, pl. 13, figs g-i.

MATERIAL Examined: New Records: NZOI Stn E774, 1, USNM 93983; Stn E784, 2, NZOI; Stn E869, 1, USNM 93984; Stn F911, 1, NZOI; Stn K805, 1, NZOI; Stn U197, 3, USNM 93985. Previous Records: *See* Cairns (1989a: 8).

DISTRIBUTION: New Zealand region: Lord Howe Rise; Norfolk Ridge; Kermadec Ridge; Challenger Plateau; east of North Cape (Map 1); 1142–1705 m. Elsewhere: southwest Indian Ocean; Gulf of Aden; Bay of Bengal; off Japan; Philippines; Indonesia; 245–2000 m.

TYPES: The holotype is presumed to be deposited at the Indian Museum, Calcutta.

TYPE LOCALITY: *Investigator* Stn 133, 15°43'30 N, 81°19'30 E (off Krishna Delta, Bay of Bengal), 1240 m.

REMARKS: Complete descriptions and synonymies of this species are given by Cairns (1989a, 1994) in the context of revisions of the Philippine and North Pacific Scleractinia, respectively. The records reported herein represent a southern range extension

for the species and the first record from the New Zealand region. The largest New Zealand specimen (NZOI Stn U197) is 39.5 mm in calicular diameter and 17.2 mm in height, which is thought to be about the maximum size for the typical (concave base) form of the species.

Fungiacyathus stephanus is quite similar to *F. fragilis* and is compared to that species in that account. It is distinguished from other species in the subgenus by having extremely tall septal lobes, a broad marginal shelf, and highly corrugated septa.

Fungiacyathus (F.) fragilis G. O. Sars, 1872
(Plate 1, d, f)

Fungiacyathus fragilis Sars, 1872: 58, pl. 5, figs 24–32; Zibrowius 1980: 23–24, pl. 5, figs A–J (synonymy); Cairns 1982: 7, pl. 1, figs 3–7 (synonymy).

Bathyactis hawaiiensis Vaughan, 1907: 145–147, pl. 27, figs 1, 1a.

Not *Fungiacyathus symmetricus fragilis* Keller, 1976: 41–43 (junior homonym).

MATERIAL EXAMINED: New Record: NZOI Stn E880, 2 fragments, USNM 93975. Previous Records: Specimens reported by Cairns (1982): *Eltanin* Stn 1412 and 1846; holotype of *B. hawaiiensis.*

DISTRIBUTION: New Zealand region: off west coast of New Zealand (rare) and Macquarie Ridge (Map 1); 1029–1693 m. Elsewhere: North Atlantic; Hawaiian Islands; 285–2200 m.

TYPES: One syntype of *F. fragilis* is known to be deposited at the Oslo Museum (B626). The holotype of *B. hawaiiensis* is deposited at the USNM (20834).

TYPE LOCALITIES: *F. fragilis*: "Skraaven in Lofoten" (Norway), 549 m. *B. hawaiiensis: Albatross* Stn 4125, between Oahu and Kauai, Hawaiian Islands, 1761–2056 m.

REMARKS: Nothing can be added to the descriptions of this species previously given by Zibrowius (1980) and Cairns (1982). The largest New Zealand specimen examined (*Eltanin* Stn 1846) is 25.6 mm in diameter. It is quite similar to *F. stephanus*, the only other species in the subgenus to attain a large calicular diameter. In fact, damaged and/or juvenile specimens of the two species are difficult to distinguish; however, adult *F. fragilis* differs by lacking P2, lacking a marginal shelf, and by having much lower septal lobes.

Fungiacyathus (F.) pusillus pacificus n. subsp.
(Plate 1, g-i, l)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Known only from the New Zealand region on the Norfolk, Three Kings, and southern Colville Ridges (Map 13); 350–988 m.

DESCRIPTION: Holotype 17.5 mm in diameter and 8.8 mm in height; largest specimen (NZOI Stn I97) 21.4 mm in diameter. D:H of most well-preserved specimens about 2. Base flat to slightly concave. Costae straight, finely serrate ridges, appearing as beaded in centre of worn coralla. Intercostal width near calice edge 2–4 times width of a costa. Corallum white.

Septa hexamerally arranged in 5 complete (96 septa) cycles, even in coralla as small as 9.0 mm diameter. S1 consist of 3 or 4 thick, ridged inner trabecular spines that are vertical to slightly incurved in shape. Peripheral to these spines is a tall septal lobe bearing 12–15 vertical serrate ridges on each face, the ridges alternating in position on either septal face. Peripheral to the tall lobe are 13–15 trabeculae that form a series of disjunct lobes, each composed of only 2 or 3 trabeculae. 11 or 12 synapticulae occur per S1, the largest usually the sixth from the centre. S2 consist of 5 or 6 inner trabecular spines, the inner 3 inclined toward the columella (the third being quite massive), the outer 2 or 3 smaller and inclined outward. Peripheral to these spines is a tall septal lobe similar in size and shape to that of the S1, but positioned slightly further from centre of fossa and inclined slightly outward (not vertical). Peripheral to the tall S2 lobe is a similar arrangement of 13–15 trabeculae that form smaller, disjunct lobes, as in the S1. S3 consist of 4 large inner trabecular spines, each spine consisting of 2 or 3 trabeculae, bordered by a septal lobe consisting of 7–9 ridges per face. S3 lobe positioned further outward from centre of calice than S2 lobe and orientated even more obliquely, its outer edge extending beyond the base. This overextension of the S3 lobes and the virtually vertical outer edges of all septa produces a slight marginal shelf encircling the corallum, quite similar to that seen in some species of *Stephanophyllia.* Outer edges of S3 consist of 7–9 trabeculae arranged in smaller lobes. S4 consist of 12–15 trabecular spines, some of them doubled into small lobes, but not united into a larger septal lobe. S5 consist of 5–7 slender trabecular spines. All septa are planar with straight edges, having no sinuousity or undu-

lations. Only S1 are independent; pairs of S5 fuse to S4, pairs of S4 to S3, and pairs of S3 to S2, the inner edges of the S1–2 reaching the columella. No septal canopies are present. Columella papillose and indistinguishable from inner septal trabecular spines of S1–2.

TYPES: Holotype: NZOI Stn U599, NZOI H-621. Paratypes: NZOI Stn G3, 2, NZOI P-1000; Stn I96, 3, NZOI P-1001; Stn I97, 12, NZOI P-1002, 6, USNM 93974; Stn K795, 3, NZOI P-1003; Stn P10, 3, USNM 93973; Stn U582, 3, USNM 93972; Stn U591, 1, NZOI P-1004; Stn U599, 7, NZOI P-1005, 5, USNM 93971.

TYPE LOCALITY: 30°43'S, 173°16'E (northern Three Kings Ridge), 590–640 m.

ETYMOLOGY: The subspecies name *pacificus* alludes to the larger-sized Pacific subspecies of the species.

REMARKS: *Fungiacyathus pusillus pacificus* is easily distinguished from *F. fragilis* and *F. stephanus* by its planar septa and solid corallum; it differs from *F. paliferus* in having serrate (not granular) costae, and in lacking P2; it differs from *Fungiacyathus* sp. A (*sensu* Cairns 1994) in lacking septal canopies and in having a papillose columella. But, *F. pusillus pacificus* is remarkably similar to the nominate subspecies (Pourtalès 1868), which is known only from the Caribbean at 285–439 m (*see* Cairns 1979), apparently differing only in size. The maximum known size for the Atlantic subspecies is 16.8 mm, that of the Pacific subspecies 21.4 mm. Correlated with the larger calicular diameter, *F. pusillus pacificus* also has better-developed and more numerous trabeculae per corresponding septal cycle.

Fungiacyathus (Bathyactis) Moseley, 1881

Fungiacyathus having 48 (four cycles) septa.

TYPE SPECIES: *Fungia symmetrica* Pourtalès, 1871, by monotypy.

REMARKS: Nineteen species are known in this subgenus (*see* Cairns 1989a, Filkorn in press), five of them exclusively fossil in occurrence. The remaining 14 species occur worldwide at depths of 183-6328 m.

Fungiacyathus (B.) marenzelleri (Vaughan, 1906) (Plate 1, j-k)

Bathyactis marenzelleri Vaughan, 1906a: 66–67, pl. 4, figs 1-1b.

Fungiacyathus marenzelleri: Cairns 1979: 35–37, pl. 2, figs 8-9, pl. 3, figs 3, 8 (synonymy); Zibrowius 1980: 24–25, pl. 6, figs A–M, pl. 7, figs A–K (synonymy); Cairns 1982: 5–7, pl. 1, figs 1–2, 8 (synonymy); 1994: 15–16, pl. 1, figs a-f (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn J667, 3, USNM 93976; Stn P939, 1, USNM 93978; Stn U203, 8, USNM 93977; Stn U204, 1, NZOI; Stn U224, 15, NZOI. Previous Records: Type series of *B. marenzelleri*.

DISTRIBUTION: New Zealand region: abyssal plain south of Lord Howe Island; Bellona Trough; Raukumara Plain (Map 1); 1760–4954 m. Elsewhere: virtually cosmopolitan, including amphi-Atlantic, amphi-Pacific, Subantarctic, and off continental Antarctica (Cairns 1994); 300–6328 m.

TYPES: The holotype is deposited at the USNM (47415) and three paratypes are at the MCZ.

TYPE LOCALITY: *Albatross* Stn 4721, 8°07.5' S, 104°10.5' W (off Peru), 3820 m.

REMARKS: Because of its widespread distribution, *F. marenzelleri* has been adequately described and figured before (see synonymy) and will therefore not be redescribed here. It differs from the other species in its subgenus by having a relatively large corallum, straight septal edges, and relatively few, widely spaced trabecular ridges. A large, well-preserved New Zealand specimen (NZOI Stn J667, Plate 1, j, k) is 34.7 mm in diameter, but even larger coralla up to 40 mm GCD have been reported (Cairns 1989a). *Fungiacyathus marenzelleri* is the deepest-living coral known, and represents the deepest record of a scleractinian from the New Zealand region.

Fungiacyathus (B.) margaretae n. sp. (Plate 2, a-c)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Known only from the northern Colville Ridge (Map 20); 635-673 m.

DESCRIPTION: Holotype 16.3 mm in calicular diameter and 8.3 mm in height; largest specimen (NZOI Stn P944) 18.3 mm in diameter. Base highly concave,

the outer septal edges extending as much as 2 mm beyond basal perimeter. C4 consist of narrow, serrate ridges, but C1–3 are wider (about 0.35 mm) and rounded, bearing small, rounded granules. CS1–3 develop small (1.1 mm), downward projecting spurs at calicular edge. Corallum white.

Septa hexamerally arranged in four complete cycles. S1 consist of 2 or 3 inner trabecular spines bordered by a highly exsert septal lobe that bears 16–23 closely spaced, vertical, serrate ridges, these ridges becom-ing horizontally oriented near calicular edge. S2 less exsert, consisting of 3 or 4 inner trabecular spines, bordered by a slightly smaller lobe consisting of 10–13 trabecular ridges. S3 about two-thirds width of an S3 and consist of a lobe of 8 or 9 projecting trabecular spines, each pair of S3 solidly fused to their common S2 by an imperforate canopy. S4 about two-thirds width of an S3 and also consist of 8 or 9 projecting trabecular spines, each pair of S4 solidly fused to their common S3 through an imperforate canopy. Both S1 and S2 extend from columella to calicular edge, the S1 being the only independent septa. Septa are planar with straight inner edges. Synapticular plates solid, 7 or 8 per S1 or S2, the sixth from the columella being the tallest, rising well above the adjacent S4. Columella a central, circular plate 2.5–3.0 mm in diameter, often slightly concave and usually penetrated by various trabecular spines from the inner edges of the S1–2.

TYPES: Holotype: NZOI Stn P944, NZOI H-622. Paratypes: NZOI Stn P944, 1, USNM 93979; Stn P947, 2, NZOI P-1006; Stn P966, 1, USNM 93980.

TYPE LOCALITY: 27°20.8′ S, 179°20.9′ W (Colville Ridge), 673 m.

ETYMOLOGY: This species is named in honour of my wife.

REMARKS: Among the 13 other recent species in this subgenus, *F. margaretae* is most similar to *F. granulosus* Cairns, 1989a (Philippines, 390–567 m), both species having granular costae and similarly shaped septal trabecular ridges. *Fungiacyathus margaretae* differs in having a highly concave base, costoseptal spurs, more exsert S1, more highly developed synapticular plates, and a smaller corallum.

Fungiacyathus (B.) turbinolioides Cairns, 1989
(Plate 2, d, e)

Fungiacyathus (B.) turbinolioides Cairns, 1989a: 12–13, pl. 6, figs a-g.

MATERIAL EXAMINED: New Records: NZOI Stn E275, 1, NZOI; Stn E868, 1, USNM 93981; BS391, 6, MoNZ CO252, 3, USNM 93982; *Slope* Stn 33, 1, USNM, 2, NMV F67776. Previous Records: Type series.

DISTRIBUTION: New Zealand region: southern Norfolk Ridge; off Three Kings Islands (Map 13); 600–751 m. Elsewhere: Celebes Sea; Formosa Strait; off Victoria (reported herein); 622–930 m.

TYPES: The holotype and 65 paratypes are deposited at the USNM; two paratypes are also deposited at the AMS.

TYPE LOCALITY: *Albatross* Stn 5586, 4°06′50 N, 118°47′20 E (off Sabah, Celebes Sea), 635 m.

REMARKS: *Fungiacyathus turbinolioides* was recently described and figured; nothing can be added to our knowledge of that species based on the worn New Zealand specimens except for the range extension. It is easily distinguished from other *Fungiacyathus* by its deep peripheral intercostal furrows that separate wide, granular costae, which makes it appear like a turbinoliid from a basal view. Other distinguishing characters include its robust compound trabecular spines; relatively few (3 or 4), low synapticular plates per S1 (barely visible in an intact corallum); and lack of septal canopies.

Family MICRABACIIDAE Vaughan, 1905

Letepsammia Yabe & Eguchi, 1932d

Corallum solitary, discoidal, and free; a small marginal shelf usually present. Costae thin and ser-rate, separated by wide, porous intercostal regions. Synapticulothecate, highly perforate septa alternat-ing in position with an equal number of costae. Columella spongy to papillose.

TYPE SPECIES: *Stephanophyllia formosissima* Moseley, 1876, by original designation.

REMARKS: Three species are currently recognised in this genus: *L. formosissima* (Moseley, 1876), *L. superstes* (Ortmann, 1888), and *L. fissilis* n. sp.

Letepsammia superstes (Ortmann, 1888)
(Plate 2, f-i)

Stephanophyllia superstes Ortmann, 1888: 160-161, pl. 6, fig. 5; Owens 1986b: 487.

Stephanophyllia (Letepsammia) japonica Yabe & Eguchi, 1932b: 443 (*nom. nud.*); 1934: 281, figs 1-3; 1942b: 139, 156–157, pl. 12, fig. 8.
Micrabacia japonica: Omura 1983: 119.
Stephanophyllia japonica: Zou 1988: 75, pl. 5, fig. 7.
Letepsammia formosissima forma *superstes*: Cairns 1994: 40–41, pl. 15, figs. c, f.

MATERIAL EXAMINED: New Records: NZOI Stn K795, 3, USNM 94080; Stn K828, 1, USNM 94081; Stn K838, 1, NZOI; Stn K840, 11, USNM 94082; Stn T256, 1, NZOI; BS441, 3, MoNZ CO226.

DISTRIBUTION: New Zealand region: Kermadec Ridge (Map 20); 200–710 m. Elsewhere: Sagami Bay, Japan, to off Hong Kong, South China Sea; 77–307 m (Cairns 1994).

DESCRIPTION: Corallum discoidal to patellate, some coralla having a flat base but most having a slightly conical base, the basal angle as low as 140°. Largest corallum examined (NZOI Stn K840) 19.7 in diameter and 7.4 mm in height. Costal ridges about 0.15 mm wide near calicular edge, separated by intercostal spaces about 2 times as wide. Each costa bears a uniserial row of small (0.10–0.15 mm in height), closely adjacent, blunt teeth, producing finely serrate costal edges. Costae project 0.5–0.7 mm beyond septal edge perimeter, producing a narrow marginal shelf. Regularly spaced cylindrical synapticulae unite each costa to its 2 adjacent septa, 25–36 synapticular bridges occurring per major septum (= corallum radius) depending on size of corallum. Synapticular bridges create a series of intercostal pores that increase in diameter from epicentre to calicular edge (e.g., 0.10–0.25 mm diameter range). Corallum white.

Septa invariably 96 in number, arranged in typical micrabaciid fashion. S1 independent and semicircular in profile, with an oblique inner edge that slopes toward the columella. S1 bear 16 or 17 slender trabecular spines, the innermost spines inclined toward columella. S2 bear about 13 trabecular spines, the innermost 3 spines quite robust, cylindrical, and finely granular. S3, prior to bifurcation, bear 2 or 3 massive (0.5 mm in diameter), cylindrical spines, which constitute the highest point of corallum. Remaining S3 trabecular spines are smaller diameter cylinders or flattened perpendicular to septal plane. Each pair of S3 solidly fuses to its common S2 near columella. All septa highly porous and solidly fused to one another by synapticular rods that are circular to slightly elliptical in cross section, which usually occur in oblique rows relatively high in corallum. Fossa shallow, containing an elliptical field of 11–18 slightly clavate granular papillae, all interconnected among their bases.

TYPES: The holotype of *S. superstes* is deposited at the Strasbourg Zoological Museum. Two syntypes of *S. japonica* are deposited at the TIUS (50236).

TYPE LOCALITIES: *S. superstes*: Sagami Bay. *S. japonica*: Pleistocene limestone of the Ryukyu Islands.

REMARKS: In my revision of the North Pacific Scleractinia (Cairns 1994), I referred to the Japanese populations of this species as *L. formosissima* forma *superstes*, the Japanese specimens described as differing from typical *L. fomosissima* in being smaller, having fewer septa, and having a papillose columella. Having seen additional specimens of this species from the New Zealand region I now believe this "form" to represent a distinct species, *L. superstes*. It differs from *L. formosissima* in having a smaller corallum (GCD max. 20 mm vs 47 mm for *L. formosissima*); having fewer septa (96 vs ≥120 for *L. formosissima*); having spinose, sloping inner S1 edges (those of *L. formosissima* are vertical and not spinose); having a flat-based to patellate corallum (coralla of *L. formosissima* are exclusively flat); and having a papillose columella (that of *L. formosissima* is spongy). Overall, *L. superstes* has a denser, more robust corallum and more closely spaced septa.

Letepsammia fissilis n. sp. (Plate 3, a-e)

?*Stephanophyllia formosissima*: Wells 1958: 263 (part: specimen from New Zealand); Ralph & Squires 1962: 16.
Letepsammia sp. Squires 1964b: 3; Squires & Keyes 1967: 21, pl. 4, fig. 1.

MATERIAL EXAMINED: Types, q.v.; specimens reported by Squires (1964b) as *Letepsammia* sp. (*Ikatere* Stn B23, B26, B27, and *Lachlan*, AIM).

DISTRIBUTION: Known only from New Zealand region from southernmost Norfolk Ridge; off Three Kings Islands; and off North Island from North Cape to East Cape (Map 10); 106–206 m.

DESCRIPTION: The typical shape of this species is a triangular wedge-shaped sector representing one-sixth (or 1 system minus enclosing S1) of a typical micrabaciid corallum. Its outer (calicular) edge is rounded and its two sides straight, making an inner

angle of about 60°. In time, these wedges grow outward as well as generate additional septa, resulting in an increase in radius and edge angle. In only one case (NZOI Stn P5) was an entire circular corallum generated from an initial fragment, the calice being 12.5 mm in diameter. Most sectors appear to originate at a calicular radius of about 9 mm and a septal complement of 19. Multiplying 19 by 6 and adding 6 for the missing S1 yields a theoretical complement of 120 septa for an entire corallum. The holotype began from such a sector, but extended its radius to 12.1 mm and widened its calicular edge to encompass 31 septa. Regeneration of the original wedge-shaped corallum is most easily seen and illustrated in basal view (Plate 3, e) as discontinuities or irregular additions to the costal structure. Costae are typical for the genus, consisting of narrow (0.10–0.15 mm), finely granular costal ridges separated by rather wide (about 0.3 mm), porous intercostal regions. Virtually all specimens examined were worn, but it would appear that a low marginal shelf is present. Corallum white.

Most coralla contain 12–32 septa, the majority having 19, and only one (the complete but juvenile corallum from NZOI Stn P5) having 96 septa. Septal complements between 20–32 are the result of irregular additions by septal bifurcation of peripheral septa of the original wedge. Because fission appears to occur along the symmetry of the S1, these septa are lost in the process. S2 independent and unbranched, rather low in relief, and highly porous, bearing 20–25 trabecular spines that constitute its entire border. S3 bifurcate in micrabaciid fashion, being quite irregularly developed along edges of regenerating coralla. Synapticulae absent from septal faces, but do occur basally, linking septa to costae. This lack of septal synapticular reinforcement may predispose the corallum to splitting and explain the usual loss of the S1 and columella following fission.

Types: Holotype: BS881 (O627), MoNZ CO281. Para-types: NZOI Stn E256, 2, NZOI P-1007; Stn E261, 4, NZOI P-1008; Stn E359, 2, NZOI P-1009; Stn P5, 1, NZOI P-1010; BS770 (R128), 1, MoNZ CO308; BS833, 18, MoNZ CO287, 6, USNM 94085; BS881 (O627), 10, MoNZ CO281, 3, USNM 94086; BS897 (O643), 2, MoNZ CO223; *Ikatere* Stn B26, 6, USNM 81868; *Lachlan*, 10, USNM 81869.

Type Locality: 34°20′ S, 173°06′ E (off North Cape), 163–168 m.

Etymology: The species name *fissilis* (Latin *fissilis*, splittable) refers to the fragile nature of the corallum of this species, which often splits into six wedge-shaped fragments.

Remarks: *Letepsammia fissilis* is distinguished from its two congeners by its distinctive asexual form of reproduction and regeneration, mitigated by its lack of septal face synapticulae. Although an intact corallum would appear to consist of 120 septa, as in *L. formosissima*, it differs from that species in having a smaller but more robust corallum. Furthermore, *L. formosissima* occurs at a greater depth in the New Zealand region. *Letepsammia fissilis* is approximately the same size as *L. superstes*, but would appear to have more septa in the fully developed condition (120 vs 96) and a flat base. Furthermore, *L. superstes* is characteristic of deeper waters to the north of the range of *L. fissilis*.

Letepsammia formosissima (Moseley, 1876)
(Plate 3, f, g)

Stephanophyllia formosissima Moseley, 1876: 561–562.
Letepsammia formosissima: Owens, 1986b: 486–487; Cairns, 1989a: 15–18, pl. 6, fig. j, pl. 7, fig. g-i, pl. 8, figs a-d (synonymy); Cairns & Parker, 1992: 8–9, pl. 1, figs f, h; Not Cairns, 1994: 40–41, pl. 15, figs c, f (= *L. superstes*).

Material Examined: New Records: Stn K804, 5 (dead), NZOI; Stn K844, 1, NZOI; Stn P10, 6, USNM 94084; Stn P14, 5, USNM 49232; Stn T256, 1, NZOI; BS888 (O634), 1, MoNZ.

Distribution: New Zealand region: southern Norfolk Ridge, including Wanganella Bank; Kermadec Islands (off Raoul, Macauley, and Curtis) (Map 10); 290–378 m. Elsewhere: Indo-West Pacific from south-west Indian Ocean to Hawaiian Islands and South China Sea; 97–457 m.

Diagnosis: Discoidal coralla up to 46.7 mm in diameter (NZOI Stn P10); base flat to slightly convex; D:H up to 4.9 in large specimens. Thin (0.06–0.07 mm), ridged costae bear very small teeth or short spines, producing a finely serrate edge; intercostal regions quite wide (3–6 times costal width) and porous, the synapticular bars connecting each costa to its 2 alternating, adjacent septa clearly visible in basal view through the intercostal region. Synapticulae circular in cross section and rather scarce, restricted to base and lower edges of septa. A low, marginal shelf up to 3 mm wide present on

well-preserved specimens. Corallum white.

Septa arranged in typical micrabaciid fashion (Cairns 1989a: text-fig. 2), attaining 144 septa at a calicular diameter of 30-40 mm, but larger coralla of up to 46 mm diameter (MoNZ CO153) having up to 199 septa. S1 independent and unbranched, having a smooth upper, inner edge, but a spinose peripheral edge. S2 also unbranched but not independent, a pair of S3 fusing to each S2 near the columella. Each S3 bifurcates repeatedly, producing a majority of the septa. S1–2 primarily non-porous, except for attenuate region in vicinity of marginal shelf, where all septa are porous. S3 also porous to varying degrees at regions of septal bifurcation. Columella elongate, papillose, and often heavily fused.

TYPES: Five syntypes are deposited at the BM(NH).

TYPE LOCALITY: Philippines and Indonesia, 174–236 m.

REMARKS: *Letepsammia formosissima* is compared to the two other species in its genus in previous remarks, but it is most likely to be confused with *Rhombopsammia niphada* Owens, 1986a. *Letepsammia formosissima* differs from the latter in having porous S1 and no vepreculae and lacking septal canopies. Furthermore, *R. niphada* is more typical of deeper water (405–804 m) and is not yet known from the New Zealand region.

Stephanophyllia Michelin, 1841

Corallum solitary, discoidal, and free; a small marginal shelf may be present. Costae granular. Synapticulothecate, 96 imperforate septa alternate in position with costae, the septa and costae interconnected by elongate, bar-shaped synapticulae in base (fulturae) or septal face synapticulae circular to elliptical in cross section. Columella lamellar to papillose.

TYPE SPECIES: *Fungia elegans* Bronn, 1837, by original designation.

REMARKS: The generic synonymy is discussed in detail by Cairns (1989a) and the four species compared in a tabular key. The recognised species are *S. elegans* (Bronn, 1837) (Mio-Pliocene, Europe); *S. complicata* Moseley, 1876; *S. fungulus* Alcock, 1902b; and *S. neglecta* Boschma, 1923.

Stephanophyllia complicata Moseley, 1876

(Plates 3, h, 4, a-e)

Stephanophyllia complicata Moseley, 1876: 558–561, text-fig; 1881: 198–201, pl. 4, fig. 12, pl. 13, figs 3–5; Van der Horst 1926: 51; 1931: 11; Gardiner & Waugh 1939: 234; Pillai & Scheer 1976: 14; Cairns 1989a: 21, pl. 12, figs. a-b; Cairns & Keller 1993: 231–232.

MATERIAL EXAMINED: New Records: NZOI Stn I96, 1, NZOI; Stn P13, 1, NZOI; Stn P14, 1, USNM 94078; Stn U568, 1, NZOI; Stn U584, 11, USNM 94079; Stn U592, 1, NZOI. Previous Records: Syntypes of *S. complicata;* specimens reported by Van der Horst (1926, 1931).

DISTRIBUTION: New Zealand region: southern Norfolk Ridge; Three Kings Ridge (Map 10); 319–1137 m. Elsewhere: Indian Ocean (Saya de Malha Bank, Chagos and Maldive Archipelagos); Banda Sea; 229–236 m.

DESCRIPTION: Corallum up to 18 mm in diameter and 7.2 mm in height (NZOI Stn U584), with vertical outer edges and a flat to slightly convex base. Costae flat and relatively wide (about 0.20 mm at calicular edge), each separated by a porous intercostal space about same width. In large coralla each intercostal region is bridged at regular intervals by 20–22 synapticular bars, which produce the porous basal structure. Each costa bears a central row of granules (about 50 μm in diameter) for its innermost 3-4 mm, beyond which the granules slightly decrease in size and form 2 rows, 1 row on each edge of the costa, the central region being flat to slightly concave. At calicular edge costae often slightly upturned, bifid, and extend about 0.5 mm beyond septal perimeter, producing a small marginal shelf. Corallum white.

Septa invariably 96 in number arranged in typical micrabaciid fashion like that of *S. fungulus* (Cairns 1989a: text-fig. 3); however, in 2 specimens (figured syntype and 1 from NZOI Stn U584) pairs of very small septa appear to diverge from the outer edges of both S1 and S2. S1 independent, usually unbranched, and have an arched upper edge describing a half circle; a vertical, non-spinose inner edge that borders the columella; and a spinose upper outer edge that reflects the 18–21 trabecular spines that project from the septum. Trabecular spines gradually decrease in size away from the columella, each spine corresponding to a low, serrate ridge (vepreculum) on the septal face. S2 consist of 3 or 4 rather massive, inward-inclined trabecular spines, peripheral to which is a semicircular septal lobe composed of about 15 trabecular spines. S3 and its

subsequent bifurcations also consist of trabecular spines, the innermost region of each S3 bearing 2 or 3 thick spines. Each pair of S3 strongly fused to its common S2 by their inner edges as well as by numerous synapticular bars. Synapticular bars solidly join all adjacent septa, particularly the S1 and its adjacent septa, the bars (fulturae) occurring from the base to quite high in the corallum. All septa imperforate; S1–2 planar and straight, whereas S3, because of their repeated bifurcations, appear to meander. Fossa shallow, containing a prominent, narrow (0.5 mm wide), lamellar columella, the summit of which is often divided into papillae or stout, lamellar segments.

TYPES: Two syntypes are deposited at the BM(NH) (1880.11.25.155A–B).

TYPE LOCALITY: *Challenger* Stn 192, 5°42′ S, 132°25′ E (off Kai Islands, Banda Sea), 236 m.

REMARKS: *Stephanophyllia complicata* differs from the two other recent species in the genus by having a relatively thin, lamellar columella and in having S1 with vertical, non-spinose inner septal edges. Also, *S. complicata* attains a larger size than the other species and has more widely spaced septa. *Stephanophyllia complicata* is further differentiated from *S. fungulus* by having a thinner base and synapticular bars that are circular in cross section, not as massive and elongate as those in *S. fungulus*.

Suborder FAVIINA
Superfamily FAVIOIDEA Gregory, 1900
Family RHIZANGIIDAE d'Orbigny, 1851

Culicia Dana, 1846

Corallum colonial (reptoid), consisting of short, cylindrical corallites linked together by stolons. Corallites epithecate, the epitheca often rising above upper, outer septal edges as a thin, continuous rim. S1 and often S2 lobate; higher cycle septa lobate to coarsely dentate. Paliform lobes often present; columella papillose.

TYPE SPECIES: *Culicia stellata* Dana, 1846, by subsequent designation (Wells 1936).

REMARKS: Approximately 15 species have been described in the genus *Culicia*, but, like for most other shallow-water azooxanthellate genera, a worldwide revision is needed to establish the valid species and their synonyms. Despite the report of at least four species of *Culicia* from New Zealand waters, it is suggested that only one species exists, *C. rubeola*, and that it may be endemic to this region.

Culicia rubeola (Quoy & Gaimard, 1833)
(Plates 4, g, h, 5, a–c)

Dendrophyllia rubeola Quoy & Gaimard, 1833: 197–198, pl. 15, figs 12–15; Dana 1846: 389.
Angia rubeola: Milne Edwards & Haime 1848c: pl. 7, figs 6, 6a; 1849: 176.
Cylicia rubeola: Milne Edwards & Haime 1857: 607–608; Not Tenison Woods 1878a: 324, 325 (= *C. hoffmeisteri*); ?Tate 1890: 173; Not Dennant 1904: 9 (= *C. australiensis*); Not Howchin 1909: 247 (= *C. hoffmeisteri*).
Cylicia huttoni Tenison Woods, 1879: 132, pl. 12, fig. 1; Hutton 1904: 315.
Not *Culicia rubeola*: Wells 1954: 464–465, pl. 185, figs 3–6.
Culicia rubeola: Squires 1960c: 6–7, figs 5–6; Ralph & Squires 1962: 4–5, pl. 1, figs 1–5; Squires 1964b: 3; Squires & Keyes 1967: 21, pl. 1, fig. 1; Morton & Miller 1968: 159–160, pl. 7, fig. 4; Grace & Grace 1976: 99; Dawson 1979: 28; Brook 1982: 168–169; Hayward, *et al.* 1985: 101.
Not *Culicia* sp. cf. *C. rubeola*: Cairns 1991a: 7.

MATERIAL EXAMINED: New Records: NZOI Stn C910, 1, NZOI; Stn M763, 3, NZOI; Stn M793, 20, USNM 94000; Stn S251, 3, NZOI; Doubtful Sound, 20–30 m, 2, USNM 76306; Ocean Beach, Kawhia, 20, AUM 12020; Rangaunu Harbour, 82 m, 6, AUM 147; Manukau Harbour on bivalve *Perna canaliculus*, 2, AUM 140, H1201; between Great and Little Barrier Islands, 77 m, 1, AIM. Previous Records: Some of the specimens reported by Ralph and Squires, 1962 (AIM); Squires, 1964b (AIM); and Squires and Keyes, 1967 (NZOI).

DISTRIBUTION: New Zealand region: Probably endemic to New Zealand region, off all coasts of North Island and off Fiordland (Map 6); 0–82 m.

DESCRIPTION: Colonies low and encrusting, formed by reptoid budding from short, flat stolons. If the substratum is smooth (e.g., a bivalve shell, Plate 4, g, h), a circular colony may develop, one of the larger known colonies (AUM 140) being 60 mm in diameter and consisting of about 200 corallites. In these circular colonies, corallites are relatively short (1.5–2.0 mm) and usually spaced less than 1 calicular diameter from each other, but rarely directly adjacent. The reptoid budding sequence can usually even be traced to a founder corallite, which is invariably ≤ 8 budding generations from

colony edge. Corallites in centre of colony vertical, whereas peripheral corallites are usually inclined outward. But if the substratum is irregular or other organisms are competing from the same space, corallites are more irregular in arrangement, have longer stolons, and are often taller (up to 8 mm). Calices circular and 3.0–6.0 mm in diameter (although most corallites are 3.5-4.5 mm in diameter), larger corallites apparently associated with sheltered environments (Brook 1982). Coralla epithecate, bearing thin, horizontal thecal corrugations encircling each corallite. Occasionally vertical granular costae are detectable beneath the veil of epitheca, the epitheca rising above the level of the septa as a thin, entire (smooth), circular rim. Corallum white; polyps pink.

Septa hexamerally arranged in 4 cycles, the fourth cycle rarely complete (most corallites having 30-40 septa); however, one large corallite (GCD = 5.6, AU147) has 62 septa. Hexameral symmetry often difficult to determine because of unequal development of S4 within systems and the similarity of S2 to S1 in systems having pairs of S4. Often the 2 systems of a corallite on the leading edge of the colony are more developed, these 2 systems each having 2 pairs of S4, whereas the proximal systems will have only 1 pair or no S4. Each S1 has 1 or 2 narrow lobes on its upper margin adjacent to epitheca, then widens to a fuller primary septal lobe with a straight inner edge and 1 or 2 tall but narrow pali-form lobes adjacent to columella. S2 half to three-quarters width of an S1 and bear 5 or 6 rounded lobes, the innermost lobes similar in size and shape to P1. If a pair of S4 flanks an S3, the S3 is almost as wide as an S2, each S3 pair fusing with the inner edge of the common S2. Inner edges of these S3 composed of numerous slender, horizontally oriented lobes and several larger, inner paliform lobes. S3 unflanked by pairs of S4 are much smaller, about one-third width of an S2, and composed of numerous slender, horizontally oriented lobes. S4, if present, rudimentary. Fossa moderate to deep, containing a well-developed papillose columella composed of 5–10 slender, nongranular pillars that are indistinguishable in size (about 0.15 mm in diameter) and shape from inner paliform lobes (P1–3).

TYPES: The type specimen of *Dendrophyllia rubeola* was stated to be deposited at the Otago Museum by Ralph and Squires (1962: 5, pl. 1, fig. 5); however, this specimen could not be located there in 1991 and it is more likely that Quoy and Gaimard's type would be at the MNHNP. The holotype of *C. huttoni* was not traced, although the original description implies that it also was deposited in the Otago Museum, Dunedin.

TYPE LOCALITIES: *Dendrophyllia rubeola*: Tamise (= Thames) River, New Zealand; depth unknown. *Cylicia huttoni*: "on old metal near the slip at Wellington, therefore may have been introduced" (Tenison Woods 1879: 132).

REMARKS: No attempt was made to rigorously compare *C. rubeola* to the 12–14 other species in the genus, many of those species being known from few specimens and often from dubious localities. A revision of the genus is obviously needed. It is noted, however, that Wells' (1954) *C. rubeola* from the Marshall Islands and Cairns' (1991a) specimen from the Galápagos are not conspecific with the New Zealand *C. rubeola*, and that the New Zealand species is similar to *C. hoffmeisteri* Squires, 1966 (known from off southeastern Australia), but differs in aspects of septal dentition.

It should also be noted that a second species, *C. smithii* (Milne Edwards & Haime, 1849), has been reported from off New Zealand. Only one specimen is known, the reputed type illustrated by Ralph and Squires (1962: pl. 1, fig. 6) and Squires and Keyes (1967: pl. 1, fig. 1). This specimen appears to differ from *C. rubeola* in having very closely adjacent corallites (cerioid) and, according to Ralph and Squires (1962), its septa are not lobate at the epithecal wall. Squires and Keyes (1967) indicated some uncertainty about the legitimacy of this type specimen as well as the accuracy of its type locality. Because no additional specimens of this shallow-water species have been reported from off New Zealand since 1849, I strongly doubt that *C. smithii* occurs in New Zealand waters.

A third species, *Cylicia vacua* Tenison Woods, 1879, is synonymised with *Monomyces rubrum*.

Family OCULINIDAE Gray, 1847

Oculina Lamarck, 1816

Corallum colonial (arborescent), corallites formed by extratentacular, alternate budding; axial corallites absent. Coenosteum dense and costate or uniformly granular. Pali or paliform lobes present before all but last septal cycle, usually in 2 crowns. Columella papillose.

TYPE SPECIES: *Madrepora virginea* Lamarck, 1816 (= *Oculina diffusa* Lamarck, 1816), by subsequent designation (Milne Edwards & Haime 1850: xix).

REMARKS: Of the approximately 25 nominal species in the genus, probably only 4 or 5 appear to be valid species (Cairns 1991a). The genus includes both zooxanthellate and azooxanthellate species and is commonest in the western Atlantic.

Oculina virgosa Squires, 1958 (Plates 4, f, i, 5, c, d)

Oculina virgosa Squires, 1958: 39, pl. 5, figs 8–16, text-fig. 11; Ralph & Squires 1962: 5–6, pl. 1, fig. 7; Squires & Keyes 1967: 22, pl. 1, fig. 3; Cairns 1991a: 10; Grant-Mackie, 1993: 16, 17, 20.

MATERIAL EXAMINED: New Records: NZOI Stn F928, 5 branches, NZOI; Stn J969, NZOI; Stn J970, NZOI; BS895 (O641), 10 branches, MoNZ CO307 and 312; BS898 (O644), 1 colony, MoNZ CO290; BS899 (O645), 3 colonies, MoNZ CO166 and 299; BS907 (O653), MoNZ; BS910 (O656), 1 colony, MoNZ CO27; 5–6 km off North Cape, 40 m, 2 colonies, AUM 9129, H1200; *Elingamite* wreck, West King Island, 42-46 m, 3 colonies, AIM; off Poor Knights Island, 29 m, NZGS; Cape Karikari, Doubtless Bay, 49 m, NZGS. Previous Records: Specimens reported by Squires (1958) several of which are at the USNM; Ralph and Squires (1962); and Squires and Keyes (1967).

DISTRIBUTION: Known only from New Zealand region in a circumscribed area off northeast coast of North Island from Three Kings Islands to Poor Knights Island (Map 8); 29–388 m.

DESCRIPTION: Corallum sparsely and irregularly branched, one of the largest specimens examined (AU9129, Plate 4, f) 140 mm in height and 14 mm in basal branch diameter, having 13 terminal branches. Slender terminal branches bear distally inclined, sympodially arranged corallites, but intermediate to large-diameter branches bear perpendicularly oriented corallites that are uniformly distributed on all branch faces. Most corallites are exsert, as much as 3.0 mm; however, corallites on basal branches sometimes flush or even recessed into coenosteum. Calices circular, ranging from 2.5–4.5 mm in diameter. Costae conspicuous only near calice, where they are 0.22–0.31 mm wide and separated by shallow intercostal striae about 30 µm in width. Costae, as well as remaining coenosteum, covered with low, rounded granules 70–80 µm in diameter.

Septa predominantly hexamerally arranged in 4 complete cycles, one pair of S4 usually occurring in each of the 2 systems on the leading (distal) edge of each corallite, resulting in 28 septa (6:6:12:4). Occasionally, one system is without the S4 pair or a third system acquires a pair of S4, resulting in 26 or 30 septa, respectively. In about 10% of the corallites examined, septa are heptamerally arranged in 3 complete cycles (7:7:14), also resulting in 28 septa. S1 exsert (up to 0.8 mm) and rather narrow (0.7 mm), having straight, vertical, slightly dentate inner edges, each of which bears a narrow (0.15 mm wide) paliform lobe near the columella. S2 slightly less exsert and less wide (about three-quarters width) than an S1, each bearing a slightly wider (0.25– 0.30 mm) paliform lobe. S3 half to two-thirds width of an S2 and have dentate inner edges, unless flanked by a pair of S4, in which case they are as wide as an S2 and bear a paliform lobe of equal size and same relative position as a P2, the 2 paliform lobes within such a system being paired. The crown of 6 P1 lie low in the fossa directly adjacent to the columella; the 6–8 P2 form a second crown of lobes that rise higher in the fossa and are slightly more recessed from the columella than the P1. Columella papillose, composed of 2–4 granular pillars.

TYPES: The holotype and three paratypes are deposited at the NZGS, the holotype numbered CO1219.

TYPE LOCALITY: Sandstone, Waitemata Group, the Funnel, Kaipara Harbour, Auckland, North Island, Altonian (early Miocene).

REMARKS: Two exclusively fossil species of *Oculina* are known from New Zealand: *O. oamaruensis* Park, 1917 (middle Eocene to early Miocene) and *O. nefrens* Squires, 1958 (Cretaceous), and only one other recent Pacific species is known: *O. profunda* Cairns, 1991a (Galápagos and California, 119–578 m). *Oculina virgosa* is distinguished from these three species by its tendency to have 28 septa, either in an incomplete hexamerally arranged fourth cycle or a full heptamerally arranged three cycles. Squires' (1958: text-fig. 11) diagram of the septal plan of this species is incorrect, showing twice as many septa (56) as proper and thus also confusing the paliform lobe arrangement.

Madrepora Linnaeus, 1758

Corallum colonial (arborescent), corallites formed by extratentacular alternate budding; no axial corallites. Coenosteum dense and weakly costate or uniformly granular. P2 sometimes present. Columella papillose or absent.

TYPE SPECIES: *Madrepora oculata* Linnaeus, 1758, by subsequent designation (Verrill 1901).

REMARKS: Many species names have been attributed to the genus *Madrepora* (*see* Zibrowius 1974b); however, there are probably only three or four valid recent species, which includes the highly variable, cosmopolitan *M. oculata* Linnaeus, 1758. A discussion of its variation is found in Zibrowius (1980) and Cairns (1982, 1991a). Other distinctive species include: *M. carolina* (Pourtalès, 1871) and *M. kauaiensis* Vaughan, 1907.

Madrepora oculata Linnaeus, 1758
(Plates 5, e, f, 6, a, b)

Madrepora oculata Linnaeus, 1758: 798; Zibrowius 1974b: 762–766, pl. 2, figs 2-5 (synonymy); Cairns 1979: 39–42, pl. 3, fig. 2, pl. 4, fig. 5, pl. 5, figs 1–3 (synonymy); Zibrowius 1980: 36–40, pl. 13, figs A–P (synonymy); Cairns 1991a: 9–10, pl. 2, fig. j, pl. 3, figs a-d; 1994: 1819, pl. 3, figs. f-h (synonymy).
Madrepora vitiae Squires & Keyes, 1967: 22, pl. 1, figs 4–8; Dawson 1979: 29–30.

MATERIAL EXAMINED: New Records: typical (*vitiae*) form: NZOI Stn B490, USNM 88376; NZOI Stn C509, NZOI; Stn D6, NZOI; Stn D424 (dead), NZOI; Stn E908, NZOI; Stn F10, NZOI; Stn H222, NZOI; Stn H223, NZOI; Stn P68, NOZI; Stn S572, USNM 93989; Stn T235, NZOI; Stn T256, NZOI; *Volcanolog* Stn 64, AUM AU12299. Encrusting form: NZOI Stn K828, NZOI; Stn K840, NZOI; Stn K858, NZOI; Stn U591, USNM 93987; Stn U594, USNM 93988; Stn Z2098, NZOI; BS441, MoNZ CO256. Previous Records: Types of *M. vitiae*; specimens reported by Squires and Keyes (1967) and Cairns (1982).

DISTRIBUTION: New Zealand region: typical form: widespread from southern Macquarie Ridge to Kermadec and Three Kings Ridges (Map 2); 149–946 m, the shallowest records off Fiordland. Symbiotic form: Three Kings and Kermadec Ridges: 398–850 m. Elsewhere: cosmopolitan except for off continental Antarctic; 15–1500 m.

TYPES: The types of *M. oculata* are lost (Zibrowius 1980). The holotype and three paratypes of *M. vitiae* are deposited at the NZOI (H-17, P-18–20) (*see* Dawson 1979).

TYPE LOCALITIES: *M. oculata*: Tyrrhenian Sea and off Sicily, Mediterranean; depth unknown. *M. vitiae*: NZOI Stn B314, 39°22′ S, 171°50′ E (northwest of Cape Farewell), 230–251 m.

REMARKS: *Madrepora oculata* is a widespread and variable species that has been described and illustrated many times (*see* synonymy). Two forms of the species occur in the New Zealand region: forma *vitiae*, decribed as a new species by Squires and Keyes (1967) and the "symbiotic" form, so named because of its association with commensal poly-chaetes that form tube galls throughout the corallum. Forma *vitiae* consists of robust colonies with long sympodially budded branches that infrequently anastomose. Its coenosteum is white and faintly striate. Calices are 2.6–3.3 mm in diameter and septa are hexamerally arranged in three complete cycles (S1>S2>S3). P2 may or may not be present; the columella is rather small and papillose. The symbiotic form consists of small, bushy colonies that are penetrated by polychaete worm tubes. Its branches are relatively short and frequently anastomose. Its coenosteum is light brown and finely granular, not striate. Calices are smaller, only 1.9–2.2 mm in diameter, and septa are hexamerally arranged in three cycles (S1>S2>S3). P2 may or may not be present; columella papillose and rather large.

Family ANTHEMIPHYLLIIDAE Vaughan, 1907

Anthemiphyllia Pourtalès, 1878

Corallum solitary and patellate or bowl-shaped. Coralla begin attached to substratum but usually become free as an adult. Base porcellanous and/or costate, often showing a scar of attachment. Septotheca thick and dense. Septal edges dentate to coarsely lobate. Pali absent; columella papillose.

TYPE SPECIES: *Anthemiphyllia patera* Pourtalès, 1878, by monotypy.

REMARKS: *Anthemiphyllia* is the only genus in the Anthemiphylliidae; however, Best and Hoeksema (1987) consider it to be a faviid genus, with close affinities to *Indophyllia* Gerth, 1921. Six species are known in the genus: *A. patera* Pourtalès, 1878 (western Atlantic, 500–700 m); *A. dentata* (Alcock, 1902a); *A. pacifica* Vaughan, 1907 (off Hawaiian Islands, 205– 296 m); *A. patella* Gerth, 1923 (Tertiary, Java); *A. frusta* Cairns, 1994 (off Japan, 237–241 m); and an undescribed species (*A. dentata sensu* Cairns 1984) (off Hawaiian Islands, 369 m).

Anthemiphyllia dentata (Alcock, 1902)
(Plate 6, c-g)

Discotrochus dentatus Alcock, 1902a: 104; 1902c: 27, pl. 4, figs 26, 26a.

Anthemiphyllia dentata: Wells 1958: 264, pl. 1, figs 8–11; Not Cairns 1984: 11, pl. 1, figs F–G (= undescribed species); Best & Hoeksema 1987: 398–399, figs 9a-c; Cairns & Parker 1992: 16–17, pl. 4, figs e-f (synonymy); Cairns 1994: 44–45, pl. 18, figs d-f (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn C527, 8, USNM 93990; Stn I92, 1, NZOI; Stn K828, 2, USNM 93991; Stn K840, 3, NZOI; Stn K842, 1 attached form, USNM 93992; Stn K858, 2, NZOI; Stn K872, 1 attached form, USNM 93993; Stn P10, 4, NZOI; Stn T217, 5, USNM 93994; Stn U591, 1, USNM 93995; Stn U594, 2, NZOI; BS441, 16, MoNZ CO226 and 234, 6, USNM 94357.

DISTRIBUTION: New Zealand region: ridges north of New Zealand, including southern Norfolk, Three Kings, and Kermadec Ridges (Map 14); 280–570 m. Elsewhere: Arabian Sea; Maldives; Sulu and Banda Seas; off Japan; off southeast Australia and Tasmania; 50–560 m.

DESCRIPTION: Corallum shaped as a shallow bowl, the largest specimen examined (NZOI Stn T217) 21.9 mm in diameter and 11.4 mm in height. Most coralla are free, but often display a circular scar or irregularity 4–6 mm in diameter at centre of base. Several specimens, including all juvenile specimens and 2 adults from NZOI Stn K842 and K872, are firmly attached to the substratum by a region 4–6 mm in diameter. It is believed that free coralla result when specimens originally attach to a small and/or unconsolidated substratum; attached coralla persist if the substratum is large and solid. Central basal region often smooth, even porcellanous, but toward basal perimeter discrete, rounded costae 0.8–1.0 mm wide occur, separated by narrow (0.2 mm) intercostal furrows that become increasingly deep towards basal edge. Occasionally very thin ridges bisect each intercostal furrow. Costae very finely granular, 6 or 7 granules occurring across the width of a costa, each granules about 50 µm in diameter. Corallum white.

Septa hexamerally arranged in 5 cycles, the last cycle usually incomplete, the most common septal complement being 60, achieved by having one pair of S5 in each system. In some coralla, 2 pairs of S5 occur in a system, but invariably within the same half-system. S1–2 quite thick (up to 1 mm) and bear 7–11 septal lobes, the number dependent on the calicular radius. Innermost septal lobes cylindrical (0.3–0.4 mm in diameter), but become increasingly wider and thicker toward calicular edge such that outermost lobes are quite coarse (up to 1 mm wide) and have blunt tips. S1–2 have straight inner edges and highly granular faces, especially the faces of the prominent septal lobes. S2 only slightly less exsert and less wide than the S1. S3 almost as wide as the S2 (reaching almost to columella), but only half as thick. S3 bear 12–16 tall, cyclindrical teeth, the tallest being near the calicular edge. Unflanked S4 and all S5 about half width of an S3 and bear 10–12 tall, laciniate teeth, each about 0.3 mm in diameter. Fossa shallow, containing a granular, papillose columella, the elements about 0.5 mm in diameter, and indistinguishable from inner teeth of S1–2.

TYPES: Seven syntypes of *D. dentatus* are deposited at the ZMA (Coel. 716–718) (Van Soest 1979).

TYPE LOCALITY: *Siboga* Stns 95, 98, and 100, Sulu Sea; 350–522 m.

REMARKS: The New Zealand specimens reported herein differ slightly from those reported from the Indian Ocean (Cairns & Keller 1993), Australia (Cairns & Parker 1992), and the Sulu Sea (Alcock 1902a) in having smaller, bowl-shaped coralla. Specimens from other regions are usually larger and flatter, and, being larger, have more septal spines/lobes per septum. The S1–2 septal lobes of the New Zealand specimens are, in general, fewer in number and coarser in shape than those from other regions, but there appears to be great variation in this character, even among specimens from the same station. *Anthemiphyllia dentata* is distinguished from other species in the genus by having up to 5 cycles of septa and relatively large coralla, most other species having smaller coralla and only 4 cycles of septa. The New Zealand specimens are similar to the unique specimen reported as *A. dentata* by Cairns (1984), both taxa having bowl-shaped coralla of about the same size and 60 septa, but the Hawaiian specimen is distinguished by its distinctive S1 lobation.

Suborder CARYOPHYLLIINA
Superfamily CARYOPHYLLIOIDEA Dana, 1846
Farmily CARYOPHYLLIIDAE Dana, 1846

Caryophyllia Lamarck, 1816

Corallum solitary; attached (subcylindrical, ceratoid, trochoid) or free (cornute). Calice circular, elliptical, or compressed; thecal edge spines present on species having compressed coralla. Septal symmetry variable, but hexameral symmetry with 4 cycles of septa most common. One crown of pali present before penultimate or (rarely) antipenulti-

mate septal cycle. Columella fascicular, composed of one to several twisted laths.

REMARKS: Three subgenera are recognised in this genus: the nominate subgenus, *C. (Premocyathus)* and *C. (Acanthocyathus)*, the first two of which occur in New Zealand waters.

Caryophyllia (Caryophyllia) Lamarck, 1816

Caryophyllia in which the calice is circular to elliptical (not highly compressed) and in which the corallum does not have edge spines or thecal crests.

TYPE SPECIES: *Madrepora cyathus* Ellis & Solander, 1786, by subsequent designation (Broderip 1828).

REMARKS: The approximately 56 recent species in this diverse subgenus were listed by Cairns (1991a) in such a way as to facilitate comparison among species. Characters found useful and relatively conservative in grouping species include: presence or absence of attachment; septal symmetry; and number of septal cycles. Other characters useful in discriminating species are: position of palar crown (before penultimate or antipenultimate septal cycle); relative width of highest-cycle septa relative to penultimate cycle; relative exsertness of septal cycles; degree of septal and palar sinuosity; development of columella; and pigment pattern.

Key to the 12 Species of *Caryophyllia (Caryophyllia)* known from the New Zealand Region

1 Corallum attached (ceratoid, trochoid, subcylindrical) 2
Corallum free (cornute) 11

2 Corallum with 12 or more pali 3
Corallum with 8–10 pali 9

3 Adult corallum large (GCD > 20 mm); 64-98+ septa 4
Adult corallum small to medium-sized (GCD usually < 20 mm); 48-60 septa 6

4 Pedicel narrow (PD: GCD < 0.2); last cycle of septa (third) wider than penultimate (second); 14-16-18 pali ..... *C. atlantica*
Pedicel robust (PD: GCD > 0.2); last cycle of septa less wide than penultimate cycle; 12-26 pali 5

5 Twelve narrow pali present before S3 ..... *C. ralphae*
Sixteen to 26 wide pali present before S4 ..... *C. profunda*

6 S4 wider than S3; fossa deep ..... *C. elongata*
S4 narrower than S3; fossa of moderate depth 7

7 Theca transversely ridged; septa pigmented black-brown ..... *C. lamellifera*
Theca costate and/or granular; septa white 8

8 S1–2, 4 have straight inner edges; theca costate, columella consists of numerous (7–39) elements; common off North Island and Chatham Rise ..... *C. japonica*
S1–2, 4 slightly sinuous; theca porcellanous; columella consists of 3–12 elements; common on Kermadec and Colville Ridges ..... *C. diomedeae*

9 Septa octamerally arranged (8 pali); theca transversely ridged; septa and pali highly sinuous ..... *C. rugosa*
Septa pentamerally or hexamerally arranged (usually 10 pali); theca granular or porcellanous; septa and pali moderately sinuous 10

10 S1 wider and more exsert than S2; pentameral symmetry; S4 wider and more exsert than S3; corallum usually pigmented ..... *C. hawaiiensis*
S1 equal to S2 in exsertness and width; decameral symmetry; S4 ≤ width of S3; corallum white ..... *C. quadrageneria*

11 Corallum with 24 pali ..... *C. ambrosia*
Corallum with 12-16 pali ..... *C. scobinosa*

Caryophyllia (C.) rugosa Moseley, 1881

(Plates 6, h, 7, a-c)

Caryophyllia rugosa Moseley, 1881: 141–143, pl. 1, fig. 8; Cairns 1984: 11–13, pl. 2, figs A–B, pl. 4, fig. I (synonymy); Cairns & Keller 1993: 236, pl. 3, fig. I; Cairns 1994: 47, pl. 20, fig. i, pl. 21, fig. a.

MATERIAL EXAMINED: New Records: NZOI Stn C527, 2, USNM 88387; Stn C530, 23, USNM 94005; Stn C531, 14, USNM 94003; Stn I91, 1, NZOI; Stn I741, 1, NZOI; Stn K803, 2, NZOI; Stn K825, 1, NZOI; Stn K826, 3, NZOI; Stn K839, 2, NZOI; Stn K842, 4, NZOI; Stn K843, 3, NZOI; Stn K844, 1, USNM 94004; Stn K867, 1, NZOI; Stn

Q70, 1, NZOI; BS307, 3, MoNZ CO87; BS309, 2, MoNZ CO251; BS310, 16, MoNZ CO82; BS313, 4, MoNZ CO94; BS438, 1, MoNZ CO255; BS441, 3, MoNZ CO233; BS 571, 3, MoNZ CO231; RV *Franklin* Stn 5/89/40, 3, AMS G15559.

DISTRIBUTION: New Zealand region: Lord Howe Seamount Chain; off Norfolk Island; Kermadec Islands (Map 16); 142–508 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan and the Hawaiian Islands, including off the Chesterfield Islands (reported herein); 71–439 m.

DESCRIPTION: Corallum ceratoid to cylindrical and firmly attached through a thick pedicel and thin encrusting base, the latter covering a substratum up to twice the diameter of the calice. Largest New Zealand specimen (NZOI Stn C531) 6.4 x 5.8 mm in calicular diameter; coralla usually 8–10 mm in height. Theca porcellaneous in well-preserved coralla, covered with narrow (65–75 µm wide), transverse, circumferential ridges, these ridges splitting and rejoining one another in their circuit around the corallum. Approximately 7–9 ridges occur per mm, each separated by a shallow groove of equal width. Costal ridges present on encrusting base as well as the apex of each exsert septum (Plates 6, h, 7, a). Most coralla are white; however, some coralla are light brown or have a light-brown thecal pigmentation encircling the calice. In several specimens thick, but short, longitudinal brown stripes are associated with the theca of the secondary septa.

In most (95%) of the specimens examined, septa are octamerally arranged in 3 complete cycles (8:8:16, 32 septa). Two specimens have nonameral symmetry (9:9:18, 36 septa), one has decameral symmetry (10:10:20, 40 septa), and one had septameral symmetry (7:7:14:4, 28 septa). Primary septa exsert (0.7–0.8 mm), extend about three-quarters distance to columella, and have extremely sinuous inner edges. Secondary septa less exsert, about four-fifths width of a primary, and also have extremely sinuous inner edges. Tertiary septa about three-quarters width of secondaries and have moderately sinuous inner edges. Septal faces bear short carinae. A tight crown of 7–8–10 slender (0.3–0.4 mm wide), extremely sinuous pali (P2) encircle a fascicular columella. Columella consists of 1–15 narrow (0.20–0.25 mm in diameter) elements. Based on 52 coralla, the average number of columellar elements/calice is 4.44 (σ = 2.19) and the mode was 4. When 4 columellar elements are present, they are usually arranged in a diamond pattern: 2 aligned with the 2 principal septa, and 2 aligned with the 2 mid-lateral primary septa. Fossa shallow.

TYPES: The syntypes of *C. rugosa* are deposited at the BM(NH).

TYPE LOCALITY: *Challenger* Stns 192 and 201, Banda and Sulu Seas; 187–230 m.

REMARKS: Four species of attached recent *Caryophyllia* are known to have octamerally arranged septa: *C. rugosa; C. octopali* Vaughan, 1907; *C. barbadensis* Cairns, 1979; and *C. marmorea* Cairns, 1984. *Caryophyllia rugosa* is easily distinguished from the others species by its transverse thecal ridges and extremely sinuous septa and pali. It appears to be an opportunistic species, often found attached to dead coralla of various species, bivalve shells, sponges, and rocks.

Caryophyllia (C.) hawaiiensis Vaughan, 1907

(Plate 7, d-f)

Caryophyllia hawaiiensis Vaughan, 1907: 76, pl. 5, figs 4a-b (not *Albatross* Stn 3885, = *Balanophyllia*); Cairns 1984: 11; 1991a: 12.

MATERIAL EXAMINED: New Records: NZOI Stn C530, 1, NZOI; Stn I76, 1, USNM 94010; Stn K803, 1, USNM 94011; Stn K838, 1, NZOI; Stn P5, 1, USNM 94012; Stn P48, 1, NZOI; Stn P115, 1, USNM 94013; BS310, 1, MoNZ CO85; BS571, 2, MoNZ CO229; BS807, 1, MoNZ CO87; *Albatross* Stn 3708, 2, USNM 22060; *Albatross* Stn 4894, 1, USNM 92684. Previous Records: Types of *C. hawaiiensis*.

DISTRIBUTION: New Zealand region: Kermadec and southern Three Kings Ridges; off Lord Howe Island (Map 18); 126–279 m. Elsewhere: off Hawaiian Islands; off Japan (Suruga Bay, and off Fukue Jima), reported herein; 128–174 m.

DESCRIPTION: Corallum ceratoid, straight, and firmly attached by a robust pedicel 0.34–0.49 GCD. Largest specimen known (NZOI Stn P115) 11.6 x 9.1 mm in calicular diameter and 27.7 mm in height, with a pedicel diameter of 5.3 mm. Costae absent or poorly defined, although in some specimens the 10 C1–2 are slightly ridged. Intercostal striae either faint or absent, the theca being porcellanous and uniformly covered with very low, rounded granules, 2 or 3 occurring between each intercostal stria. Theca thin (about 0.2 mm), the upper half often speckled with a dark-brown colour. All septa except for the S3 are also bear dark-brown bands of pigmentation that parallel the inner septal edges. Degree of thecal and septal pigmentation quite variable.

Septa usually pentamerally arranged in 4 cycles (5:5:10:20), resulting in 40 septa and 10 pali, but see remarks for exceptions. S1 (5 primary septa) highly exsert (2.5–3.8 mm) and have straight, vertical inner edges that extend about three-quarters distance to columella. Because of the odd-numbered nature of symmetry, only one S1 is aligned with the greater calicular axis, the septum opposite this S1 being an S2. S2 about three-quarters as exsert (2.0–2.7 mm) and as wide as an S1 and have slightly sinuous inner edges. S3 only about one-third as exsert as an S2 but threequarters their width, and have more sinuous inner edges than an S2. S4 variable in exsertness and width, depending on their position. S4 adjacent to S1 are almost as exsert and as wide as an S2 but considerably thinner, each pair of S4 flanking an S1 fused to it to form an exsert triangular lancet. On a slightly smaller scale, the S4 that flank each S2 also form smaller lancets, these S4 being slightly less exsert and wide as those that flank the S1. Pali relatively wide (0.7 mm) and sinuous, forming a distinct crown of 10 pali (P3) encircling a fascicular columella composed of 6–18 slender (0.6–0.9 mm in diameter) elements. Fossa deep.

TYPES: Four syntypes are deposited at the USNM (20749–50).

TYPE LOCALITY: *Albatross* Stn 3838, 21°04'05" N, 157°10'35 W (off Molokai, Hawaiian Islands), 168–388 m.

REMARKS: All but one of the New Zealand specimens has pentameral symmetry and 10 pali, the specimen from NZOI Stn I76 having 48 hexamerally arranged septa and 12 pali. It should be noted that among the four Hawaiian syntypes, three have 10 pali, whereas one (USNM 20749) has 11 pali and 44 septa. And, of the three nontype specimens reported by Vaughan (1907) from *Albatross* Stn 4061 and 3838, two are typically pentameral but one has 11 pali. Also, the three specimens reported herein from off Japan are all hexameral, having 12 pali and 48 septa. Thus, although there is a tendency for this species to have pentameral symmetry and 10 pali, specimens with hexameral symmetry and 11 or 12 pali occur as well.

Caryophyllia (C.) quadragenaria Alcock, 1902
(Plate 7, g, h)

Caryophyllia quadrageneria Alcock, 1902a: 91–92; 1902c: 10, pl. 1, figs. 4, 4a; Keller, 1981a: 18; Cairns 1994: 46–47, pl. 20, figs c-h, pl. 41, figs c-d (synonymy).

Caryophyllia scobinosa decapali Yabe & Eguchi, 1942b: 120, 149, pl. 10, figs 6-7.

Caryophyllia profunda: Squires & Keyes 1967: 23 (in part: NZOI Stn C797, C810).

MATERIAL EXAMINED: New Records: NZOI Stn B489, 4, NZOI; Stn C776, 1, USNM 94007; Stn C777, 3, NZOI; Stn D74, 1, NZOI; BS899 (O645), 1, MoNZ CO298. Previous Records: Types of *C. quadragenaria* and *C. scobinosa decapali;* specimens reported as *C. profunda* by Squires and Keyes (1967) from NZOI Stn C797(2) and C810(1).

DISTRIBUTION: New Zealand region: coastal New Zealand from Three Kings Islands to Auckland Island (Map 7); 77–198 m. Elsewhere: off Japan; Korea Strait; Makassar Strait; Banda and Timor Seas; 54– 296 m.

DESCRIPTION: Corallum ceratoid, straight, and attached by a pedicel 0.22–0.39 GCD. Coralla small, the largest New Zealand specimen (NZOI Stn C776) only 9.7 x 8.8 mm in calicular diameter and 13.4 mm in height, with a pedicel diameter of 3.0 mm. Theca granular, but costae well defined only near the calice where intercostal striae are deeply incised. Corallum white.

Septa decamerally arranged in 3 cycles (10:10:20, 40 septa). Primary septa about 1.5 mm exsert and have straight, vertical to slightly inclined inner edges that extend about three-quarters distance to columella. Secondary septa less exsert (about 1 mm), about five-eights width of a secondary, and have sinuous inner edges. Tertiary septa equally exsert and usually equally as broad as the secondaries, and have straight inner edges. Ten broad (about 1.4 mm wide), highly sinuous pali (P2) form a crown before the secondary septa. Palar face ornamentation consists of tall, sparse granules, often fused into short carinae. Fossa of moderate depth; columella consists of 3–11 slender, twisted elements.

TYPES: Two syntypes of *C. quadragenaria* are deposited at the ZMA (Coel. 5534). The holotype and paratypes of *C. scobinosa decapali* are deposited at the TIUS.

TYPE LOCALITIES: *C. quadragenaria*: *Siboga* Stns 90, 251, 289; Makassar Strait, Banda and Timor Seas; 54–281 m. *C. scobinosa decapali*: *Soyo-Maru* Stn 210; 33°29 'N, 135°28' E (Kii Strait, southeastern Honshu), 165 m.

REMARKS: Among the recent *Caryophyllia*, seven species are distinguished as having decameral symmetry (Cairns 1991a), four of which occur in the Pacific: *C. quadragenaria, C. hawaiiensis, C. solida* Cairns, 1991a

(Galápagos, 37–488 m); and *C. perculta* Cairns, 1991a (Galápagos and off Panama, 54–64 m). *Caryophyllia quadragenaria* is most similar to *C. perculta,* but can be distinguished by lacking septal-face carinae and having short palar-face carinae. Vaughan (1907: 76) noted a similarity betweem *C. quadragenaria* and *C. hawaiiensis,* but the latter is relatively easily distinguished by having five extremely exsert S1 that are larger than the five S2, which more accurately classifies this species as pentameral instead of decameral. Furthermore, the S4 of *C. hawaiiensis* are wider than their S3 and the corallum is mottled with brown pigment.

Caryophyllia (C.) profunda Moseley, 1881
(Plates 7, i, 8, a-c)

Caryophyllia profunda Moseley, 1881: 138–139, pl. 1, figs 6, 6a (in part: not specimen from Cape Verde Islands); Marenzeller 1904a: 298; Gardiner 1913: 688–689; 1929: 126; 1939: 331; Powell 1947: 8, fig. 15; Ralph 1948: 108–109, top and middle figures; Squires 1958: 44, 91; 1960b: 196, 198–200, pl. 34, figs 5–7, pl. 35, figs 9–11; Ralph & Squires 1962: 6–7, pl. 1, figs 8–11; Squires 1964a: 11; Squires & Keyes 1967: 23, pl. 2, figs 1–4 (but not NZOI Stn A904, C608, C797, C810); Squires 1969: 17, pl. 6, map 1; Zibrowius 1974b: 751–755, pl. 1, figs 1–10 (discussion); Dawson 1979: 28; Cairns 1982: 17–19, pl. 5, figs 1–5 (in part: not *Eltanin* Stn 1403) (synonymy); Zibrowius & Gili 1990: 25–26, pl. 4, figs L–R; Cairns & Keller 1993: 235–236.

Caryophyllia maculata: Ralph 1948: 109, lower right figure.

Caryophyllia cf. *C. maculata*: Ralph & Squires 1962: 7, pl. 2, figs 1–2; Squires & Keyes 1967: 23, pl. 2, figs 5–6.

Material Examined: New Records: NZOI Stn B152, 1, NZOI; Stn B473, 7, NZOI; Stn B476, 1, USNM 94018; Stn B487, 2, NZOI; Stn B489, 2, USNM 94014; Stn B554, 1, NZOI; Stn C399, 1, NZOI; Stn C642, 1, USNM 94015; Stn C690, 1, USNM 94016; Stn C703, 5, USNM 94017; Stn C814, 1, NZOI; Stn D6, 1, NZOI; Stn D228, 5, NZOI; Stn D876, 7, USNM 94019; Stn D888, 2, NZOI; Stn D899, 1, NZOI; Stn E291, 2, NZOI; Stn E636, 1, NZOI; Stn E720, 20, NZOI; Stn E751, 3, USNM 94020; Stn E755, 2, NZOI; Stn E792, 4, NZOI; Stn E796, 5, NZOI; Stn E804, 5, NZOI; Stn E846, 2, NZOI; Stn E849, 5, NZOI; Stn E908, 50, NZOI; Stn F10, 4, USNM 94021; Stn F797, 1, NZOI; Stn F933, 5, NZOI; Stn G303, 1, NZOI; Stn I375, 16, NZOI; Stn I745, 1, NZOI; Stn J55, 2, USNM 94037; Stn J59, 1, NZOI; Stn J676, 25, USNM 94038; Stn J679, 18, NZOI; Stn J971, 2, NZOI; Stn M782, 1, USNM 94039; Stn O841, 2, NZOI; Stn O852, 3, USNM 94040; Stn P13, 2, NZOI; Stn P14, 2, NZOI; Stn P842, 1, NZOI; Stn P846, 1, NZOI; Stn Q24, 3, NZOI; Stn Q25, 4, NZOI; Stn Q31, 1, NZOI; Stn Q38, 5, NZOI; Stn Q40, 10, NZOI; Stn Q743, 1, NZOI; Stn S6, 8, NZOI; Stn S8, 1, NZOI; Stn S122, 1, NZOI; Stn S130, 20, NZOI; Stn S216, 5, NZOI; Stn S222, 10, NZOI; Stn S257, 4, NZOI; Stn S260, 1, NZOI; Stn T7, 1, NZOI; Stn U208, 4, NZOI; BS402, 1, MoNZ CO102; BS630, 6, MoNZ CO124; BS654 (R12), 1, MoNZ CO168; BS682 (R40), 1, MoNZ CO296; BS697 (R55), 1, MoNZ; BS718 (R76), 3, MoNZ; BS753 (R111), 4, MoNZ; BS770 (R128), 1, MoNZ CO308; BS842 (O588), 4, MoNZ; BS856 (O602), 1, MoNZ; BS888 (O634), 2, MoNZ; BS889 (O635), 20, MoNZ CO152; Doubtful Sound, Malaspina Beach, 20–30 m, USNM 76304. Previous Records: Syntypes of *C. profunda;* specimens reported by Gardiner (1939), Ralph and Squires (1962), Squires and Keyes (1967), and Zibrowius (1974b).

Distribution: New Zealand region: widespread in New Zealand region from southern Norfolk Ridge to off Macquarie Island (Map 3); 20–1300 m, the shallow records limited to fiord locations. Elsewhere: cold-temperate southern hemisphere from Walvis Ridge (off Namibia) to New Zealand, including Tristan de Cunha, Gough Island, Agulhas Bank and Plateau, Madagascar Plateau, and St. Paul and Amsterdam Islands; 35–1116 m.

Description: Corallum ceratoid to subcylindrical, straight, and firmly attached through a robust pedicel up to 60% of GCD. Largest New Zealand specimen (NZOI Stn J55) 39.5 x 35.1 mm in calicular diameter and 81 mm in height, with a pedicel diameter of 13.3 mm. Calice usually a regular ellipse but occasionally elongate or polygonal. Costae well defined and approximately equal in width, each costa about 0.9 mm wide and separated by very thin (0.1 mm wide), shallow intercostal striae, which become wider and deeper only near the calicular edge. C1–3 sometimes slightly ridged. Theca glisten-ing, each costa bearing numerous small rounded granules often arranged in horizontal rows of 4 or 5 granules, each short row resembling a transverse ridge. Corallum usually white, but often the theca is tinted a light brown.

Septa hexamerally arranged in 5 cycles, most large specimens having a full 96 septa and 24 pali; however, many specimens of medium size have fewer septa (64–92 septa, 16–23 pali, respectively), whereas one large specimen had 104 septa and 26 pali. A full fifth cycle can be present in coralla as small as 13 mm GCD. S1–2 moderately exsert (about 3 mm) and have straight, vertical inner edges that fuse to the columella only deep within fossa. S3 four-fifths to equivalent width of S1–2 and 2–3 mm exsert, the larger S3 characteristic of large specimens. S4 about three-quarters width of an S3 and have slightly sinuous inner edges, each of which is bordered by a broad, lamellar palus, the palus sometimes wider (2.2–4.8 mm wide) than its corresponding S4. Each

P4 is a thin (0.25 mm) lamella, rounded on top and with a vertical inner edge, separated from its corresponding S4 by a deep, U-shaped notch. Pali straight-edged (not sinuous), their faces virtually smooth, together forming a well-defined elliptical crown encircling the columella. S5 about three-quarters width of an S4 and have straight inner edges. Occasionally some pali of some specimens are divided into 2 or 3 lobes, each lobe separated by a deep thin slit. All septal and palar faces bear low, rounded granules. Fossa of moderate depth, containing the palar crown and fascicular columella, the latter composed of 5–30 slender, twisted elements, often fused among themselves.

TYPES: Approximately 20 syntypes of *C. profunda* are deposited at the BM(NH) (*see* Cairns 1982).

TYPE LOCALITY: *Challenger* Stn 135, 37°01'50 S, 12°19'10 W (Nightingale Island, Tristan de Cunha Islands), 183–274 m.

REMARKS: One of the commonest species in the New Zealand region, *C. profunda* is found in unusually shallow water in the fiords off the southwestern coast of South Island. This robust species is distinguished from other *Caryophyllia* by often having a broad pedicel, 16–24 pali (corresponding to 64–96 septa), and a characteristic costal granulation.

Caryophyllia (C.) atlantica (Duncan, 1873)
(Plate 8, d, e)

Bathycyathus atlanticus Duncan, 1873: 318, pl. 48, figs 1–2.
Caryophyllia laevicostata Moseley, 1881: 134, pl. 1, fig. 1.
?Caryophyllia panda Alcock, 1902a: 91; 1902c: 9, pl. 1, figs 3, 3a (new synonymy).
Caryophyllia alcocki Vaughan, 1907: 73-74, pl. 5, fig. 1; Not Yabe & Eguchi 1942b: 120.
Caryophyllia atlantica : Zibrowius 1980: 56–57, pl. 20, figs A–K (synonymy); Cairns 1982: 11.
Caryophyllia profunda: Squires & Keyes 1967: 23 (in part: NZOI Stn A904).
?Caryophyllia pacifica Keller, 1981a: 16–17, pl. 1, figs 2a-b; 1981b: 33, pl. 1, figs 1a-b (new synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn A904, 1, USNM 94023; Stn I694, 4, NZOI; Stn S46, 2, NZOI; Stn U595, 1, USNM 94024; *Eltanin* Stn 1712, 11, USNM 94022. Previous Records: Types of *C. alcocki;* specimens reported by Zibrowius (1980) and Squires and Keyes (1967) as *C. profunda.*

DISTRIBUTION: Characteristic of seamounts, guyots, and off small oceanic islands from east of East Cape to the Campbell Rise (Map 3); 1004–1474 m. Elsewhere: eastern Atlantic from Mediterranean to Ascension Island; Hawaiian Islands; ?Marcus-Necker Ridge (Keller 1981a); ?Ceram Sea (Alcock 1902c); 776–2165 m.

DESCRIPTION: Corallum ceratoid, often slightly curved near base, and attached through a slender pedicel rarely over 5 mm in diameter (PD:GCD = 0.18–0.20). Largest New Zealand specimen examined (NZOI Stn A904, originally reported by Squires & Keyes, 1967 as *C. profunda*) 30.3 x 27.6 mm in calicular diameter (broken at base); other intact coralla up to 50 mm in height. Calice elliptical, the edges quite lacerate. Costae well defined, 0.9–0.11 mm wide, and flat to slightly convex, the C1–3 sometimes slightly ridged. Intercostal striae quite narrow (about 50 µm) and shallow. Costae covered with small (0.10–0.15 mm diameter) rounded granules, 4 to 6 occurring across a costal width, but not aligned in rows. Corallum white.

Septa arranged in 3 size classes and 14–18 sectors, the most common complement being 16:16:32 (64 septa), which is displayed in 9 coralla; 2 coralla have 14 sectors (14:14:28, = 56 septa); 2 have 15 sectors (15:15:30, = 60 septa); and the large corallum from NZOI Stn A904 has 18 sectors (18:18:36 = 72 septa). Primary septa 4.0–4.5 mm exsert, extend about three-quarters distance to columella, and have straight, vertical inner edges. Secondary septa only about 1 mm exsert, about two-thirds width of a primary, and have slightly sinuous inner edges, each secondary bordered by a broad palus. Tertiary septa about 2 mm exsert, each pair fusing with its common primary to form a small triangular lancet. Tertiary septa wider than the secondaries by about 1 mm (about three-quarters width of a primary), their straight inner edges slightly overlapping the outer edges of the pali. Pali quite wide (up to 5 mm), slightly sinuous, and occasionally wider and thicker than their corresponding secondary septa. Septal faces bear tiny granules but those of the pali are quite coarse, 3–4 times the size of those on the septa. In only one specimen (NZOI Stn A904) were some pali divided into 2 or 3 smaller lobes. The palar crown of 14–18 lamellae is well defined and encircles an elongate columella composed of 2-8 broad fascicular elements that are usually linearly arranged.

TYPES: The lecto- and paralectotype of *B. atlanticus* are deposited at the BM(NH) (*see* Zibrowius 1980). The holotype of *C. laevicostata* is also deposited at

the BM(NH) (1880.11.25.22). Two syntypes of *C. alcocki* are deposited at the USNM (10744-45). The holotype of *C. panda* is deposited at the ZMA (Coel. 573). The type of *C. pacifica* is presumed to be deposited at the IOM.

TYPE LOCALITIES: *C. atlantica*: 39°39′ N, 9°43′ W (off Portugal), 1355–2000 m. *C. laevigata*: off Ascension Island, 776 m. *C. alcocki*: 23°05′ N, 161°52′ W (off Nihoa, Hawaiian Islands), 1602 m. *C. panda*: *Siboga* Stn 177, 2°24′ S, 129°38′ E (Ceram Sea), 163 m. *C. pacifica*: 23°32′ N, 157°23′ E (Marcus-Necker Ridge), 1420 m.

REMARKS: Although not apparent from Vaughan's (1907) description of *C. alcocki*, the two syntypes of this species contain 13 and 14 sectors of septa (52 and 56 septa, respectively), not four cycles of 48 hexamerally arranged septa as might be inferred. Zibrowius (1980) reported that eastern Atlantic specimens have 12–15 sectors (48-60 septa); the type of *C. pacifica* Keller, 1981a appears to have 13 sectors (54 septa). The New Zealand populations thus appear to differ from those reported previously by having a higher number of sectors (14–16–18), only its lower range consistent with Atlantic and Hawaiian populations. The New Zealand specimens also differ in having less exsert primary septa (4.0–4.5 mm), the primary septa of those from other regions reaching as high as 7 mm above the calicular edge.

Although Squires and Keyes (1967) included one specimen of *C. atlantica* in their account of *C. profunda*, *C. atlantica* is distinguished by having: tertiary septa wider than their secondary septa; on average, fewer septa and pali (*C. profunda* of equivalent size usually have 96 septa and 24 pali); a narrower pedicel; more exsert primary septa; thicker pali; and nonaligned costal granules. Comparisons to *C. diomedeae* are made in that account.

The synonymies of *C. panda* and *C. pacifica* are considered as tentative only because I have not examined their type specimens.

Caryophyllia (C.) ralphae n. sp. (Plate 8, f–i)

MATERIAL EXAMINED: Types, q.v. Reference Specimens: two syntypes of *C. capensis* (BM(NH) 1950.1.11.63a).

DISTRIBUTION: Known only from northern Lord Howe Seamount Chain (Gifford Guyot) and south of the Chesterfield Islands (Map 18); 315–360 m.

DESCRIPTION: Corallum ceratoid, slightly flared distally, straight, and attached by a robust pedicel (PD: GCD = 0.31-0.40). Largest specimen (holotype) 32.5 x 24.8 mm in calicular diameter and 36.7 mm in height, with a pedicel diameter of 12.9 mm. Calice elliptical; edge serrate. Theca thick and smooth (but not porcellanous); costae well developed only from the calice to 4–6 mm below the calice, the rounded costae 0.6-0.9 mm wide and separated by deep intercostal furrows about 0.4 mm wide. Otherwise, costae on lower theca are flat, and intercostal striae are poorly defined (thin and shallow), covered with very low, rounded granules arranged 2 or 3 across a costa. Corallum white.

Septa hexamerally arranged in 4 cycles and an incomplete fifth cycle, 1 corallum having 1 pair of S5 in each of 9 half-systems (66 septa), another having a pair of S5 in every half-system and 2 pairs in 1 half-system (74 septa). S1-2 about 3.2 mm exsert, quite thick (about 1.5 mm at apex), and have straight, vertical inner edges that extend about two-thirds distance to columella. S3 only slightly less exsert, about three-quarters width of an S1–2, and have slightly sinuous inner edges. S4 only slightly less exsert and about three-quarters width of an S3, and have straight inner edges. S5 slightly less exsert and about two-thirds width of an S4. Before each S3 is a narrow (2.0–2.2 mm wide), rounded, thick, lamellar (not sinuous) palus (P3), together forming a crown of 12 elements deep in fossa. P4 are not formed even when pairs of S5 occur; instead, the position of the P3 seems to migrate to a location between the S3 and the accelerated S4. Columella consists of 3-6 granular rods, aligned along the axis of the GCD.

TYPES: Holotype: NZOI Stn I741, NZOI H-623. Paratypes: RV *Franklin* Stn 5/89/40, 3, AMSG15500, 1, USNM 94006.

TYPE LOCALITY: 22°43′00 S, 159°16′00 E (Gifford Guyot, northern Lord Howe Seamount Chain), 328 m.

ETYMOLOGY: This species is named in honor of Patricia M. Ralph for her contributions to our knowledge of New Zealand Scleractinia.

REMARKS: Among the approximately 58 recent species of *Caryophyllia* (*see* Cairns 1991a), a small subset of four species is characterised by having pali before its antipenultimate (vs penultimate) cycle of septa: *C. paucipalata* Moseley, 1881 (Lesser Antilles, 714–843 m); *C. capensis* Gardiner, 1904 (off South Africa, 59 m); *C. eltaninae* Cairns, 1982 (off South

Georgia, 101–261 m); and *C. ralphae*. *Caryophyllia paucipalata* is easily distinguished as having pentameral symmetry: 40 septa and five pali; *C. eltaninae* differs from *C. ralphae* in having a much larger, fascicular columella; a shallower fossa; non-incised intercostal furrows; and a narrow pedicel. However, *C. ralphae* is remarkably similar to *C. capensis*, both species not only having a maximum of 12 pali regardless of S5, but also both species having a papillose columella. *Caryophyllia ralphae* differs in having much more highly exsert septa, a deeper fossa, and much larger and higher pali (those of *C. capensis* are almost indistinguishable from the columel-lar elements). Zibrowius and Gili (1990) do not consider *C. capensis* as a "true *Caryophyllia*", perhaps because of its papillose columella and odd palar shape and placement, but they do not suggest an alternative genus. *Caryophyllia capensis* may well belong to a different genus, and, if so, *C. ralphae* should be placed with it.

Caryophyllia (C.) diomedeae Marenzeller, 1904
(Plate 9, a-d)

Caryophyllia diomedeae Marenzeller, 1904b: 79–80, pl. 1, fig. 2; Cairns 1991a: 11–13, pl. 4, figs c-e (synonymy).
Caryophyllia sarsiae Zibrowius 1974a: 779–782, pl. 3, figs a-f (new synonymy); 1980: 62–63, pl. 24, figs A–J (synonymy); Cairns 1991a: 12, pl. 4, fig. f; Cairns & Parker 1992: 19–20, pl. 5, figs b-f.
?Caryophyllia sp. Zibrowius 1974b: 755, 756, pl. 1, fig. 11, pl. 2, fig. 1.
Caryophyllia profunda: Cairns 1982: 17–19 (in part: *Eltanin* Stn 1403).

MATERIAL EXAMINED: New Records: NZOI Stn P946, 11, USNM 94057; Stn P947, 2, USNM 94058; Stn Q68, 1, USNM 94059; Stn R438, 1, NZOI; Stn S46, 1, NZOI; Stn T226, 7, USNM 94060; Stn T243, 1, NZOI; Stn T257, 1, NZOI; Stn U325, 7, USNM 94061; *Volcanolog* Stn B30-28, 3, AU11622, AUM; *Alexander Nesmeyanov* Stn N17–6, 5, AU12251, AUM; *Eltanin* Stn 1403, 1, USNM 47518. Previous Records: Types of *C. diomedeae*; specimens reported by Zibrowius (1980) and Cairns (1982) as *C. profunda*.

DISTRIBUTION: New Zealand region: Lord Howe Seamount Chain; Colville and Kermadec Ridges; off Cape Palliser; Campbell Plateau (Map 3); 660–1200 m. Elsewhere: northeastern Atlantic from the Mediterranean to the Azores; Bermuda; off Pacific Panama; Cocos and Galápagos Islands; off Tasmania and Victoria; ?St. Paul Island; off Pukapuka Atoll, Cook Islands, 1585 m (reported herein, NZOI Stn U325); 245–2200 m.

DESCRIPTION: Corallum ceratoid, often flared distally, straight to slightly curved near base, and attached through a pedicel 0.26–0.36 GCD. Largest New Zealand specimen (*Eltanin* Stn 1403) 29.9 x 25.1 mm in calicular diameter and 35 mm in height, with a pedicel diameter of 10.2 mm; however, most specimens examined from this region 15–17 mm GCD. Calice elliptical; edges serrate. Theca thick and usually porcellanous (smooth) with little or no indication of costae. Intercostal striae and costal granules usually covered with stereome, producing a smooth, dense theca; costal granules usually visible only near calice. C1–2 sometimes slightly ridged. Corallum white, light yellowish brown, or cream colour.

Septa of most coralla hexamerally arranged in 4 complete cycles (48 septa); however, of the 38 New Zealand specimens examined, 1 contains only 11 sectors (44 septa, 11 pali), another 13 sectors (52 septa, 13 pali), another 14 sectors (56 septa, 14 pali), and yet another 15 sectors (60 septa, 15 pali). Most Atlantic specimens reported by Zibrowius (1980) have 4 cycles of septa, but he also reported specimens with 10, 11, and 13 sectors. Six of the 10 specimens reported by Cairns and Parker (1992) have 14 sectors. S1–2 thick, about 3 mm exsert (up to 5.5 mm in large specimens), and have slightly sinuous inner edges that extend about three-quarters distance to columella. S3 about 2 mm exsert, two-thirds width of an S1–2, and have moderately sinuous inner edges. S4 1.5–2.0 mm exsert, two-thirds to four-fifths width of an S3, and have only slightly sinuous inner edges. A tight crown of 12–15 P3 encircles the columella, each palus about 2 mm wide and having sinuous edges, especially their outer edge. Columella consists of 3–12 slender, twisted elements.

TYPES: One syntype of *C. diomedeae* is deposited at the USNM (22083). The holotype and paratype of *C. sarsiae* are deposited at the BM(NH) (1974.1.10.1–2).

TYPE LOCALITIES: *C. diomedeae*: *Albatross* Stn 3358, 6°30 'N, 81°44' W (off Coiba Island, Panama), 1043 m. *C. sarsiae*: 47°19' N, 6°36' W (Celtic Sea), 880–980 m.

REMARKS: I previously noted the resemblance of *C. sarsiae* to *C. diomedeae*, concluding that *C. sarsiae* differed in having a more robust corallum and in lacking costal ridges (Cairns 1991a). The specimens from the New Zealand region bridge the morphological gap between these two nominal species, indicating that the type of *C. diomedeae* is a relatively small specimen (GCD = 12.9 mm) having

48 septa, which is typical of most specimens, but that the species is capable of attaining a GCD of 30 mm and having up to 15 sectors (60 septa).

Four species of relatively large, attached species of *Caryophyllia* occur in the New Zealand region: *C. profunda, C. atlantica, C. diomedeae,* and *C. ralphae. Caryophyllia profunda* is characterised by having in 16–24–26 sectors of septa (and thus 64–96–104 septa and 16–24–26 pali); wide, lamellar pali; a robust pedicel (PD: GCD up to 0.6); and horizontally aligned costal granules. *Caryophyllia diomedeae* has fewer septa and pali (usually 48 septa and 12 pali, but as many as 60 septa and 15 pali); relatively narrow pali; a narrow pedicel (PD: GCD = 0.26–0.36); and a porcellanous theca. *Caryophyllia atlantica* is distinguished by having its tertiary septa wider than its secondary septa; 14–16–18 sectors of septa (56–64–72 septa and 14–16–18 pali); wide, slightly sinuous pali; a narrow pedicel (PD: GCD = 0.18–0.20); uniformly distributed costal granules; and highly exsert primary septa. *Caryophyllia ralphae* is distinguished by having pairs of S5 within a half-system without a corresponding P4. Within the New Zealand region the four species also have distinctive geographic and bathymetric ranges — *Caryophyllia ralphae* is known only from the northern Lord Howe Seamount Chain from relatively shallow water (315– 360 m); *C. profunda,* contrary to its name, is the shallowest-occurring of the four species, found primarily off North and South Islands, including off Fiordland, at 20–1300 m; *Caryophyllia diomedeae* is more characteristic of the Kermadec Ridge and Campbell Plateau, usually at greater depths (660– 1200 m) than *C. profunda; C. atlantica* is known from isolated seamounts and off small islands at 776– 2165 m.

Caryophyllia (C.) japonica Marenzeller, 1888
(Plate 9, e-h)

Caryophyllia japonica Marenzeller, 1888: 16; Cairns 1994: 45, pl. 4, fig. 1, pl. 19, figs c-i (synonymy).
Caryophyllia profunda: Squires & Keyes 1967: 23 (in part: NZOI Stn C608 and part (9 specimens) of C690).

MATERIAL EXAMINED: New Records: NZOI Stn B544, 1, USNM 94028; Stn D224, 1, NZOI; Stn E719, 5, USNM 94031; Stn E752, 1, NZOI; Stn F924, 9, NZOI; Stn G184, 4, USNM 94032; Stn G208, 1, NZOI; Stn G230, 1, USNM 94033; Stn G344, 2, USNM 94034; Stn G885, 2, NZOI; Stn H947, 4, NZOI; Stn I671, 6, USNM 94035; Stn J55, 3, NZOI; Stn Q2, 2, NZOI; Stn Q8, 1, NZOI; Stn Q174, 2, NZOI; Stn S67, 2, NZOI; Stn V372, 4, USNM 94036; Stn V373, 9, NZOI; BS480, 3, MoNZ CO137; Chatham Island Expedition Stn 34, 2, MoNZ CO246; *Eltanin* Stn 1403, 6,USNM 94025. Previous Records: Two syntypes of *C. japonica;* specimens reported by Squires and Keyes (1967) as *C. profunda* (NZOI Stn C608, C690).

DISTRIBUTION: Bounty Plateau; Chatham Rise; Cook Strait; Challenger Plateau; off North and East Cape (Map 7); 106–946 m, but most records from 300–450 m. Elsewhere: Commander Islands, Bering Sea to Kyushu, Japan; 77–1680 m (Cairns 1994).

DESCRIPTION: Corallum ceratoid, straight, and firmly attached by a pedicel 0.21–0.39 GCD. Largest specimen examined (NZOI Stn C690) 18.4 x 16.1 mm in calicular diameter, but most coralla are much smaller, i.e., in the 10–12 mm GCD range. Adult coralla 10-16 mm in height. Costae variable in expression, usually slightly convex or even slightly ridged, but smooth (nongranular and glistening), with poorly defined intercostal striae. Near calice, intercostal striae absent, the theca being smooth. Corallum white.

In all coralla examined septa were hexamerally arranged in 4 complete cycles (48 septa) according to the formula: S1-2>S3≥S4, the S4 of larger coralla approximating the width of an S3. S1–2 1.0–1.7 mm exsert, with straight, vertical inner edges that meet the columella only deep within the fossa. S3 less exsert (0.5–0.7 mm), about half the width of an S1–2, and have slightly sinuous inner edges. S4 slightly more exsert than S3, each pair fusing with their adjacent common S1 or S2 to form a low calicular lancet. Inner edges of S4 straight and extend 0.8–1.0 width of an S3, depending on size of corallum. Twelve rather narrow (1.5–2.1 mm wide) pali form an elliptical crown, each palus having a highly sinuous outer edge but less sinuous inner edge. Tall granules and short carinae occur on summits of palar face undulations. Columella a discrete, sometimes hemispherical, structure, composed of numerous (7–39) slender, twisted elements.

TYPES: Two syntypes of *C. japonica* are deposited at the NMW (8168).

TYPE LOCALITY: Enoshima, Sagami Bay, Japan; depth unknown.

REMARKS: *Caryophyllia japonica* is part of a species (or subspecies) complex that extends from California to Japan (*see* Cairns 1994), including the taxa *C. arnoldi* Vaughan, 1900; *C. alaskensis* Vaughan, 1941; and *C. japonica* Marenzeller, 1888. The New Zealand specimens are indistinguishable from those

collected off Japan (Cairns 1994).

Caryophyllia japonica differs from *C. profunda* in having fewer septa and pali (only 48 and 12, respectively, vs 96 and 24), small specimens of *C. profunda* of equivalent size to large *C. japonica* having many more septa and pali. *Caryophyllia japonica* also differs in having sinuous S3 and P3; smaller and more numerous columellar elements; almost equivalent S3 and S4; and in lacking aligned costal granules.

Although similar, C. japonica differs from *C. diomedeae* in having: a thinner theca; better defined costae; S1–2, 4 with straight (not sinuous) inner edges; and more columellar elements. Also, *C. japonica* is usually found at shallower depths than *C. diomedeae* and, in general, in different parts of the New Zealand region (compare Maps 3 and 7).

One of the nine specimens from NZOI Stn C690 possesses a hypertrophied calice characterised by an enlarged, spongy, exsert columella, and an additional cycle of rudimentary P1–2 (Plate 9, f). This kind of structure is usually indicative of a gall of a parasitic ascothoracid barnacle (*see* Zibrowius & Grygier 1985), but a transverse section through the enlarged region showed it to be a solid structure, not hollow as would be a barnacle gall. The structure is also centralized and symmetrical in shape, which is not typical of ascothoracid galls.

Caryophyllia (C.) lamellifera Moseley, 1881
(Plates 9, i, 10, a–c)

Caryophyllia lamellifera: Moseley, 1881: 140–141, pl. 1, fig. 7a-b; Hutton 1904: 315; Not Squires 1958: 47, pl. 7, figs 21–22; Cairns 1991a: 12.
?Caryophyllia cincticulatus (sic): Van der Horst 1931: 4.
?Caryophyllia lamellifera: Cairns & Keller 1993: table 2.

MATERIAL EXAMINED: New Records: NZOI Stn I87, 2, NZOI; Stn I91, 1, USNM 94358; Stn P115, 3, USNM 94359; Stn Q46, 1, NZOI; BS307, 1, MoNZ CO87; *Soela* 1/82/59, 2, NMV F67791; R V *Franklin* 5/89/5, 5, AMS G15555. Previous Records: Syntypes of *C. lamellifera*.

DISTRIBUTION: New Zealand region: Kermadec Ridge between Raoul and Macauley Islands; southern Norfolk Ridge; off Lord Howe Island; Taupo Tablemount, Tasman Sea (Map 18); 89–1152 m. Elsewhere: ?southwest Indian Ocean (Van der Horst 1931); 128–274 m.

DESCRIPTION: Corallum ceratoid to trochoid, straight, and firmly attached by a robust pedicel 0.38–0.53 GCD. Largest specimen examined (NZOI Stn I91) 15.5 x 15.3 mm in calicular diameter and 21 mm in thick (1.0–1.3 mm) and covered with closely spaced, transverse ridges, each horizontal ridge 0.18–0.20 mm wide and rounded on its edge. Ridges best developed on lower half of corallum. Costae and costal granules absent; theca glistening. Most coralla predominantly white, with brown vertical stripes corresponding to the C1–2 in upper corallum; upper edges of S1–2 and upper outer edges of S3–4 also brown.

Among the 15 specimens examined (new records), 8 have hexamerally arranged septa in 4 cycles (48 septa, 12 pali), whereas 7 coralla have septamerally arranged septa (56 septa, 14 pali). The larger of the two syntypes (GCD = 7.0 mm) has 46 septa and 11 pali, missing one pair of S4 and its corresponding P3; the smaller syntype (GCD = 2.2 mm) has only 24 septa and 6 pali. S1 highly exsert (up to 4.3 mm), with straight to slightly sinuous inner edges that extend about three-quarters distance to columella. S2 about three-quarters as exsert and as wide as an S1, with slightly sinuous inner edges. S3 least exsert septa (about 2.3 mm), extend two-thirds to three-quarters width of an S2, and have moderately sinuous inner edges. S4 adjacent to S1 almost as exsert as an S2, each pair of S4 flanking an S1 fusing with it to form a triangular lancet. S4 adjacent to S2 only slightly more exsert than an S3, each pair flanking an S3 also forming small lancets. S4 0.8–0.9 width of an S3 and have straight to slightly sinuous inner edges. Pali 1.05–2.20 mm wide and have sinuous inner edges, 12–14 pali forming a palar crown encircling the columella. Fossa of moderate depth; columella consists of 1–19 very slender (0.25–0.35 mm in diameter) twisted elements.

TYPES: The two syntypes of *C. lamellifera* are deposited at the BM(NH) (unregistered).

TYPE LOCALITY: *Challenger* Stn 170, 29°55′ S, 178°14′ W (north of Macauley Island, Kermadec Ridge), 1152 m.

REMARKS: *Caryophyllia lamellifera* was found at some of the same stations as *C. hawaiiensis* and both species share a similar pigmentation pattern and are about the same size. *Caryophyllia lamellifera* is distinguished by having: a transversely ridged theca (not granular); predominantly hexameral symmetry (12–14 pali) vs predominantly pentameral symmetry (10–12 pali); S4 less wide than S3; and a thicker theca and septa.

Two other recent species of *Caryophyllia* have a transversely ridged theca — *C. rugosa* (reported herein) and *C. corrugata* Cairns, 1979 (western Atlantic, 183–380 m). *Caryophyllia corrugata* differs in

height, but has a broken pedicel. Theca relatively having: ridged C1–2, a very small pedicel and flared calice, lamellar pali, and S4 that are much narrower than its S3; *C. rugosa* differs in having: a smaller corallum, octameral symmetry, and extremely sinuous septa and pali.

The specimen reported by Squires (1958) as *C.* sp. cf. *C. lamellifera* from the lower Miocene of New Zealand has transverse thecal ridges but has 72 septa (18 pali) and is unlikely to be conspecific.

The larger syntype (from *Challenger* Stn 170, Plate 10, b, c) is a small, probably juvenile, specimen lacking a full fourth cycle and differs from most of the other New Zealand specimens reported herein in having sharper thecal ridges, a smaller corallum, and S4 that are wider than its S3. The first two differences may be attributed to ontogenetic changes, but the difference in relative widths of the third and fourth cyles is puzzling, since this is usually a conservative character throughout ontogeny.

Caryophyllia (C.) elongata Cairns, 1993
(Plate 10, d–f)

Caryophyllia elongata Cairns *in* Cairns & Keller, 1993: 236–237, pl. 4, figs A–B.

MATERIAL EXAMINED: New Records: NZOI Stn K804, 1, NZOI; NZOI Stn K830, 1, USNM 94056; Stn K858, 1, NZOI; Stn S571, 1, USNM 94055; Stn X221, 1, NZOI; BS310, 1, MoNZ CO85,3, USNM 94054. Previous Records: Holotype.

DISTRIBUTION: New Zealand region: Kermadec Ridge from Raoul to Curtis Island; northern Three Kings Ridge (Map 14); 165–590 m. Elsewhere: Madagascar Plateau; 630–680 m.

DESCRIPTION: Corallum ceratoid to subcylindrical, having a thick pedicel (PD: GCD = 0.59–0.81) and a thin, expansive, encrusting base. Corallum relatively small, the largest New Zealand specimen (BS310) only 10.7 x 10.1 mm in calicular diameter (pedicel broken). Theca porcellanous (not costate), and uniformly covered with low, rounded granules. Corallum light yellowbrown.

Septa hexamerally arranged in 4 complete cycles (48 septa), even at a GCD of only 4.2 mm, according to the formula: S1>S2≥S4≥S3. S1 about 1.5 mm exsert, with straight, vertical inner edges that reach the columella. S2 less exsert (about 1 mm), about 0.8 width of an S1, and also with straight inner edges. S3 and S4 about 0.6 mm exsert, the S3 about 0.8 width of an S2, with slightly sinuous inner edges. S4 unequal in width, those adjacent to S1 invariably wider (0.9–1.0 width of an S2) than those adjacent to S2 (0.8–0.9 width of an S2, which is equal to or slightly wider than an S3). P3 slender (about 1.1 mm wide), with very sinuous inner edges, forming a tight palar crown of 12 elements deep in fossa. Columella composed of 3–9 slender, twisted elements, even more deeply set in fossa than the palar crown.

TYPES: The holotype is deposited at the IOM.

TYPE LOCALITY: *Vityaz* Stn 2716, 33°17′ S, 44°55′ E (off Walter's Shoal, Madagascar Plateau), 630–680 m.

REMARKS: Of the 18 recent *Caryophyllia* species that can be characterised as attached species with four cycles of hexamerally arranged septa (*see* Cairns 1991a), in only five are the S4 equal to or greater than the width of their S3 — *C. calveri* Duncan, 1873 (northeastern Atlantic, 130–1050 m); *C. atlantica* (Duncan, 1873) (= *?C. panda* Alcock, 1902a) (widespread, 776–2165 m); *C. polygona* Pourtalès, 1878 (Antilles, 700–1817 m); *C. alberti* Zibrowius, 1980 (Azores, 76–506 m); and *C. elongata* Cairns, 1993. *Caryophyllia elongata* differs from these other species in having S1 that are wider than their S2, a very deep fossa, and a yellow-brown corallum.

Caryophyllia (C.) scobinosa Alcock, 1902
(Plates 10, g-i, 11, a-c)

Caryophyllia cultrifera Alcock, 1902a: 89–90; 1902c: 7–8, pl. 1, figs 1, 1a (new synonymy).
Caryophyllia scobinosa Alcock, 1902a: 90; 1902c: 8, pl. 1, figs 2, 2a; Keller, 1981a: 17, fig. 2 (in part: *Vityaz* Stn 4680); Cairns & Keller 1993: 235 (synonymy); Cairns 1994: 45–46, pl. 20, figs a-b (synonymy).
Not *Caryophyllia* sp. cf. *C. scobinosa*: Cairns 1994: 45–46, pl. 19, figs j-l.

MATERIAL EXAMINED: New Records: NZOI Stn G817, 2, NZOI; Stn G818, 2, USNM 94045; Stn G819, 2, NZOI; Stn G821, 2, NZOI; Stn G822, 4, NZOI; Stn G824, 8, NZOI; Stn G825, 6, NZOI; Stn P943, 8, USNM 94046; Stn Q84, 73, USNM 94047; Stn U344, 1, NZOI; Stn U351, 3, NZOI; RV *Franklin* Stn 5/89/25, 4, AMS G15497, G15567, RV *Franklin* Stn 6/88/4, 10°34.28′ S, 144°13.33′ E, 815–825 m, 20 August 1988, 1, USNM 86559. Previous Records: Syntypes of *C. scobinosa;* holotype of *C. cultrifera.*

DISTRIBUTION: New Zealand region: known only from northern Lord Howe Rise (Map 16); 784–1051 m. Elsewhere: southwestern Indian Ocean from Tan-

zania to Madagascar Plateau; Sulu Sea; Celebes Sea; off Queensland (reported herein); off Tonga and Samoa (reported herein: NZOI Stn U344, 1, USNM 94048; Stn U351, 2, USNM 94049); 535–1270 m.

DESCRIPTION: Corallum cornute (usually curved between 45–90°) and free, the original unconsoli-dated pedicel only 0.9–1.1 mm in diameter. Largest New Zealand specimen examined (AMS G15497) 20 x 16 mm in calicular diameter and 24 mm in height. Calice elliptical: GCD: LCD = 1.15–1.25. Costae well defined, C1–2 0.5–0.6 mm wide and often ridged, especially near calice, where the ridges are sometimes sinuous. C3–4 0.6–0.9 mm wide and flat to slightly convex. Costae separated by thin, shallow striae and covered with low rounded granules 3 or 4 across a costa. Corallum white; however, theca from base to a parallel line 2–3 mm below calice usually worn and discoloured.

Coralla of most specimens hexamerally arranged in 4 cycles (48 septa) according to the formula S1–2>S3–4; however, larger coralla (e.g., GCD > 16 mm) have 56 or even 64 septa arranged in 14 or 16 sectors and have correspondingly 14 and 16 pali. S1–2 highly exsert (2.4–3.0 mm) and have slightly sinuous vertical inner edges that reach four-fifths distance to columella. The paliferous S3 are least exsert septa (about 0.7 mm) and have moderately sinuous inner edges. S4 about 2 mm exsert, a pair of S4 fusing with each S1+2 to form 12 rectangular lancets. Width of S4 often slightly less than S3 in young coralla, equal to width of S3 in most coralla, and sometimes slightly wider than S3 in larger coralla. A crown of 12–16 wide (1.8–1.9 mm), sinuous pali encircles a fascicular columella composed of 4–14 relatively broad, twisted elements.

TYPES: Six syntypes of *C. scobinosa* are deposited at the ZMA: Coel. 574, *Siboga* Stn 45, includes Alcock's illustrated specimen; Coel. 575, *Siboga* Stn 102, includes the largest syntype of 18.1 mm GCD. The holotype of *C. cultrifera* is also deposited at the ZMA (Coel. 1180).

TYPE LOCALITIES: *C. scobinosa*: Flores and Sulu Seas, 535–794 m. *C. cultrifera*: *Siboga* Stn 101, 6°15′ N, 120°21′ E (Sulu Sea), 1270 m.

REMARKS: Unattached, cornute species of *Caryophyllia* have been described from bathyal depths worldwide, including the following ten species: *C. cornuformis* Pourtalès, 1868; *C. seguenzae* Duncan, 1873; *C. scillaemorpha* Alcock, 1894; *C. scobinosa* Alcock, 1902a; *C. planilamellata* Dennant, 1906; *C. paucipaliata* Yabe & Eguchi, 1942b; *C. grandis* Gardiner & Waugh, 1938; *C. mabahithi* Gardiner & Waugh, 1938; *C. balaenacea* Zibrowius & Gili, 1990; and *C. valdiviae* Zibrowius & Gili, 1990. Whereas some species are quite distinctive (e.g., *C. cornuformis*, *C. planilamellata*, *C. paucipaliata*, *C. grandis*, and *C. mabahithi*), the others are very similar, characterised by having highly exsert primary septa and associated calicular lancets, highest cycle septa that are wider than the pen-ultimate cycle, wide pali, and broad columellar elements. The number of septa and pali vary from 48/12 to 96/24, seemingly as a function of corallum size. It remains to be proven whether the remain-ing five taxa are separate sibling species, different subspecies, or simply growth forms of the same species. The specimens reported herein as *C. scobinosa* represent specimens having small coralla and only 48 septa (12 pali), only several specimens having more septa. *Caryophyllia cultrifera* (holo-type with a GCD of 21.8 mm, having 48 septa) is suggested to be a synonym of *C. scobinosa*, its prominent C1–2 being part of the variation characteristic of *C. scobinosa*.

Caryophyllia (C.) ambrosia Alcock, 1898

(Plate 11, d, e)

Caryophyllia ambrosia Alcock, 1898: 12, pl. 1, fig. 1, 1a; Zibrowius 1980: 63–65, pl. 25, figs A–K (synonymy).
Caryophyllia ambrosia ambrosia: Cairns 1979: 59; Cairns & Keller, 1993: 234, pl. 13, fig. H; Cairns 1994: 48, pl. 21, figs d-h (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn D226, 3, NZOI; Stn D227, 4, NZOI; Stn D231, 3, NZOI; Stn E712, 1, NZOI; Stn E717, 1, NZOI; Stn E772, 1, USNM 94042; Stn E884, 7, USNM 94043; Stn F877, 4, USNM 94044; Stn F896, 1, NZOI; Stn F900, 3, NZOI; Stn P120, 6, NZOI; BS763 (R121), 1, MoNZ CO 244; BS 812 (O556), 3, MNZ; BS844 (O590), 24, MoNZ, 1, USNM 94041; J15/9/76, 1, MoNZ; *Alexander Nesmeyanov* Stn N17-15, 1, AU12248, AUM; east of Broken Bay, NSW, 827 m, 1, USNM 78612; RV *Franklin* 6/88/4, 10°34′ S, 144°13′ E, 815–825 m, 4, USNM 86558. Previous Records: Two syntypes of *C. ambrosia* (USNM); specimens reported by Zibrowius (1980).

DISTRIBUTION: New Zealand region: Lord Howe Rise; Challenger Plateau; Raukumara Plain; southern Colville Ridge (Map 7); 701–1180 m. Elsewhere: widespread: amphi-Atlantic; Indian Ocean; southeastern Australia (reported herein): off Japan and Ryukyu Islands; 311–2670 m.

DESCRIPTION: Corallum straight to cornute (curved up to 90°), with a non-reinforced base 1.3–1.9 mm

diameter. Adult coralla massive and dense, with thick deposits of internal stereome. Largest corallum examined (BS844, MoNZ) 49 x 40 mm in calicular diameter and 42 mm in height. Calice elliptical: GCD: LCD = 1.2–1.3. C1–3 sometimes slightly ridged, but, in general, all costae equal in width, slightly convex, and separated by very thin intercostal striae. Costae uniformly covered with fine (about 0.2 mm in diameter) granules, 4 or 5 occurring across a costa. As in *C. scobinosa*, only a thin band of theca adjacent to the calice is well preserved (white), the remainder of the theca being worn and often discoloured.

Septa almost always hexamerally arranged in 5 complete cycles (96 septa), even at the small size of 19 mm GCD; however, a specimen of 15 mm GCD has only 12 pali and a partial fifth cycle. Two exceptions worth noting are a specimen of GCD 41 mm with 104 septa (26 pali) and the largest specimen of GCD 49 mm, which has only 92 septa (23 pali). S1–2 highly exsert (up to 7 mm) and have slightly sinuous inner edges that extend about three-quarters distance to columella. S3 only slightly less exsert, but otherwise similar to S1–2. S4 least exsert septa (about 2 mm) and have moderately sinuous inner edges extending two-thirds width of an S1–3. S5 3.0–4.5 mm exsert, a pair of S5 fusing with each S1–3 at the calicular edge to form lancets that alternate in height, the S1–2 lancets being slightly more exsert than those of the S3. Inner edges of S5 straight, the S5 equal to or slightly wider than the S4. A prominent crown of 24 wide (up to 5.5 mm) pali occurs before the S4. Palar edges only slightly sinuous, and bear granules 2–3 times the size of those on septal faces. Fossa of moderate depth, containing an elongate fascicular columella composed of 5–19 broad (up to 2.9 mm in diameter), twisted elements.

TYPES: Approximately 200 syntypes are presumed to be deposited at the Indian Museum, Calcutta. Two syntypes are deposited at the USNM (18157); two syntypes are at the MNHNP; two are at the ZMA (Coel. 1179); and one is at the MNW (8165).

TYPE LOCALITY: Laccadive Sea, Arabian Sea; 1829–1957 m.

REMARKS: At least four populations (?forms, subspecies, species) of *C. ambrosia* are recognised: (1) specimens from the eastern Atlantic and northern Indian Ocean (typical), characterised as having small to medium-sized coralla and 14–18 pali (56–72 septa); (2) specimens from the western Atlantic called *C. ambrosia caribbeana* by Cairns (1979), characterised as having large coralla, but still only 14–18 pali; (3) specimens from off Japan (*see* Cairns 1994), characterised as having large coralla and usually 18–20 pali (72–80 septa), and (4) those specimens reported from off New Zealand and southeastern Australia, which have large coralla and a stong tendency to have 24 pali (96 septa). As mentioned in the discussion of *C. scobinosa*, these morphotypes may represent sibling species, subspecies, or just clinal or environmental variation.

Caryophyllia (Premocyathus) Yabe & Eguchi, 1942b

Caryophyllia having compressed coralla with carinate (but not spinose) convex thecal edge. Base invariably an open scar. Columella fascicular or papillose.

TYPE SPECIES: *Premocyathus compressus* Yabe & Eguchi, 1942b, by original designation.

REMARKS: Three species are recognised in this subgenus: *?C. (P.) dentiformis* (Alcock, 1902b); *C. (P.) compressa* Yabe & Eguchi, 1942b; and *C. (P.) burchae* Cairns, 1984.

Caryophyllia (P.) compressa Yabe & Eguchi, 1942
(Plate 11, f–i)

Caryophyllia compressa Yabe & Eguchi, 1932b: 443 (*nom. nud.*).

Not *Caryophyllia compressa* Gardiner & Waugh, 1938: 180 (junior homonym); Cairns 1984: 14.

Premocyathus compressus Yabe & Eguchi, 1942b: 121, 151–152, pl. 10, figs 13–14.

Caryophyllia (P.) compressa: Mori 1987: 21–30, 9 figs; Not Wells 1956: F422, fig. 323, 3; Cairns 1994: 50–51, pl. 22, figs e-f (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn E840, 1, USNM 94062; BS441, 14, MoNZ CO240, 241; BS633 (P461), 3, MoNZ CO268. Previous Records: Specimens reported by Wells (1956), USNM.

DISTRIBUTION: New Zealand region: off Raoul Island, Kermadecs; off Three Kings Islands (Map 14); 402–757 m. Elsewhere: off Japan (Cairns 1994); 115–366 m; Pleistocene of Ryukyu Islands.

DESCRIPTION: Corallum conpressed (GCD: LCD = 1.2–1.4) and invariably curved 30–45° in plane of GCD, the concave thecal edge rounded, the convex thecal edge usually crested or even keeled (up to

0.7 mm), although the expression of this costal ridge is quite variable. Costoseptum of primary septum aligned with convex edge often continuous with thecal edge ridge. Base of corallum invariably displays an open circular scar 1.0–1.5 mm in diameter. Costae equal in width (about 0.5 mm), flat to slightly convex, and covered with small, low, rounded granules arranged 4 or 5 across a costa. Intercostal striae quite thin and narrow. Corallum white.

Septal symmetry and number quite varied, the 16 specimens examined displaying 6 patterns. The 4 specimens from off Three Kings Islands show: 9:9:14, 7 (32 septa, 7 pali); 8:8:16, 8 (32 septa, 8 pali); 8:8:14, 7 (30 septa, 7 pali); and 7:7:14, 7 (28 septa, 7 pali). The 12 smaller specimens from Raoul Island have only 2 patterns: 6:6:12, 6 (24 septa, 6 pali), shared by 8 specimens, and 7:7:14, 7 (28 septa, 7 pali), shared by 4 specimens. Primary septa are little exsert (about 1.1 mm) and have quite sinuous edges that extend about three-quarters to columella. Secondary and tertiary septa equally exsert (about 0.8 mm), the secondaries about three-quarters width of a primary septum and have very sinuous inner edges, and the tertiaries less wide than the secondaries with only slightly sinuous inner edges. Narrow (about 0.7 mm wide) pali occur before the secondary septa, but only in those sectors in which paired tertiaries occur, which is sometimes irregular within a corallum. Pali have highly sinuous edges and bear larger granules than occur on septal faces. Fossa of moderate depth, containing a fascicular columella composed of 1-4 twisted elements.

TYPES: Four syntypes of *C. compressa* are deposited at the TIUS (60747).

TYPE LOCALITY: Pleistocene (Wan Formation) of Ryukyu limestone, Kikai-jima, Kagosima-ken.

REMARKS: Mori (1987) studied 1090 topotypic specimens of *C. compressa*, tabulating them into categories of type of septal symmetry and number of pali. His specimens fell into 57 septal arrangements permutations, ranging from 6:6:12, 6 (24 septa, 6 pali) to 14:14:12, 6 (40 septa, 6 pali), the commonest septal complement being 10:10:14, 7 (34 septa, 7 pali), possessed by 11.1 % of the population. The septal/palar arrangements of the New Zealand speci-mens represent some of the rarer permutations listed by Mori, e.g., the 9:9:14, 7 permutation was the 11th most common (2.4%) of his material, whereas the two patterns found in the Raoul specimens were found in only 0.5 and 0.9% of Mori's specimens. Nonetheless, these specimens are considered to be conspecific with *C. compressa* and represent the first record of this species outside Japanese waters.

Coenocyathus Milne Edwards & Haime, 1848a

Like *Caryophyllia (Caryophyllia)*, but forming colonies through extratentacular budding from a thick basal coenosteum and occasionally from theca of parent corallites. Pali before penultimate cycle of septa; columella fascicular.

TYPE SPECIES: *Coenocyathus cylindricus* Milne Edwards & Haime, 1848, by subsequent designation (Milne Edwards & Haime 1850: xii).

Remarks: Six recent species are known in the genus (*see* Cairns 1994), two of which are known from the Pacific: *C. brooki* and *C. sagamiensis* Eguchi, 1968.

Coenocyathus brooki n. sp. (Plate 12, a-d)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Known only from the Kermadec Islands, including Raoul, Macauley, Curtis, and Cheeseman Islands, and Esperance Rock (Map 22); 7–95 m. Most specimens were collected by Fred Brook from the roofs of caves and from beneath overhangs.

DESCRIPTION: Coralla form small encrustations on rocks or calcareous substrata, the largest colony (the holotype) about 4 cm in diameter and containing 29 corallites. Primary mode of increase is by extratentacular budding from edge zone of the common coenosteum or between corallites. In some colonies (e.g., the holotype) calices elongate and then constricted medially, producing two equal-sized daughter corallites by intratentacular budding. No corallites were noted to bud from the theca of another corallite. Calices circular, elliptical, or irregular in shape, becoming quite elongate prior to intratentacular budding. Large corallites that are not in process of budding measure 12–13 mm in GCD. Costae 0.30-0.35 mm in width and are quite flat, separated by thin, shallow intercostal striae. Costae covered with low, rounded granules, usually aligned across a costa and fused into short transverse ridges. Corallum white.

Septal symmetry extremely irregular, ranging from 8–18 primary septa and pali, and 3 to 4 cycles of septa. The commonest symmetry is 6:6:12:24 (48 septa, 12 pali) or 6:8:14:28 (56 septa, 14 pali); in the latter case the original hexameral symmetry is pre-

served even though an irregular number of higher cycle septa are present. Although most half-systems contain 3 septa, some within the same corallite have 5 septa. Largest corallite examined has 18 pali and 84 septa. S1 highly exsert (up to 2.8 mm), extending about three-quarters distance to columella, with straight, vertical inner edges. S2 about half as exsert and three-quarters width of an S1, and also have straight inner edges. S3 least exsert septa, about three-quarters width of an S2, and have slightly sinuous inner edges. S4 equal to or more exsert than S3, four-fifths width of an S3, and have straight inner edges. Pali (P3) lamellar, 1.0–1.5 mm wide, and only slightly sinuous. Fossa deep, containing a fascicular columella consisting of 2–20 tightly twisted elements, each about 0.8 mm in diameter.

TYPES: Holotype: L4721, AIM AK72405. Paratypes: L892, 1 colony, AIM AK72410; L999, 3 colonies, AIM AK72409; L1050, 3 colonies, AIM AK72411; L 1051, 2 colonies, AIM AK72408; L1413, 2 colonies, AIM AK72407, 2, USNM 94588; L1630, 1 colony, AIM 72406; L4722, 5 colonies, AIM AK72412; NZOI Stn K820, P-1011, 3 colonies, NZOI, 2 colonies, USNM 94130.

TYPE LOCALITY: L4721, west side of Cheeseman Island, Kermadec Ridge, 26 m.

ETYMOLOGY: This species is named for Fred Brook, who collected most of the type specimens and has made other collections of shallow-water azooxanthellate corals from the Kermadec, Norfolk, and Three Kings Islands.

REMARKS: *Coenocyathus brooki* is quite similar to *C. bowersi* Vaughan, 1906, known from the Gulf of Panama to southern California at 9–302 m (Cairns, 1994), particularly in its growth form and irregular septal symmetry. *Coenocyathus brooki,* however, differs in having transversely granulated costae, highly exsert S1, lamellar pali, more numerous columellar elements, and more septa in large corallites. Furthermore, although both species reproduce intratentacularly, *C. bowersi* does so by subdividing a corallite into numerous very small ones, whereas corallites of *C. brooki* elongate and then constrict, resulting in only two equal-sized daughter corallites.

Crispatotrochus Tenison-Woods, 1878a

Corallum solitary, ceratoid to turbinate, and usually attached. Septotheca costate or covered with transverse ridges. Pali absent; columella fascicular, composed of discrete, twisted elements.

TYPE SPECIES: *Crispatotrochus inornatus* Tenison-Woods, 1878a, by monotypy.

REMARKS: Fourteen species are recognised in the genus, 12 listed by Cairns (1991a) and another two described herein. Four of the 14 species have decameral symmetry; of the remaining ten species, six have only four cycles of septa, including the two species from the New Zealand region. Both species described herein have unique characters that distinguish them from others in the genus, one having a transversely ridged theca, the other an unattached, cornute corallum. Species of *Crispatotrochus* are widespread in the tropical to Subantarctic regions from 82–2505 m, but not yet known from the eastern Atlantic.

Crispatotrochus curvatus n. sp. (Plate 12, e-h)

Gardineria sp. Gardiner 1929: 125 (in part: *Terra Nova* Stn 96).

MATERIAL EXAMINED: Types, q.v.; 5 specimens identified as *Gardineria* sp. by Gardiner (1929), BM(NH) 1929.10.22.15–17.

DISTRIBUTION: Raukumara Plain and Bounty Trough; off North Cape (Map 7); ?128–1373–2505 m.

DESCRIPTION: Corallum trochoid and cornute, most coralla curved 45–90°. All specimens examined unattached, tapering to a slender (2.4–3.9 mm in diameter), circular, flat base. PD: GCD ranges from 0.16–0.29, the smaller ratio corresponding to large specimens, the larger to small specimens, a result of the pedicel diameter remaining constant as the calice increases in diameter. Largest specimen examined (holotype) 15.0 x 14.4 mm in calicular diameter and 26.0 mm in height, with a basal diameter of 2.4 mm. Calice circular to very slightly elliptical (GCD: LCD = 1.0–1.1) and serrate, the calicular theca associated with each S1–2 forming a small (about 0.9 mm in height) isosceles triangle and the 3 S3-4 between each S1–2 forming a lower (about 0.5 mm in height) equilateral triangle. Theca of lower half to three-quarters of corallum worn; upper theca costate, consisting of broad (0.8 mm), slightly convex, glistening costae separated by very thin (0.1 mm), shallow intercostal striae. Corallum white; theca and septa quite thin, both only about 0.1 mm thick.

Septa hexamerally arranged in 4 complete cycles (48 septa) in all but the smallest specimens of 11–12 mm GCD, these small specimens having very reduced S4, 3 or 4 pairs of which may be missing (resulting in 40–42 septa). S1–2 have vertical, broadly sinuous inner edges that fuse with columellar elements deep in fossa. S3 half to two-thirds width of an S1–2 and also have broadly sinuous inner edges. S4 one-quarter to half width of an S3, sometimes quite rudimentary, and have slightly sinuous inner edges. Septa thin and widely spaced, separated by 0.7–0.8 mm form one another. Septal faces of most specimens covered with sparse, low, pointed granules, but faces of those specimens from *Terra Nova* Stn 96 also bear short, obliquely inclined carinae. Fossa of moderate depth with a fascicular columella consisting of 2–14 twisted elements.

Types: Holotype: NZOI Stn S154, NZOI H-624. Paratypes: NZOI Stn G703, 1, NZOI P-1012; Stn J658, 2, NZOI P-1013; Stn S152, 2, USNM 94122; Stn S154, 4, USNM 94123.

Type Locality: 45°24.2′ S, 173°59.8′ E (Bounty Trough, northeast of Dunedin), 1373 m.

Etymology: The species name *curvatus* (Latin *curvus*, bent) refers to the curved shape of the corallum.

Remarks: Of the twelve previously described species of *Crispatotrochus* (*see* Cairns 1991a), only four have four cycles of hexamerally arranged septa: *C. inornatus* Tenison-Woods, 1878a; *C. cornu* (Moseley, 1881); *C. irregularis* Cairns, 1982; and *C. galapagensis* Cairns, 1991a, the other species having decameral symmetry or five cycles of hexamerally arranged septa. *Crispatotrochus curvatus* is distinguished from all congeners by having a narrow, unattached pedicel, which is invariably associated with a cornute corallum. This species is also distinctive in having a serrate calicular edge, widely separated septa, and a deep bathymetric range (?128–1 373–2505 m), only *C.* sp. A (*sensu* Cairns 1982) having a similarly deep range (2305–2329 m).

Crispatotrochus rugosus n. sp. (Plate 13, a, b)

Material Examined: Types, q.v.

Distribution: Kermadec Ridge from south of Esperance Rock to north of Raoul Island; Lord Howe Seamount Chain (Map 16); 142–508 m.

Description: Corallum ceratoid, elongate, and often slightly flared distally. Corallum attached through an elongate but thickened pedicel (PD: GCD = 0.35–0.41) and encrusting base. Holotype 14.3 x 13.0 mm in calicular diameter and 24.7 mm in height, with a pedicel diameter of 5.0 mm; largest specimen (NZOI Stn K840) 16.5 x 13.8 mm in calicular diameter and 31.4 mm in height. Calice slightly elliptical: GCD: LCD = 1.1–1.2. Theca uniformly covered with thin transverse ridges, 6–7 horizontal ridges per mm of theca. Thecal ridges sometimes better developed on lower half of corallum and encrusting base, but often present up to calicular edge. Corallum usually white, but two coralla (NZOI Stn C527) display a brown colouration on the upper edges of their S1–2 and associated C1-2.

Septa hexamerally arranged in 4 complete cycles (48 septa) according to the formula: S1>S2>S3>S4, only specimens below a GCD of 6.5 mm having an incomplete fourth cycle. S1 highly exsert (up to 3.2 mm) with sinuous (low amplitude, high period) inner edges that reach the columella. S2 less exsert (about 2.8 mm), about three-quarters width of an S1, and have the most sinuous inner edges of all 4 cycles (higher amplitude and shorter period than S1). S3 and S4 equally exsert (about 1.2 mm), each about three-quarters width of next lower cycle septa, and have only slightly sinuous inner edges. Fossa of moderate depth, containing a closely grouped, elliptical to elongate mass of discrete, slender (0.5–0.7 mm in diameter), twisted elements (a fascicular columella).

Types: Holotype: NZOI Stn Q70, NZOI H-625. Paratypes: NZOI Stn C527, 19, USNM 94125; Stn K826, 1, NZOI P-1014; Stn K840, 2, NZOI P-1015; Stn Q70, 1, USNM 94124.

Type Locality: 26°59.7′ S, 159°18.9′ E (Lord Howe Seamount Chain), 376 m.

Etymology: The species name *rugosus* (Latin *ruga*, wrinkled) refers to the fine transverse thecal ridges of this species.

Remarks: *Crispatotrochus rugosus* is distinguished from its congeners that have four cycles of hexamerally arranged septa (see previous account) by having a distinctively transversely ridged theca and by having S2 that are less exsert and less wide than their S1. In all other species of *Crispatotrochus*, S1 and S2 are of equal size. *Labyrinthocyathus limatulus* is a similar species — having a transversely ridged theca, the same number of septa, and occurring at some of the same stations — but is distinguished by its maze-like columella and the equality of its S1 and S2.

Labyrinthocyathus Cairns, 1979

Corallum solitary, ceratoid to subcylindrical, and attached. Costae usually poorly defined or composed of transverse epithecal ridges. Pali absent; columella composed of an interconnected maze of lamellar plates.

TYPE SPECIES: *Labyrinthocyathus langae* Cairns, 1979, by original designation.

REMARKS: *Labyrinthocyathus* is quite similar to *Crispatotrochus*, differing primarily in its distinctive columellar structure, *Labyrinthocyathus* has a lamellar-maze columella, whereas *Crispatotrochus* has a fascicular columella. Eight species are recognised in the genus (*see* Cairns 1994), including three fossil species. A ninth, unnamed species is discussed below as *Labyrinthocyathus* sp. The genus is known from Eocene to recent and is widespread in tropical to temperate regions.

Labyrinthocyathus limatulus (Squires, 1964) (Plate 13, c-f)

Ceratotrochus (Ceratotrochus) limatulus Squires, 1964b: 3–5, pl. 1, figs 5–9; Squires & Keyes 1967: 24, pl. 2, figs 9–10.
Labyrinthocyathus limatulus: Cairns 1979: 70.

MATERIAL EXAMINED: New Records: NZOI Stn C527, 4, NZOI; Stn I94, 2, USNM 94127; L1056, 1, AIM AK78393; L1057, 1, AIM AK76085; RV *Franklin* Stn 5/89/40, 3, AMS G15570, 1, USNM 94128; 7 km northeast of the Aldermen Islands (topotypic), 102 m, 2, MoNZ; 7.2 km northeast of the Aldermen Islands (topotypic), 102 m, 26, AUM. Previous Records: Type series of *C. limatulus*.

DISTRIBUTION: Lord Howe Seamount Chain; off Norfolk Island; off Three Kings Islands; southern Kermadec Ridge; off Alderman Islands (Map 17); 20–508 m.

DESCRIPTION: Corallum ceratoid to subcylindrical, attached through a robust pedicel (PD: GCD = 0.37–0.89) and stereome-reinforced base. Largest specimen examined (AMS G15570) 12.8 x 12.1 mm in calicular diameter and 18.9 mm in height, with a pedicel diameter of 5.5 mm. Calice circular to slightly elliptical (GCD: LCD = 1.0–1.1). Theca of basal third of large specimens distinctively transversely ridged; however, ridges on theca of middle third of corallum quite faint, and on upper third of large coralla the transverse sculpturing consists merely of rows of horizontally aligned granules. Theca relatively thick; corallum white.

Septa hexamerally arranged in 4 cycles according to the formula: S1=2>S3>S4. Coralla 2–3 mm in GCD have only 3 cycles of septa, and those above 6 mm GCD usually have 4 cycles; however, pairs of S4 are sometimes missing resulting in 44 or 46 septa. S1–2 0.8–1.6 mm exsert and have highly sinuous inner edges that almost attain the columella. S3 0.5–0.8 mm exsert, about four-fifths width of an S1–2, and have moderately sinuous inner edges. S4 only 0.3–0.4 mm exsert, one-quarter to three-quarters width of an S3, and have only slightly sinuous inner edges. Fossa shallow to moderate in depth and contains a rather large columella that is elliptical in shape, composed of a maze of interconnected lamellae.

TYPES: The holotype and 12 paratypes of *C. limatulus* are deposited at the AIM. Ten paratypes are also deposited at the USNM (68260).

TYPE LOCALITY: 7.2 km northeast of the Aldermen Islands, off Coromandel Peninsula; 102 m.

REMARKS: *Labyrinthocyathus limatulus* is the only species in its genus to have a transversely ridged theca. The specimens reported herein are the first records of this rarely collected species subsequent to its description. One specimen (AMS G15570) bears an ascothoracid cavity in its theca, which caused the coral to wall off a section of the fossa (Plate 13, c, d).

Labyrinthocyathus sp. (Plate 13, g, h)

MATERIAL EXAMINED: NZOI Stn D159, 1, NZOI; Stn G941, 2, USNM 94129; Stn R439, 1, NZOI.

DISTRIBUTION: Hikurangi and Solander Troughs (Map 6); 665–1000 m.

DESCRIPTION: Corallum ceratoid, straight, and attached through a robust pedicel 0.35–0.45 GCD. Corallum small: 5.0–6.8 mm in circular calicular diameter and only 7.6–10.5 mm in height. Theca smooth or weakly costate and granular. Theca relatively thick; corallum white. Septa hexamerally arranged in 3 complete cycles (24 septa) according to the formula: S1>S2>S3. S1 only slightly exsert and have very sinuous inner edges that almost attain the columella. S2 less exsert, about threequarters width of an S1, and have moderately sinuous inner edges. S3 about threequarters width of an S2 and have only slightly

sinuous inner edges. Fossa of moderate depth, containing a rudimentary maze-like columella composed of lamellar to T-shaped columellar elements that are just beginning to fuse together.

REMARKS: *Labyrinthocyathus* sp. differs from *L. limatulus* in lacking a transversely ridged theca and in having fewer septa at a corresponding calicular diameter (neotenic). Specimens of *Labyrinthocyathus* sp. have only 24 septa even at a GCD of 6.8 mm, a size at which *L. limatulus* would have 44–48 septa. *Labyrin-thocyathus* sp. also appears to have a slightly deeper bathymetric range and a more southerly distribution.

Polycyathus Duncan, 1876

Corallum colonial, cylindrical corallites basally united by a common coenosteum or by stolons. Septotheca costate. Three to four cycles of septa; pali present before all but last cycle; columella papillose.

TYPE SPECIES: *Polycyathus atlanticus* Duncan, 1878, by monotypy.

REMARKS: There are approximately 16 species in *Polycyathus*, most listed and discussed by Wijsman-Best (1970) and Verheij and Best (1987). All species are characteristic of relatively shallow-water (less than 100 m) cave environments. Verheij and Best (1987) place the genus in the Rhizangiidae because of its similarity to *Astrangia*, but its septal and palar morphology seem to be more consistent with the caryophylliids, especially *Trochocyathus.*

Polycyathus norfolkensis n. sp. (Plate 16, g, h)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Known only from caves and shaded overhangs off Norfolk Island; 10–20 m.

DESCRIPTION: Colonies consist of ceratoid to cylindrical corallites up to 12 mm in height, each corallite budding from a common basal coenosteum (not reptoid) or from the lower theca of a parent corallite. Holotypic colony consists of 9 corallites all united laterally or basally. Calices circular to slightly elliptical in shape, up to 4.2 mm in GCD. Costae about 0.5 mm wide, only slightly convex, and separated by very shallow, narrow (about 0.1 mm) intercostal striae. Costae covered with low, rounded granules, 2 or 3 occurring across the width of a costa. Costae usually well developed only on upper half to third of corallite, the lower portion usually encrusted with calcareous polychaetes, foraminiferans or bryozoans. Corallum white.

Septa hexamerally arranged in 3 complete cycles (S1>S2–3), a juvenile specimen 0.8 mm in diameter having only 12 septa, but all other specimens examined between a GCD range of 1.6–4.2 having 24 septa. S1 0.5–0.7 mm exsert, extend about half distance to columella, and have entire, slightly sinuous inner edges. Each S1 bears a small, cylindrical (0.15 mm in diameter) paliform lobe. S2–3 equal in size (about three-quarters width of an S1) and slightly less exsert than the S1. Inner edges of S2–3 of small corallites are usually dentate to laciniate; however, when the corallite matures (e.g., > 3.0 mm GCD) these septal edges become entire like the S1. Each S2 bears a lamellar palus that is about twice the thickness and width of a P1, slightly more recessed from the columella, and usually slightly taller than a P1. Outer edges (adjacent to S2) of P2 are thickened and highly granular. Together, the 12 P1–2 form a single irregular palar crown. Fossa shallow, containing the palar crown and a small papillose columella consisting of 1–5 cylindrical (0.1 mm in diameter) elements.

TYPES: Holotype: L4622, a colony of 9 corallites, AIM AK72401. Paratypes: L4620, 9 corallites composing 6 coralla, AIM AK72403; L4621, 11 corallites composing 3 coralla, AIM AK72404; L4622, 6 corallites composing 3 coralla, USNM 94592, L4623, 22 corallites composing 11 coralla, AIM AK72402.

TYPE LOCALITY: West side of Nepean Island, Norfolk Island (roof of cave at 15 m).

ETYMOLOGY: This species is named for its type locality.

REMARKS: According to Verheij and Best (1987), two previously described species of *Polycyathus* have only three cycles of septa: *P. hondaensis* (Durham & Barnard, 1952), known from Pacific Panama and the Galápagos; and *P. hodgsoni* Verheij & Best, 1987, known from the Philippines and Maldive Islands. *Polycyathus norfolkensis* differs from both species in having dimorphic pali (P2>P1) and a low number of columellar elements (1–5 vs 10–15 for the other two species). It is further distinguished from *P. hodgsoni* by larger corallites, and from *P. hondaensis* by having S2 and S3 of equivalent size and in lacking ornate septal granulation (*see* Cairns 1991a).

Trochocyathus Milne Edwards & Haime, 1848a

Corallum solitary, turbinate to ceratoid or bowl-shaped, fixed or free. Septotheca costate, sometimes covered with a thin epitheca. Discrete pali before all but last cycle of septa; columella papillose.

REMARKS: Three subgenera are recognized: the nominate subgenus, *T. (Aplocyathus)*, and *T. (Platycyathus)*. Species of the first two subgenera are represented in the New Zealand region.

Trochocyathus (Trochocyathus) Milne Edwards & Haime, 1848a

Trochocyathus lacking basal costal spines and with other than discoidal coralla (e.g., turbinate, ceratoid, or bowl-shaped). Most species attached, but several species are known to asexually divide transversely resulting in free anthocyathi. P1–2 usually form innermost and lowest palar crown; P3 form a second, higher crown; and P4, if present, form an even higher, more recessed crown. Columella papillose.

TYPE SPECIES: *Turbinolia mitrata* Goldfuss, 1827, by subsequent designation (Milne Edwards & Haime, 1850: xiv).

REMARKS: Species of *Trochocyathus* and *Paracyathus* have been interchanged by many authors. In this account I follow the distinction described by Cairns (1979), i.e., species of *Trochocyathus* bear discrete pali arranged in crowns, whereas species of *Paracyathus* bear multilobate paliform lobes that are usually indistinguishable from columellar elements. Nineteen recent species are attributed to this subgenus: *T. philippinensis* Semper, 1872; *T. rawsonii* Pourtalès, 1874; *T. cinticulatus* (Alcock, 1898); *T. caryophylloides* Alcock, 1902a; *T. rhombocolumna* Alcock, 1902a; *T. rawsonii sensu* Gardiner (1904); *T. cooperi* (Gardiner, 1905); *T. mauiensis* (Vaughan, 1907); *T. oahensis* Vaughan, 1907; *T. gardineri* (Vaughan, 1907); *T. japonicus* Eguchi, 1968; *T. fossulus* Cairns, 1979; *T. fasciatus* Cairns, 1979; *T. aithoseptatum* Cairns, 1984; *T.* sp. A *sensu* Cairns & Keller (1993); *T. decamera* Cairns, 1994; *T. maculatus* n. sp.; *T. gordoni* n. sp.; and *T. cepulla*, n. sp.

Trochocyathus (T.) rhombocolumna Alcock, 1902 (Plates 13, i, 14, a, b)

Trochocyathus (Thecocyathus) rhombocolumna Alcock, 1902a: 98; 1902c: 16, pl. 2, fig. 12.

Paracyathus tenuicalyx Vaughan, 1907: 69–70, pl. 6, figs 1a-b (new synonym).

Paracyathus gardineri: Gardiner & Waugh, 1938: 183–184 (in part: *John Murray* Stn 157, pl. 3, fig. 5).

Trochocyathus rhombocolumna: Cairns & Keller, 1993: 240.

MATERIAL EXAMINED: New Records: NZOI Stn N897, 3, NZOI; Stn S572, 7, USNM 94100; RV *Franklin* Stn 47, 1, AMS G15493 (Britannia Seamount). Previous Records: holotypes of *P. tenuicalyx* and *T. rhombocolumna*.

DISTRIBUTION: New Zealand region: Lord Howe Seamount Chain (Britannia Seamount); Three Kings Ridge; southern Kermadec Ridge (Map 19); 419–530 m. Elsewhere: off southwestern Mozambique; Maldive Islands; Sulu Sea; and Hawaiian Islands; 110–522 m.

DESCRIPTION: Corallum ceratoid, straight, and attached through a robust pedicel 0.34–0.56 GCD. Largest New Zealand specimen (NZOI Stn S572) 14.4 x 12.1 mm in calicular diameter and 19.6 mm in height, with a pedicel diameter of 4.8 mm. Entire theca, from base to calice, covered with small, transverse ridges, each ridge 0.18–0.20 mm wide. Corallum white.

Septa hexamerally arranged in 4 complete cycles according to the formula: S1>S2>S4>S3. S1 moderately exsert (about 2.1 mm) and quite thick (up to 0.8 mm), with straight inner edges that extend about four-fifths distance to columella. S2 slightly less exsert (about 1.9 mm), less wide (four-fifths of an S1), and also with straight inner edges. S3 about 1.6 mm exsert, three-quarters width of an S2, with slightly sinuous inner edges. S4 least exsert septa (about 1.3 mm) but slightly wider than the S3, each S4 adjacent to an S1 being wider than those adjacent to an S2. A crown of 6 small (about 0.5 mm wide) pali occur before the S1 low in the fossa. Six wider pali (about 0.9 mm wide) occur before the S2, their upper edges rising higher than those of the P1. A third crown of 12 large pali occur before the S3, each P3 1.4–1.5 mm wide and rising higher in the fossa than the P2. Inner edges of all pali straight, those of the P1–2 being directly adjacent to columella, those of the P3 slightly recessed from the columella. Fossa of moderate depth. Columella variable, composed of 4 or 5 coarse papillae or several solid, irregularly shaped elements moulded into a medial line or a rhomboidal shape.

TYPES: The holotype of *T. rhombocolumna* is deposited at the ZMA (Coel. 1327). The holotype of *P. tenuicalyx* is deposited at the USNM (20755).

TYPE LOCALITIES: *T. rhombocolumna: Siboga* Stn 95, 5°43.5′ N, 119°40′ E (Sulu Sea), 522 m. *P. tenuicalyx: Albatross* Stn 3895, 20°59′45 N, 157°19′20 W (off Molokai, Hawaiian Islands), 460–784 m.

REMARKS: The New Zealand specimens of *T. rhombocolumna* differ from those previously reported by having larger coralla and better developed thecal striations. In the non-New Zealand specimens, the transverse thecal ridges occur only on the basal half to third of the corallum, the upper theca bearing convex granular costae separated by thin, deep intercostal striae. It is believed that with increase in size, the granular costae and intercostal striae are gradually covered with an epitheca that bears transverse ridging, until no evidence of costae is present in large specimens. The holotype of *P. tenuicalyx* is an example of such a juvenile specimen (GCD = 8.5 mm) in which only the lower half of the theca bears transverse ridges.

Among the recent species of *Trochocyathus*, only two have transverse thecal ridges: *T. cinticulatus* (Alcock, 1898) and *T. rhombocolumna*. Specimens of *T. cinticulatus* have not been examined but that species was described as having a 9–10 part symmetry, its illustration looking suspiciously like *Caryophyllia rugosa*.

Trochocyathus (T.) maculatus n. sp. (Plate 14, c, d)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Kermadec Islands (off Raoul and Curtis); off Lord Howe Island; Taupo Seamount and Dampier Ridge west of Lord Howe Island (Map 19); 100–183 m.

DESCRIPTION: Corallum ceratoid and straight, attached by a broad pedicel 0.60–0.75 GCD. In cross section the pedicel appears to be polycyclic, but the thecal rings are instead produced by the formation of thin exothecal dissepiments over raised basal costae. Largest specimen (NZOI Stn K851) 13.8 x 11.7 mm in calicular diameter and 14.1 mm in height, with a pedicel diameter of 9.6 mm. Calice elliptical (GCD: LCD = 1.17–1.25) and lacerate, caused by the projection of 6 highly exsert septal lancets. Costae well defined only on upper half of corallum, where they are slightly convex and granular, separated by deep intercostal furrows only near the calice. Costal definition fades on lower half of corallum to a fine uniform granulation. Theca thin (about 0.2 mm), which results in a light corallum. Corallum white, but theca and all septa (but not pali) mottled with dark-brown pigment.

Septa hexamerally arranged in 4 cycles and sometimes part of a fifth. Specimens 7.7–12.2 mm in GCD usually have 48 septa; one of 11.8 mm GCD has 58 septa; and the largest specimen of 13.8 mm GCD has 64 septa (8 pairs of S5). S1 highly exsert (2.5–2.7 mm) and have straight, vertical inner edges that extend almost to columella, each having a small (0.5 mm wide) palus deep in fossa. S2 less exsert (about 2.2 mm) and about three-quarters width of an S1, each S2 having a slightly sinuous inner edge that bears a narrow palus equal in width to the P1 but rising higher in the fossa. S3 least exsert septa (about 1.9 mm), about three-quarters width of an S2, and have slightly sinuous inner edges. P3 over twice as wide as P1–2 and project higher in the fossa. S4 that are adjacent to S1 are slightly more exsert and equal to or slightly wider than an S3, each pair of S4 flanking an S1 fusing with that septum in a triangular lancet. S4 that are adjacent to S2 are less exsert and less wide than an S3. If pairs of S5 are present, they are usually wider than the S4 they flank, and the corresponding P4 is equal in width to a P3 but rises even higher in the fossa and is more recessed from the columella. P4 occasionally dissected into 2–4 smaller lobes. Inner edges of P3–4 coarsely dentate, the dentition merging imperceptibly with the columellar elements. Fossa of moderate depth, containing an elliptical field of 20–30 fine (about 0.3 mm in diameter) papillae.

TYPES: Holotype: NZOI Stn P115, NZOI H-626. Paratypes: NZOI Stn K826, 1, NZOI P-1016; Stn K851, 2; USNM 94101; Stn Q46, 1, USNM 94102; Stn T233, 1, NZOI P-1017; RV *Franklin* Stn 5/89/5, 1 AMS G15504.

TYPE LOCALITY: 31°25.9′ S, 159°02.2′ E (off Lord Howe Island), 183 m.

ETYMOLOGY: The species name *maculatus* (Latin *maculatus*, spotted) refers to the mottled black pigmentation of the corallum.

REMARKS: Although two other species of *Trochocyathus* have pigmented coralla (*T. virgatus* and *T. aitho-septatum*), *T. maculatus* is distinguished by its discontinuous, "spotty" pigmentation. It also appears to be unique within the genus by increasing in basal diameter by producing exotheca over raised costae, which produces partitioned concentric basal rings as in *Rhizosmilia*.

Trochocyathus (T.) gordoni n. sp. (Plate 14, e-g)

MATERIAL EXAMINED: Types, q.v.; NZOI Stn T256, 1 poorly preserved specimen, NZOI.

DISTRIBUTION: Known only off the Kermadec Islands from north of Raoul to Curtis Island (Map 20); 398–710 m.

DESCRIPTION: Corallum ceratoid, straight to slightly cornute (curvature usually < 45°), and attached by a slender pedicel only 1.5–3.0 mm in diameter, or 0.14–0.33 GCD. Largest corallum (holotype) 12.8 x 11.2 mmin calicular diameter and 17.2 mm in height, with a pedicel diameter of 2.5 mm. Calice elliptical: GCD: LCD = 1.10–1.25. Costae well defined only near calicular edge, where they are 0.6–0.8 mm wide, rounded, and separated by deep intercostal furrows about 0.2 mm wide. Lower two-thirds to three-quarters of theca granular, the costal definition gradually fading toward base. Costal granules small and rounded, 4 or 5 occurring across a costae near the calice. Corallum white or yellowish-brown.

Coralla above a GCD of 4 mm consistently have 3 cycles of decamerally arranged septa (10:10:20 = 40 septa); the symmetry of smaller specimens is hexameral, often 6:6:12 = 24 septa. Primary septa moderately exsert (about 2.5 mm) and have slightly sinuous inner edges that extend three-quarters distance to columella. A crown of 10 rather slender (0.7–0.9 mm wide) pali adjoin the primary septa. These pali have slightly sinuous inner edges and oblique carinae on their faces. Both secondary and tertiary septa equally exsert (about 1.7 mm) and are about three-quarters width of a primary septum. A crown of 10 pali occur before the secondary septa, these pali about twice the width of the P1 and rise about 1 mm higher in the fossa than those before the primary septa; they also bear prominent, oblique, carinate palar faces. Thus, 2 crowns of pali are present, the inner edges of both crowns extending an equal distance to the columella, but the P2 being wider and higher in the fossa. Each pair of tertiaries flanking a primary septum form low lancets with their common primary septum. Fossa of moderate depth containing an elliptical papillose columella composed of 10–15 highly granular elements that are closely fused to one another.

TYPES: Holotype: NZOI K828A, NZOI H-627. Paratypes: NZOI Stn K828A, 91, NZOI P-1018, 20, USNM 94104; Stn K840, 3, NZOI P-1019; Stn K859, 18, NZOI P-1020.

TYPE LOCALITY: 28°35.4′ S, 177°50.7′ W (north of Raoul Island), 440–510 m.

ETYMOLOGY: This species is named in honour of Dennis P. Gordon of NZOI, who encouraged and facilitated my study of the New Zealand Scleractinia.

REMARKS: Among the 19 recent species of *Trochocyathus* listed in the generic remarks, only two have decamerally arranged septa: *T. decamera* Cairns, 1994 (Japan, 70–88 m) and *T. gordoni*. *Trochocyathus gordoni* differs from *T. decamera* in attaining a much larger size, having a much smaller PD: GCD, lacking the thin epitheca characteristic of *T. decamera*, and in having tertiary septa of equal (not greater) width than the secondaries. Aside from septal symmetry, *T. gordoni* differs from most other species of *Trochocyathus* in having only two size classes of pali; most hexamerally symmetrical species have three size classes (P1, P2, and P3), the P2 and two P3 in each system forming a chevron-shaped pattern.

Trochocyathus (T.) cepulla n. sp. (Plate 15, a, b)

Trochocyathus sp. Sieg & Zibrowius, 1989: 192, fig. 1k-m.

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: New Zealand region: Kermadec Islands (Macauley Island) and southern Norfolk Ridge (Wanganella Bank) (Map 11); 398–449 m. Elsewhere: off New Caledonia; 570–610 m.

DESCRIPTION: Anthocyathus unattached and irregular in shape, including hemispherical to cylindrical, the corallum sometimes horizontally constricted prior to transverse division. Base of anthocyathus flat to slightly convex, showing no overt scar of detachment. Largest anthocyathus examined (holotype) 10.5 x 9.4 mm in calicular diameter and 12.0 mm in height, with a basal diameter of 8.5 mm and slight thecal constriction 3.6 mm above base. Calice slightly elliptical (GCD: LCD = 1.11–1.13) and usually slightly smaller than the maximum calicular di-ameter (i.e., the corallum at calice level curves inward resulting in a lesser diameter). Costae well defined only at calicular edge where they are separated by shallow furrows; otherwise costae are broad (0.7–0.8 mm wide), flat, finely granular (5 or 6 granules across a costa), and bordered by very thin, shallow intercostal striae. Only one anthocaulus is known, measuring 6.1 x 5.5 mm in calicular di-

ameter and 5.4 mm in height, and being cylindrical in shape. Theca quite thick, about 1 mm wide, and of a uniformly light brown colour.

Septal symmetry quite irregular in the 4 specimens examined, but the basic pattern seems to be that of 4 cycles of hexamerally arranged septa: S1>S2>S3>S4. The small anthocaulus has only 42 septa, whereas the 3 anthocyathi have 44, 48, and 49 septa. Septal systems within each corallum show uneven levels of development; a corallum may have a system with 1, 2, or no pairs of S4, or even 2 pairs of S4 and a pair of S5. S1 about 2 mm exsert with slightly sinuous inner edges that extend about three-quarters distance to columella and are internally bordered by a small palus 0.7-0.8 mm wide. S2 only slightly less exsert and slightly less wide (0.8–0.9 width of an S1) and also have slightly sinuous inner edges, each of which is bordered by a wider (1.1–1.4 mm) and slightly taller palus. S3 about 0.9 width of an S2 and have sinuous inner edges, each bordered by a P3 of equal width to a P2 but slightly recessed from the columella and rising higher in the fossa. S4 about 0.9 width of an S3 and have thin straight inner edges. Fossa very shallow, the palar (P3) and columellar elements rising to the calicular edge. Columella composed of an elliptical field of 14-25 tuberculate papillae, each 0.3-0.6 mm in diameter.

TYPES: Holotype: NZOI Stn P13, NZOI H-628. Paratypes: NZOI Stn K840, 1 P-1021, USNM 94094; Stn P13, 2 P-1022, USNM 94095.

TYPE LOCALITY: 32°10.5′ S, 167°21.2′ E (Wanganella Bank, southern Norfolk Ridge), 449 m.

ETYMOLOGY: The species name *cepulla* (Latin *cepa* diminutive *cepulla*, small onion) refers to the onion-like shape of some of the coralla of this species.

REMARKS: Among the 19 recent species in this subgenus (*see* subgeneric remarks), three are known to reproduce asexually by transverse division: *T. cooperi* (Gardiner, 1905), *T. gardineri* (Vaughan, 1907), and *T. cepulla*. *Trochocyathus cooperi* is easily distinguished by its compressed calice and downward projecting thecal edge spines, but *T. cepulla* and *T. gardineri* (Hawaiian Islands, 274–470 m) are quite similar and may be sister species. In general, the two species are similar in shape and septal complement, but *T. cepulla* differs in having a much thicker theca and incurved calicular edge. Furthermore, *T. cepulla* has a very irregular septal symmetry (the hexameral symmetry of *T. gardineri* is easily distinguished), a smaller corallum size, a shallower fossa, and S4 that are smaller than their S3 (in *T. gardineri* the S4 adjacent to S1 are wider than the adjacent S3).

Trochocyathus (Aplocyathus) d'Orbigny, 1849

Coralla bowl-shaped and unattached. Coralla bear one or more basal costal spines on 5 or 6 of its C1. Pali occur before all but last cycle of septa. Columella papillose.

TYPE SPECIES: *Turbinolia armata* Michelotti, 1838, by monotypy.

REMARKS: Most of the approximately eight species in this subgenus occur in the Eocene to Miocene of Italy (*see* Chevalier 1961), Caribbean, and California; only one described recent species is known: *T. (A.) hastatus*. Wells (1984) placed this species in the subgenus *Stephanocyathus (Acinocyathus)*, and Bourne (1903) considered *S. stella* and *S. sexradii* (= *S. (Acinocyathus) spiniger)* to be congeneric with *T. hastatus*. There is little doubt that *Trochocyathus (Aplocyathus)* and *Stephanocyathus (Acinocyathus)* are quite similar and may even be identical; the only difference I can discern is that *Acinocyathus* has broad paliform lobes, whereas *Aplocyathus* has narrower pali.

Trochocyathus (A.) hastatus Bourne, 1903

(Plate 15, c-h)

Trochocyathus hastatus Bourne, 1903: 29–32 (in part: pl. 5, figs 2–5, not pl. 6, figs 8–11, =*Bourneotrochus stellulatus*).
Stephanocyathus (Acinocyathus) hastatus: Wells 1984: 213.

MATERIAL EXAMINED: New Records: NZOI Stn K828, 4, USNM 94111; Stn K859, 1, NZOI; Stn K860, fragment, USNM 94112; Stn T225, 1, USNM 94113; Stn T256, 3, NZOI. Previous Records: 2 syntypes at AMS.

DISTRIBUTION: New Zealand region: Kermadec Islands from north of Raoul to off Curtis Island (Map 21); 460–710 m. Elsewhere: off Tutanga, Funafuti, Tuvalu; 366 m.

DESCRIPTION: Corallum bowl-shaped, the base flat to evenly rounded, sometimes with a scar of former substrate attachment visible at centre of base. Largest specimen known (specimen "A" of Bourne 1903) 18 x 16 mm in calicular diameter; largest New Zealand specimen (NZOI Stn T225) 16.7 x 13.6 mm

in calicular diameter and 11.4 mm in height. Calice elliptical: GCD: LCD = 1.07–1.27. Costae well-defined in upper corallum, 0.5–0.6 mm wide, rounded, and separated by relatively deep intercostal furrows about 0.3 mm wide. On lower half of corallum intercostal furrows become shallow striae, and on corallum base costae are replaced by a smooth, porcellanous theca. Costae near calice covered with very small (30–40 µm) pointed granules, 6 or 7 occurring across a costa. In all specimens examined, 5 elongate (up to 15 mm), slender, tapered (2.2 mm to 0.4 mm) costal spines project almost horizontally from the perimeter of the base. A spine corre-sponds to 5 of the 6 C1, 1 missing from one of the 2 principal C1 aligned with the greater calicular axis. Lower half of corallum, pali, and columella white; however, upper outer regions of all septa and adjacent theca of upper corallum dark brown.

Septa hexamerally arranged in 4 complete cycles (48 septa), even at a GCD of only 12 mm. S1 highly exsert (up to 4.5 mm), quite thick (about 1.2 mm), and have straight, vertical inner edges, except for the principal S1 associated with the missing costal spine, which is slightly less exsert and less wide than an S2. S2 about three-quarters as exsert and half as wide as an S1, and have finely sinuous inner edges. S3 about two-thirds as exsert and three-quarters as wide as an S2, and also have finely sinuous inner edges. S4 adjacent to S1 slightly more exsert and wider than S3, whereas S4 adjacent to S2 are slightly less exsert and less wide than an S3. Inner edges of S4 straight. A crown of 6P1, 6P2, and 12P3 encircle the columella, the inner edges of all pali reaching the same distance toward the columella but each cycle having a different width: P1 0.6–0.8 mm wide, P2 about 1.2 mm wide, and P3 about 2.2 mm wide, each palar cycle projecting slightly higher in the fossa as well. Fossa of moderate depth; columella consists of 7–13 small (0.4– 0.5 mm in diameter) papillae that are laterally fused to one another.

TYPES: Bourne (1903) mentioned eight specimens in his original account of the species, five referred to as specimens A–E and three additional specimens received after the paper had gone to press, all of which must be considered as syntypes. Two syntypes (specimens B and D) are deposited at the AMS (G14462–3); three are deposited at the BM(NH) (1903.12.1.2–4); and the deposition of the remaining specimens is unknown. The three added specimens are a different species, named *Bourneotrochus veroni* by Wells (1984).

TYPE LOCALITY: Off Tutanga, Funafuti, Tuvalu, 366 m.

REMARKS: Of the 14 complete specimens known of this species, 13 have five costal spines and only one (Bourne 1903: pl. 5, fig. 5) has six costal spines. This apparent discrepancy between hexamerally arranged septa and pentamerally arranged costal spines is diagnostic for the species and may be unique among the Scleractinia. *Trochocyathus (A.) armatus* (Michelotti, 1838) also has only five costal spines, but its septa are also pentamerally arranged, resulting in 40 septa. The records reported herein are believed to be the first report of this species since its description.

Tethocyathus Kühn, 1933

Corallum solitary, ceratoid to subcylindrical, fixed or free; if attached, base polycyclic. Septotheca covered by a thick epitheca. Discrete paliform lobes present before all but last cycle of septa: an inner crown (P1–2) and an outer, upper crown (P3). Columella papillose.

TYPE SPECIES: *Thecocyathus microphyllus* Reuss, 1871, by original designation.

REMARKS: The difference between *Trochocyathus* and *Tethocyathus* is quite small, *Tethocyathus* being distingished by having a thick epitheca (Chevalier 1961; Cairns 1979; Zibrowius 1980). According to Zibrowius (1980) this character has little taxonomic weight and according to Cairns (1979) it is an unreliable generic level character. The genus is nonetheless provisionally maintained pending a revision of the larger *Trochocyathus-Paracyathus-Tethocyathus* species complex. The five species provisionally assigned to *Tethocyathus* are: *T. cylindraceus* (Pourtalès, 1868), *T. microphyllus* Reuss, 1871 (type species); *T. recurvatus* (Pourtalès, 1878); *T. virgatus* (Alcock, 1902a); and *T. variabilis* Cairns, 1979.

Tethocyathus cylindraceus (Pourtalès, 1868)
(Plates 15, i-k, 16, a, b)

Thecocyathus cylindraceus Pourtalès, 1868: 134.
Trochocyathus (Thecocyathus) sp. Gardiner 1929: 126; Ralph & Squires 1962: 17; Squires & Keyes 1967: 29.
Not *Paracyathus conceptus* Gardiner & Waugh, 1938: 184–185, pl. 4, figs. 8-9; Wells 1964: 113, pl. 1, figs 11–12.
Paracyathus conceptus: Ralph & Squires 1962: 7–8, pl. 2, figs 3-4; Squires & Keyes 1967: 23 (in part: Not NZOI

Stn C627, C648, or pl. 2, figs 7–8); Dawson 1979: 30 (in part: NZOI Stn A904, C814).

Tethocyathus cylindraceus: Cairns 1979: 83–84, pl. 13, figs 8–11 (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn A804, 2, USNM 94090; Stn C777, 5, NZOI; Stn C814, 7, USNM 94087; Stn F933, 2, NZOI; Stn I375, 1, USNM 94089; BS402, 1, MoNZ CO105; BS682 (R40), 2, MoNZ CO296; BS770 (R128), 11, MoNZ CO308; BS843 (O589), 1, MoNZ CO216; BS856 (O.602), 1, MoNZ CO277; BS898 (O644), 2, MoNZ CO288; BS899 (O645), 5, MoNZ CO298; north side of Poor Knights Island, 10 m, 5, NZGS; L3071, 64, AIM AK78395. Previous Records: Specimens reported by Gardiner (1929), Ralph and Squires (1962), and Squires and Keyes (1967); syntypes of *T. cylindraceus*.

REFERENCE MATERIAL: 12 syntypes of *Paracyathus conceptus*, BM(NH) 1950.1.9.839–850, 859–867.

DISTRIBUTION: New Zealand region: off northeastern New Zealand from Three Kings Islands to Hawke Bay (Map 9); usually found in cave environments in shallow water, e.g., Rikoriko Cave on Aorangi Island, Poor Knights Islands, 5–327 m. Elsewhere: Straits of Florida; off Jamaica; Barbados; 155–649 m (Cairns 1979).

DESCRIPTION: Corallum ceratoid to subcylindrical, usually straight, and attached through a robust pedicel (PD: GCD = 0.45–0.85) and polycyclic base. Largest specimen examined 11.5 mm in calicular diameter and 15.4 mm in height, with a pedicel diameter of 7.5 mm. Calice circular to slightly elliptical. Most coralla bear a thick, tranversely striate epitheca that completely obscures the underlying costae; however, in some larger specimens the epitheca is confined to the upper half of the corallum and in some small coralla this epitheca is poorly developed or not yet developed. But in most coralla the epitheca is so well developed that it forms a small rim or lip encircling the calice, resulting in a shallow circular groove between the upper, outer septal edges and the epitheca. When costae are visible, they are rounded and finely granular, the intercostal striae also bearing a row of fine granules. Theca relatively thick. Corallum white; polyps pale green (F. Brook, pers. comm.).

In all specimens examined septa are hexamerally arranged in 4 cycles according to the formula S1>S2>S3>S4, but pairs of S4 are sometimes missing in coralla less than 7 mm in GCD. Septa little exsert: S1–3 1.0–1.7 mm exsert, the S4 only about 0.8 as exsert. S1 thick with slightly sinuous inner edges, extending about three-quarters distance to columella. S2 equally as thick and only slightly less wide than an S1, also with slightly sinuous inner edges. S3 slightly less thick and about 0.8–0.9 as wide as an S2, with slightly more sinuous edges than the S1–2. S4 relatively thin (0.7–0.8 width of an S3) with straight to slightly sinuous inner edges. An inner crown of 12 P1–2 occurs low in the fossa, both cycles of pali 0.7–0.8 mm wide, but P2 thicker than P1. A second crown of 12 P3 occurs slightly higher in the fossa and recessed from the columella, each P3 about 0.3 mm wide, thick, sometimes with a bifurcate outer edge. In each system, a triad of 2 P3 and 1 P2 form in a chevron-shaped configuration, characteristic of most species of *Trochocyathus* and *Tethocyathus*. Fossa of moderate depth, containing a papillose columella consisting of 12–20 slender (about 0.5 mm in diameter), smooth rods.

TYPES: Thirteen syntypes of *T. cylindraceus* are deposited at the MCZ (2763, 5611).

TYPE LOCALITY: "Off Florida Reefs" (= Straits of Florida), 183–366 m.

REMARKS: Although the New Zealand specimens of *T. cylindraceus* are far removed from any previously reported, no differences were found among them and the syntypes and other specimens reported from the western Atlantic (Cairns 1979). *Paracyathus conceptus* Gardiner & Waugh, 1938 is known from off the Maldive Islands and the Red Sea from 229–805 m, and differs in having an elongate, elliptical calice; pairs of S5 in larger coralla (up to 58 septa); a much less well-developed epitheca; and "paracyathid" paliform lobes, i.e., sometimes doubled and often flattened perpendicular to the septal plane and not arranged in chevrons within a system. It would appear to be a true *Paracyathus*.

Tethocyathus virgatus (Alcock, 1902) n. comb.
(Plate 16, c-f)

Trochocyathus (Thecocyathus) virgatus Alcock, 1902a: 98–99; 1902c: 16–17, pl. 2, fig. 13.

Not *Trochocyathus virgatus*: Marenzeller, 1907: 21–23, pl. 2, fig. 4; Wells, 1964: 112–113, pl. 1, figs 8–10.

MATERIAL EXAMINED: New Records: NZOI Stn K826, 1, USNM 94091; Stn N897, 3, NZOI; Stn S572, 4, USNM 94093; Stn U591, 8, NZOI. Previous Records: Two syntypes.

DISTRIBUTION: New Zealand region: Three Kings, Colville, and Kermadec Ridges (Map 11); 142–530 m.

Elsewhere: Sulu Archipelago; 275 m, the depth of 15 m from *Siboga* Stn 96 is assumed to an error.

DESCRIPTION: Corallum ceratoid to subcylindrical, attached by a robust pedicel (PD: GCD = 0.54–0.84) and polycyclic base. Largest specimen examined (NZOI Stn U591) 16.3 x 15.9 mm in calicular diameter and 26 mm in height. Calice circular to only slightly elliptical: GCD: LCD = 1.0–1.1. Epitheca variable in development, in some specimens (e.g., NZOI Stn N897) quite thick, obscuring underlying costae, but in other specimens less thick, revealing flat, granular costae about 0.8 mm wide. Theca of most specimens highly encrusted and also bored by acrothoracid barnacles. Theca thick. Corallum predominantly white, but the 6 S1 and associated C1 are pigmented a dark to purplish brown, conveniently marking the hexameral symmetry of the corallum. In one syntype (*Siboga* Stn 105) and to a lesser degree specimens from NZOI Stn S572, the S2 are also darkly pigmented.

Septa hexamerally arranged in 4 complete cycles (48 septa), the arrangement and position of septa and pali sometimes made irregular by the coral's reaction to acrothoracid commensals (Plate 16, d, e). S1 1.7–2.8 mm exsert and quite thick, appearing swollen (0.7-1.3 mm thick). S2 equally as exsert and thick as S1 but only about 0.9 as wide as an S1. S3 and S4 equally exsert (about 0.6 that of S1–2) and considerably less thick than the S1–2. S3 about 0.9 width of an S2. S4 adjacent to S1 equal to or slightly wider than an S3, whereas those S4 adjacent to S2 are usually less wide than an S3. All septa have straight inner edges. A crown of 6 P1 1.2–1.6 mm wide lies deep in the fossa. Another 6 P2, each 1.4–1.5 mm wide, occur slightly higher in the fossa but at the same proximity to the columella as the P1. A third crown of 12 P3, each 1.4–1.6 mm wide, occurs slightly recessed from the columella but each P3 rising higher in the fossa than the P2. All pali quite thick (thicker than the septa), their faces being highly granular and ridged. Fossa relatively deep. Columella consists of 3–40 slender, tuberculate papillae.

TYPES: Two syntypes are deposited at the ZMA: *Siboga* Stn 105 (Coel. 1328) and *Siboga* Stn 96 (1323).

TYPE LOCALITY: *Siboga* Stn 96 and 105: Sulu Archipelago; ?15–275 m.

REMARKS: *Tethocyathus virgatus* is distinguished from other recent species in the genus by its larger size, larger pali, and distinctively pigmented CS1.

Although not common, acrothoracid barnacles are known in a variety of scleractinian hosts (Zibrowius 1976), including *T. virgatus* and western Atlantic populations of *Tethocyathus cylindraceus*.

Stephanocyathus Seguenza, 1864

Corallum solitary, bowl-shaped, free. Septotheca costate, in some species the C1 bearing long spines or the C1–2 bearing tubercles. Paliform lobes usually present before all but last cycle. Columella papillose or a solid fusion of inner septal edges.

REMARKS: The genus is divided into three subgenera, all of which are represented in the New Zealand region: *S. (Stephanocyathus)*, *S. (Acinocyathus)* and *S. (Odontocyathus)*.

Stephanocyathus (Stephanocyathus) Seguenza, 1864

Stephanocyathus in which the base does not bear elongate costal spines or tubercles.

TYPE SPECIES: *Stephanocyathus elegans* Seguenza, 1864, by subsequent designation (Wells 1936).

REMARKS: Approximately seven recent and an equal number of fossil species are known in this subgenus, only two recent species known from the Indo-West Pacific region: *S. platypus* (Moseley, 1876) and *Stephanocyathus* sp. (*sensu* Cairns & Parker 1992), from off Tasmania.

Stephanocyathus (S.) platypus (Moseley, 1876) (Plate 17, a-c)

Ceratotrochus platypus Moseley, 1876: 554.
Stephanotrochus platypus: Moseley 1881: 154, pl. 3, figs 4a-b, 5a-c.
Stephanocyathus sp. Squires & Ralph 1965: 262–263, figs 3–4; Squires & Keyes 1967: 24, pl. 2, figs 11–12.
Stephanocyathus platypus: Cairns 1982: 24–25, pl. 7, figs 3–6 (synonymy); Cairns & Parker 1992: 24–25, pl. 7, figs a-c, map 7.

MATERIAL EXAMINED: New Records: NZOI Stn E773, 1, NZOI; Stn E774, 1, NZOI; Stn E783, 1, NZOI; Stn E801, 1, NZOI; Stn E880, 1, NZOI; Stn G817, 1, NZOI; Stn G819, 3, NZOI; Stn G820, 3, NZOI; Stn G821, 2, USNM 94161; Stn G823, 4, NZOI; Stn G824, 2, USNM 94162; Stn G825, 3, NZOI; Stn E829, 1, NZOI; Stn G888, 1, NZOI; Stn I686, 1, USNM 94163; Stn I698, 1, USNM 94164; Stn P120, 1,

USNM 94165; Stn P942, 1, NZOI; Stn Q83, 7, NZOI; Stn Q84, 8, NZOI; BS707 (R65), 1, MoNZ CO284; BS761 (R119), 1, MoNZ CO144; BS762 (R120), 1, MoNZ CO145; K1/24/81, 1, MoNZ; K1/25/81, 1, MoNZ; *Poong San* 1, 1, MoNZ; KTN/26/82, 1, MoNZ; 37°28.7′ S, 167°26.1′ E, 700–892 m, 1, MoNZ; 48°22.5′ S, 179°56′ E, 547–561 m, 2, MoNZ CO9; 37°36′ S, 176°50′ E, 457–5 85 m, 1, AIM AK3106; *Trinity* II, 2, AIM AK8474. Previous Records: Specimens reported by Squires and Ralph (1965) and Squires and Keyes (1967); 2 syntypes.

DISTRIBUTION: New Zealand region: widespread in region bounded by Lord Howe Rise, eastern Chatham Rise, and Bounty Plateau (Map 2); 561–1168 m, but most common between 700–900 m. Elsewhere: Southern Australia to New South Wales, including Tasmania; and seamounts east of Chatham Island; 560–1219 m.

TYPES: Two syntypes of *C. platypus* are deposited at the BM(NH) (1880.11.25.57).

TYPE LOCALITY: *Challenger* Stn 164, 34°13′ S, 151°38′ E (off Sydney, Australia), 750 m.

REMARKS: *Stephanocyathus platypus* has been adequately described and figured by Cairns (1982) and Cairns and Parker (1992) and will not be fully redescribed here. To summarise, the corallum of this species is bowl-shaped, with a flat, unattached base and upturned edges. It may attain the quite large calicular diameter of 95 mm (uncatalogued MoNZ specimen) and a height of 47 mm, but small specimens of less than 25–30 mm GCD are low and discoidal, lacking upward peripheral thecal growth. Septa are hexamerally arranged in five cycles, pairs of S6 present in larger coralla. S1 are extremely exsert and wider than the S2, which are wider than the S3. However, those S4 adjacent to S2 are wider than S3 and often loosely fused to its adjacent S2 near the columella. Conversely, those S4 adjacent to S1 are less wide than an S3 and sometimes loosely fuse to their adjacent S3. S5 are uniformly short. The columella is flat, composed of greatly thickened inner edges of S1–2.

Although rarely reported before 1992, *S. platypus* is a common element of the temperate southwest Pacific region at 700-900 m, and aside from unusually large specimens of *D. dianthus*, *S. platypus* is one of the largest solitary corals in this region.

Stephanocyathus (Acinocyathus) Wells, 1984

Stephanocyathus in which the base bears 6 elongate costal spines corresponding to the C1.

TYPE SPECIES: *Stephanotrochus spiniger* Marenzeller, 1888, by original designation.

REMARKS: Among the approximately 10 names applied to species in this subgenus, only three appear to be valid: the type species *S. (O.) spiniger* (Marenzeller, 1888); *S. (O.) explanans* (Marenzeller, 1904a); and the fossil species *S. (O.) mantelli* (Milne Edwards and Haime, 1857). Wells (1984) and Cairns and Parker (1992) listed most of the nominal species. Wells (1984) created the combination *S. (A.) hastatus* (Bourne, 1903), but this species is considered to be in the subgenus *Trochocyathus (Aplocyathus)* herein.

Stephanocyathus (A.) spiniger (Marenzeller, 1888)
(Plates 17, d-f, 18, c)

Stephanotrochus spiniger Marenzeller, 1888: 20–21.
Stephanotrochus tatei Dennant, 1899: 117–119, pl. 3, figs 1a-c; Cairns & Parker 1992: pl. 7, fig. h.
Odontocyathus sexradii Alcock, 1902a: 100–101; 1902c: 23, pl. 3, figs 20a-b.
Odontocyathus stella Alcock, 1902b: 119–120; 1902c: 24, pl. 3, figs 21a-b.
Odontocyathus japonicus Yabe and Eguchi, 1932c: 149–152, pl. 14, text-figs 1–3.
Stephanocyathus (Acinocyathus) spiniger: Wells 1984: 209, pl. 2, figs 10–13; Cairns & Parker 1992: 26–27, pl. 7, figs. g-i (synonymy); Cairns & Keller 1993: 243; Cairns 1994: 57, pl. 25, figs a-c (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn F10, 2, NZOI; Stn F898, 1, USNM 94153; Stn F915, 1, NZOI; Stn F916, 2, NZOI, 1, USNM 94154; Stn I64, 3, NZOI; Stn I91, 3, USNM 94155; Stn I94, 7, USNM 94156; Stn I345, 1, NZOI; Stn I356, 3, USNM 94157; Stn I363, 1, NZOI; Stn I745, 6, NZOI; Stn J699, 1, NZOI; Stn J710, 1, NZOI; Stn K804, 1, NZOI; Stn P14, 39, USNM 49231 and 94158, NZOI; Stn P16, 2, USNM 94159; Stn P85, 1, USNM 94160; Stn T256, 1, NZOI; BS748 (R106), 1, MoNZ; BS756 (R114), 3, MoNZ; BS757 (R115), 1, MoNZ; BS849 (O595), 1, MoNZ; BS878 (O624), 5, MoNZ CO225; BS881 (O627), 7, MoNZ CO279; outside Poor Knights Island, depth unknown, 2, AUM; out from Doubtless Bay, depth unknown, 1, AUM.

DISTRIBUTION: New Zealand region: off Lord Howe Island; southern Norfolk Ridge; Kermadec Islands; northern North Island from Bay of Plenty to off Cape Egmont (Map 17); 174–590 m, with one outlying record at 1300 m (NZOI Stn I745). Elsewhere: widespread throughout Indo-West Pacific from southwest Indian Ocean to Japan, including South Australia; 120–695 m. Also Upper Oligocene, Victoria, Australia (as *S. tatei*) and Neogene of Kyushu (as *S. japonicus*).

TYPES: The holotype of *S. spiniger* is deposited at the NMW. The holotype and paratype of *S. tatei* are deposited at the NMV (P27072–3). The holotypes of *O. sexradii* and *O. stella* are deposited at the ZMA (Coel. 1304, 1305, respectively). The holotype of *O. japonicus* is deposited at the TIUS (40876).

TYPE LOCALITIES: *S. spiniger*: Enosima (Sagami Bay), Honshu, Japan; depth unknown. *S. tatei*: Upper Oligocene at Spring Creek, 13 miles (21 km) south of Geelong, Victoria. *O. sexradii*: *Siboga* Stn 156, 0°29.2' S, 130°05.3' E, 46 m. *O. stella: Siboga* Stn 159, 0°59.1' S, 129°48.8' E, 41 m. *O. japonicus:* Neogene of Segoe, southwet Kyushu, Japan.

REMARKS: This widespread Indo-West Pacific species has been adequately described and figured elsewhere (Cairns & Parker 1992; Cairns 1994) and need not be redescribed here. It is quite distinctive among the New Zealand species in having six elongate slender costal spines (C1) that either elevate the corallum above the substratum or anchor it into a soft substratum. Only one other species in the New Zealand region has elongate costal spines, *Trochocyathus hastatus,* that species being distinguished by having hexamerally symmetrical septa but only five costal spines and only four cycles of septa.

The largest specimen reported from the New Zealand region (NZOI Stn P85) is 33 mm in calicular diameter. Small specimens less than 20 mm in calicular diameter are flat, hexagonal in outline, and have only four cycles of septa. These small specimens (Plate 18, c) have yet to form a vertical thecal wall but do bear six prominent costal spines. This distinctive juvenile stage was named *Odontocyathus stella* by Alcock (1902b). In these small specimens it is often possible to see the incorporated substratum on which the corallum originally settled, which include foraminiferans, echinoid spines, pebbles, and bryozoans.

Stephanocyathus (Odontocyathus) Moseley, 1881

Stephanocyathus with 12–18 short basal spines or tubercles (C1-2, sometimes C3), sometimes fusing into a basal rim.

TYPE SPECIES: *Platytrochus coronatus* Pourtalès, 1867, by monotypy.

REMARKS: Five species are known in this subgenus: *S. (O.) coronatus* (Pourtalès, 1867); *S. (O.) nobilis* (Moseley, 1873); *S. (O.) weberianus* (Alcock, 1902a); *S. (O.) campaniformis* (Marenzeller, 1904a); and *S. (O.) ixine* Squires, 1958. The subgenus occurs in tropical to temperate waters of the Atlantic and Indo-West Pacific and is commonest from at 800–1500 m.

Stephanocyathus (O.) weberianus (Alcock, 1902) (Plate 17, g-i)

Stephanotrochus weberianus Alcock, 1902a: 101–102; 1902c: 25, pl. 3, figs 22, 22a.
Stephanotrochus sibogae Alcock, 1902a: 102–103; 1902c: 25–26, pl. 3, figs 23, 23a.
Stephanocyathus (O.) weberianus: Cairns 1994: 57–58, pl. 25, figs d-f (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn I745, 2, NZOI; Stn Q68, 3, USNM 94149.

PREVIOUS RECORDS: Holotype of *S. weberianus*.

DISTRIBUTION: New Zealand region: Lord Howe Seamount Chain (Map 19); 1045 m. Elsewhere: off Japan, South China Sea, Sulu Sea, Makassar Strait, Banda and Timor Seas, Chesterfield Islands (reported herein); 206–1302 m.

TYPES: The holotype of *S. weberianus* is deposited at the ZMA (Coel. 1322). The deposition of the holotype of *S. sibogae* is unknown.

TYPE LOCALITIES: *S. weberianus*: *Siboga* Stn 284, 8°43.1′ S, 127°16.7′ E (Timor Sea), 828 m. *S. sibogae*: *Siboga* Stn 88, 0°34.6′ N, 119°08.5′ E (Makassar Strait), 1301 m.

REMARKS: Based on the five specimens reported herein, nothing can be added to the description of this species given by Cairns (1994). *Stephanocyathus weberianus* is characterised by having a flat, eroded base that is often encircled by a swollen basal rim; relatively small costal tubercles; and a tendency to have numerous pairs of S5 even at a relatively small calicular diameter. The specimens reported herein are all rather small and worn, the largest specimen (NZOI Stn 745) only 23.8 mm in calicular diameter and having 60 septa. These specimens are marginal to the New Zealand region and probably represent the southern limit of the range of this tropical/subtropical species.

Stephanocyathus (O.) coronatus (Pourtalès, 1867)
(Plates 17, j-l, 18, a, b)

Platycyathus coronatus Pourtalès, 1867: 114.
Odontocyathus coronatus: Moseley 1881: 148–151, pl. 2, figs 4a-b, 5a-b.
Stephanocyathus (O.) coronatus: Cairns 1979: 109–111, pl. 20, figs 5-6, 8-9 (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn P943, 6, USNM 94146; Stn P945, 1, USNM 94147; Stn P947, 7, NZOI; Stn Q874, 1, NZOI; Stn U198, 1, USNM 94148; Stn U592, 2, NZOI; Stn Z2097, 1, NZOI; *Alexander Nesmeyanov* Stn 17–15, 2, AUM; RV *Franklin* Stn 5/89/25, 10, AMS 15560, G15568; *Franklin* Stn 5/89/32, 2, AMS G15495. Previous Records: specimens reported by Moseley (1881); holotype of *P. coronatus*.

DISTRIBUTION: New Zealand region: Lord Howe Rise; Three Kings Ridge; Kermadec Ridge (Map 11); 646–1276 m. Elsewhere: Caribbean, Bahamas, Gulf of Mexico; 543–1250 m.

DESCRIPTION: As the name implies, the corallum is crown-shaped, with a flat to slightly convex base and straight thecal edges that diverge from a hypothetical basal angle of 40–50°. Calice circular and highly lacerate, all septa being highly exsert. Medium to large-sized coralla quite tall, the ratio of corallum height to basal diameter being 1.0–1.7. Largest specimen known (NZOI Stn P945) 36.1 mm in calicular diameter and 32.3 mm in height, with a basal diameter of 18.9 mm. Base costate, the C1–2 slightly ridged and the centre of the base often slightly produced and often still attached to a fragment of the settlement substratum. At the edge of the base, each of the 12 C1–2 bears a prominent, often complexly ornamented tubercle, in one case (NZOI Stn P943, Plate 18, a, b) the blunt tubercles extending outward 9 mm and having a diameter of 2.5 mm. Tubercles project horizontally to slightly downward and provide increased stability for the corallum. Costae on vertical theca well developed, 1.0–1.4 mm wide, slightly convex, separated by intercostal striae, and covered with fine granules. C1–2 slightly wider and prominent than other costae. Corallum white.

Septa hexamerally arranged in 4 cycles and an incomplete fifth cycle, the largest specimen having only 58 septa, but a smaller corallum from AMS G15560 having 60 septa. S1 highly exsert (up to 10.5 mm), thick (up to 1.6 mm), with straight, vertical inner edges, each bordered by a broad (about 3 mm wide) notch and a thick, horizontal paliform lobe 1.5–2.0 mm wide that extends to the columella. S2 equal to or slightly less exsert (up to 8.5 mm) than the S1, but otherwise identical in structure. S3 less exsert (about 4 mm), about three-quarters width of an S1–2, and have straight inner edges, each bordered by a narrow notch (about 1.5 mm wide) and a tall (up to 5 mm) paliform lobe about 2 mm wide. If pairs of S5 are present in a half-system, the enclosed S4 is accelerated to almost the size of an S3 and bears a P4 of equal size to the P3. Pairs of S5 and S4 that are adjacent to S1–2 form short, rectangular lancets at the calicular edge. Fossa of moderate depth and quite spacious, due to the relative thinness of all septa. Columella composed of a variable number (4–20) of tuberculate papillae.

TYPES: The holotype of *P. coronatus* is deposited at the MCZ (2769).

TYPE LOCALITY: 30°41′ N, 77°03′ W (Blake Plateau off Florida), 841 m.

REMARKS: Although this species was previously known only from the western Atlantic, I have no reservation in identifying the New Zealand specimens as *S. coronatus* based on comparison with numerous typical specimens from the western Atlantic.

Stephanocyathus coronatus slightly overlaps the geographic and bathymetric range of *S. weberianus*, but is distinguished from that species by (1) having less septa at a corresponding calicular diameter, (2) having more exsert S1–2, (3) having a taller corallum (height:basal diameter of *S. coronatus* = 1.0–1.7 vs 0.64–0.72 for *S. weberianus*), (4) having a costate (not worn or smooth), slightly convex base, and (5) having well-developed, complexly ornamented costal tubercles.

Vaughanella Gravier, 1915

Corallum solitary, patellate to trochoid, and usually firmly attached by a robust pedicel. Septotheca costate. Paliform lobes present on all but last cycle of septa. Columella papillose.

TYPE SPECIES: *Caryophyllia margaritata* Jourdan, 1895, by monotypy (*see* Zibrowius 1980: 103).

REMARKS: *Vaughanella* is extremely similar to *Stephanocyathus (Odontocyathus)*, differing from that subgenus only in having an attached corallum and in lacking costal spines. Four species are known in this genus: the type species *V. margaritata* (Jourdan,

1895), known only from off Newfoundland; *V. concinna* Gravier, 1915; *V. oreophila* Keller, 1981b; and *V. multipalifera*, n. sp.

Vaughanella oreophila Keller, 1981 (Plate 18, d, e)

Vaughanella oreophila Keller, 1981b: 32–33, pl. 2, fig. 1a-b.

MATERIAL EXAMINED: NEW RECORDS: NZOI Stn P8, 1, USNM 94166; Stn P946, 5, NZOI, 5, USNM 94167;, Stn P947, 2, USNM 94168.

DISTRIBUTION: New Zealand region: southern Norfolk Ridge; northern Colville Ridge (Map 12); 646–757 m. Elsewhere: Marcus Necker Ridge, North Pacific; 1420 m.

DESCRIPTION: Corallum trochoid (basal angle 37–53°), straight, and firmly attached through a stereome-reinforced pedicel 0.28-0.38 diameter of calice. Calice circular to very slightly elliptical (GCD :LCD = 1.0–1.05). Largest New Zealand specimen (NZOI Stn P8) 22.4 x 22.0 mm in calicular diameter and 24.3 mm in height, with a pedicel diameter of 6.3 mm. Most of theca smooth and porcellanous, but near calice costae are faintly distinguishable and inconspicuously granular. Corallum white, but theca of lower half of corallum often black in colour.

Septa hexamerally arranged in 4 complete cycles (S1–2>S3>S4), the largest specimen having 5 pairs of S5, for a total of 58 septa. S1–2 3.1–3.3 mm exsert, thick (about 1.2 mm), and have vertical, straight inner edges. Each S1–2 internally bordered by a broad (1.7–2.0 mm wide) notch and a small, lamellar or papillose, pointed paliform lobe 0.4–0.9 mm in diameter, which is sometimes indistinguishable from the columellar elements. P1–2 have vertical inner edges but obliquely oriented outer edges. S3 1.5–1.8 mm exsert, about two-thirds width of an S1–2, and also have straight inner edges. Each S3 bordered by a deep notch about 1.0 mm wide and a tall (about 3 mm) rounded, lamellar paliform lobe 1.7–2.6 mm wide, the 12 P3 forming a distinct crown within the fossa. P3 thick, their inner and outer edges vertical and straight. The P3 crown rises much higher in the fossa than the P1–2 and is more recessed from the columella. S4 equally exsert but only about two-thirds as wide as an S3, and do not bear paliform lobes unless flanked by a pair of S5, in which case the enclosed S4 is about the same size as an S3 and bears a P4. S5 equal in size to an unaccelerated S4. Fossa of moderate depth. Columella papillose, consisting of 2–10 slender (0.4–0.5 mm in diameter) rods.

TYPES: The holotype is deposited at the IOM.

TYPE LOCALITY: *Vityaz* Stn 6367, 23°32′ N, 157°23′ E (Marcus Necker Ridge), 1420 m.

REMARKS: This is the first report of this species subsequent to its original description, which was based on only two specimens.

Vaughanella multipalifera n. sp. (Plate 18, g, h)

MATERIAL EXAMINED: TYPES, Q.V.

DISTRIBUTION: Known only off Macauley Island, Kermadec Ridge and Raukumara Plain off Cape Runaway (Map 12); 1357–1450 m.

DESCRIPTION: Corallum patellate (basal angle 58–100°) and firmly attached by a broad pedicel (PD: GCD = 0.36–0.70). Calice elliptical: GCD: LCD = 1.02–1.24. Largest of the 3 coralla examined (the holotype) 33.6 x 29.6 mm in calicular diameter and 22.3 mm in height, with a pedicel diameter of 12.2 mm. Costae consist of thin, finely granular ridges, but only well developed in upper corallum. Theca of holotype also have costae of equal width corresponding to each interseptal space, resulting in 192 costae for a corallum with only 96 septa. Corallum white; however, lower three-quarters of holotype discoloured to a shade of brown.

Septa hexamerally arranged in 5 complete cycles (96 septa) according to the formula S1≥S2>S3>S4>>S5, but the smaller paratype of GCD 18.5 mm lacks 7 pairs of S5, resulting in a total of only 82 septa. S1–2 highly exsert (5.0–5.7 mm) and relatively thin, their inner edges extending to the columella. Lower third of inner edges of S1–2 bear 3 or 4 small paliform lobes, the lobes ranging from 0.5–1.6 mm in width, the innermost lobes indistinguishable from the columellar elements. S3 much less exsert (2.5–3.0 mm) and thinner than the S1–2, but also extend to the columella where the inner edges of each pair of S3 within a system are loosely fused to their common S2. As with the S1–2, the lower third to half of the inner edges of the S3 bear several narrow paliform lobes. S4 less exsert (about 2 mm) than the S3 and extend about four-fifths distance to columella, the inner edges of each pair of S4 within a half-system loosely fused to their common S3. As with the other septa, the lower inner edges of the S4 bear several thin paliform lobes. S5 equally as exsert as S4, but otherwise rudimentary. Thus, only the S1 and S5 are independent septa, the inner

edges of the S2–4 bending toward and fusing with one another within each system. Inner edges of all septa very slightly sinuous, and, because the septa are relatively thin and follow the contour of the theca, a wide, open fossa results. Columella a low, central, circular papillose structure.

TYPES: Holotype: NZOI Stn T244, NZOI H-629. Paratypes: NZOI Stn F874, 2 P-1023, USNM 94152.

TYPE LOCALITY: 30°05.2′ S, 178°10.2′ W (off Macauley Island, Kermadec Ridge), 1450 m.

ETYMOLOGY: The species name *multipalifera* (Latin *multae*, much + *palus*, stake + *fera*, suffix meaning "bearing") refers to the multiple paliform lobes on the lower, inner edges of the S1–4.

REMARKS: *Vaughanella multipalifera* is distinguished from the other species in the genus by having multiple paliform lobes on their S1–4. This character is so distinctive that a placement in this genus is considered tentative; however, there are no other caryophylliid genera that are consistent with this morphology.

Bourneotrochus Wells, 1984

Corallum solitary and discoidal, often reproducing by transverse division resulting in a free anthocyathus with a large basal scar. Costal spines associated with C1. Septotheca porcellanous basally and costate laterally. Pali present before all but last cycle of septa; columella papillose.

TYPE SPECIES: *Bourneotrochus veroni* Wells, 1984 (= *Deltocyathus stellulatus* Cairns, 1984), by original designation.

REMARKS: Although I originally placed *B. stellulatus* in the genus *Deltocyathus* (Cairns 1984) and Wells (1984) independently referred to specimens of his new genus as "deltocyathids", its palar arrangement and thus taxonomic affinities seem to be closer to *Trochocyathus* than *Deltocyathus*. Its pali stand independently in sucessive crowns, not fused to one another in chevrons as in *Deltocyathus*.

Only one species is known in the genus: *B. stellulatus* (Cairns, 1984).

Bourneotrochus stellulatus (Cairns, 1984)

(Plates 18, f, i, 19, a-c)

Trochocyathus hastatus Bourne, 1903: in part, 32–37, pl. 6, figs 9–11.

Deltocyathus stellulatus Cairns, 1984 (April): 15–16, pl. 3, figs C–D.

Bouneotrochus veroni Wells, 1984 (December): 213–214, pl. 3, figs 7–18.

Bourneotrochus stellulatus: Cairns 1991b: 13, 49, 52.

MATERIAL EXAMINED: New Records: NZOI Stn F319, 3, USNM 94150; Stn G3, 2, USNM 94151; Stn K858, 1, NZOI; *Tui* AUZ40, 1, MoNZ CO247; RV *Franklin* Stn 5/89/40, 13, AMS G15557. Previous Records: Type series of *D. stellulatus* and *B. veroni*.

DISTRIBUTION: New Zealand region: off Curtis Island, Kermadecs; Norfolk Ridge; Lord Howe Seamount Chain (Gifford Guyot) (Map 18); 326–710 m. Elsewhere: off Queensland; Chesterfield Islands (reported herein); Funafuti, Tuvalu; Austral Seamounts off Cook Islands, 847 m (reported herein, NZOI Stn F319); Hawaiian Islands; 274–476 m. Pleistocene of Vanuatu.

DESCRIPTION: Corallum (anthocyathus) discoidal and cylindrical, usually tapering to a smaller calicular diameter than basal diameter. For instance, the largest specimen examined (NZOI Stn F319) is 5.5 mm in basal diameter, 4.4 mm in calicular diameter, and 3.1 mm in height. Base flat to concave, the concavity due to a circular scar of detachment measuring 1.8–2.2 mm in diameter, sometimes exceeding the calice in diameter. Theca thick. Base of corallum porcellanous, but thecal wall costate. Costae equal in width (0.15–0.18 mm) and separated by rather broad (0.09–0.10 mm), shallow intercostal furrows. Costae and costal spines covered with irregularly shaped, coarse granules 50–60 µm in diameter, whereas the granules in the intercostal furrows are smaller (7–10 µm) and angular in shape. Six costal spines (C1) present, one projecting horizontally from the outer edge of each CS1. Costal spines blunt and up to 0.9 mm in length; however, Bourne (1903) reported C1 spines up to 2.0 mm in length. In tall specimens, 2 spines may correspond to each C1, the original set of 6 and another upper set of 6 corresponding to a developing anthocyathus that will eventually detach. In some coralla an additional set of 6 much smaller (0.4 mm long) costal spines also occur on the CS2. Anthocaulus unknown. Corallum white.

Septa hexamerally arranged in 3 to 4 cycles, the fourth always incomplete. Most coralla examined have 36 septa, which includes a pair of S4 in each system, but the largest specimen of 4.4 mm calicular diameter has only 24 septa (as do all specimens

from NZOI Stn F319) and the holotype of *B. veroni* (GCD = 2.9 mm) has 30 septa. Thus, there appears to be no correlation between calicular diameter and number of septa. S1 little exsert and have slightly sinuous inner edges that extend about three-quarters distance to columella where each is bordered by a small (0.25–0.30 mm wide), lamellar to rod-shaped palus. S2 equally exsert, about three-quarters width of an S1, and also have sinuous inner edges. A larger (about 0.4 mm wide) and taller palus (P2) occurs before each S2. S3 equally exsert and as wide as an S2, but usually slightly thicker, and do not bear pali unless flanked by a pair of S4, in which case the P3 is similar in size to a P2 but slightly more recessed from the columella. When present, S4 are similar in size to a S3. All septal faces are covered with rather large (50–60 μm tall), blunt granules. P1–3 highly sinuous and bear quite tall (up to 0.1 mm), obliquely oriented, serrate carinae. Fossa shallow; columella papillose, composed of 7–18 small (0.06–0.08 mm), interconnected papillae.

TYPES: The holotype of *D. stellulatus* is deposited at the USNM (60516); paratypes are also deposited at the USNM and Bishop Museum. The holotype (*Kimbla* Stn 1) of *B. veroni* is also deposited at the USNM (71852). Three paratypes are also deposited at the USNM: #1, *Kimbla* Stn 1, USNM 71853; #2, *Kimbla* Stn 24, USNM 73966; and #3, *Kimbla* Stn 2, USNM 71854.

TYPE LOCALITIES: *D. stellulatus*: 19°48′ N, 154°58′ W (off Hawaii), 337 m. *B. veroni*: east of Lady Elliot Island, 43 miles (69 km) north of Fraser Island, Queensland; 476–531 m.

Deltocyathus Milne Edwards & Haime, 1848a

Corallum solitary, discoidal to patellate, and free in adult state. Septotheca costate. Pali before all but last cycle; within each system the inner edges of each pair of S3 fuse to the P2 near the columella (and P4 to P3, if S5 present), forming the characteristic chevrons (deltas). Paliform lobes sometimes present before last septal cycle. Columella papillose.

TYPE SPECIES: *Turbinolia italica* Michelotti, 1838, by monotypy.

REMARKS: Among the approximately 17 recent species in the genus *Deltocyathus*, the two described from the New Zealand region are easily distinguished by having either a spinose corallum or five cycles of septa, characteristics shared with only one and two, respectively, other species in the genus. Two other *Deltocyathus* species have been reported from the northern edges of the New Zealand region by Keller (1982): *D. vaughani* from off Lord Howe Island at 1640 m and *D. murrayi* from the northern Kermadec Ridge at 1950 m, neither of which I have examined. Species of *Deltocyathus* are common worldwide, except for the eastern Pacific, at lower shelf and slope depths.

Deltocyathus ornatus Gardiner, 1899

(Plate 19, d, e)

Deltocyathus ornatus Gardiner, 1899: 163–164, pl. 20, figs 25a-b.
?*Deltocyathus heteroclitus* Wells, 1984: 210, pl. 3, figs 1–6.

MATERIAL EXAMINED: New Records: NZOI Stn I86, 4, NZOI; Stn P16, 1, NZOI; Stn P27, 6, USNM 94169; Stn P34, 5, USNM 94170; RV *Franklin* Stn 5/89/40, 17, AMSG15501. Previous Records: Types of *D. heteroclitus*, USNM.

DISTRIBUTION: New Zealand region: Norfolk Ridge (Map 19); 280–390 m. Elsewhere: Sandal Bay, Lifu, Loyalty Islands; off southern Great Barrier Reef (Wells 1984); 73 m. ?Pleistocene of Vanuatu.

DESCRIPTION: Corallum circular but with highly serrate calicular edges, a small (about 1.3 mm) rectangular lancet corresponding to each C3 and adjacent pair of C4, made even more obvious by the 12 elongate costal spines (C3) that project from the lancets. Corallum base flat to undulatory, each C3 and adjacent pair of C4 forming a broad (about 1.3 mm wide) ridge, each C3 extending up to 3.0 mm beyond the calicular edge as a slender, tapered costal spine. Costal spines horizontal in orientation and taper from a diameter of about 0.9 mm to a pointed tip of 0.3 mm and are covered with tiny spines. C1–2 are slender ridges (0.2–0.3 mm wide) that fall between the valleys formed by the much larger C3–4, each C1–2 bearing a row of small spines. Often in the center of the base is a circular scar 0.9–1.1 mm in diameter. Largest specimen examined (NZOI Stn P34) 12.0 mm in calicular diameter and 4.5 mm in height. Corallum white.

Septa hexamerally arranged in 4 complete cycles (48 septa). S1 only independent septa, each extending only 0.5–0.6 distance to columella and bearing a large, lamellar palus up to 1.8 mm wide, which extends to the columella. The pali associated with the 2 principal septa (those 2 S1 aligned with the

greater calicular axis of the calicular ellipse) are smaller than the other 4, i.e., about 0.5–1.0 mm wide. S2 equal to or only slightly less wide than S1 and also bear pali (P2) of equal size to those of the S1, but the P2 crown is slightly recessed from the columella. S3 smallest of septa, reaching only about one-third distance to columella but also extending beyond calice for a short distance along proximal part of costal spines. Each S3 internally bordered by a large (up to 2.0 mm wide), tall palus (P3), the inner edges of which fuse to its adjacent P2 by a porous lamella. S4 slightly wider than S3 but do not bear pali, the inner edges of each pair of S4 fused to the lower outer edge of their common P3 through a porous lamella. Thus, 3 crowns of pali are present: the innermost 6P1, which are dimorphic in size; a second similarly sized crown of P2 slightly recessed from the columella; and a third crown of 12 P3, which are the largest, tallest, and most recessed from the columella. Fossa shallow, there being no vertical theca at the calicular edge. Columella papillose, consisting of an elliptical field of short, small (0.4–0.5 mm in diameter) tuberculate papillae that are fused to one another.

TYPES: The holotype *Deltocyathus ornatus* is deposited at the BM(NH). The types of *D. heteroclitus* are deposited at the USNM (71849–51).

TYPE LOCALITY: *D. ornatus*: Sandal Bay, Lifu, Loyalty Islands; 73 m. *D. heteroclitus*: USGS Stn 24918, Navaka River, Vanuatu, Pleistocene.

REMARKS: A series of small specimens (GCD range: 4.0–8.9 mm) from RV *Franklin* Stn 5/89/40 suggest that the equally small Pleistocene specimens from Vanuatu described by Wells (1984) as *D. heteroclitus* may be the juvenile stages of *D. ornatus*, the former being characterised by having ≤ 36 septa and only 6 costal spines. Costal spines (C3) are present only in those halfsystems having a pair of S4, and thus a corallum of 36 septa would have only 6 pairs of S4 and 6 costal spines. Specimens with a range of septa and spines (36–48 septa and 6–12 spines) were found among the specimens from RV *Franklin* Stn 5/89/40. The records presented herein are thought to represent the first report of this species since its description.

Only one other species of *Deltocyathus* bears elongate costal spines, the western Atlantic *D. calcar* Pourtalès, 1874, which is easily distinguished by having only six spines associated with the S1.

Deltocyathus formosus n. sp. (Plate 19, f, g)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Southern Norfolk Ridge; Kermadec Islands (Map 15); 142–565 m.

DESCRIPTION: Corallum shaped as a very shallow bowl, with a slightly convex base and only slightly upturned peripheral edge. Calice circular and highly serrate, each costoseptum projecting individually 1.0–1.5 mm beyond calicular perimeter. Holotype 18.1 mm in calicular diameter and 4.7 mm in height; paratypes up to 18.4 mm in calicular diameter. A small (1.8–2.0 mm in diameter) central basal scar usually present. Costae low, convex ridges that are equal in width and separated by shallow, but well-defined intercostal furrows. Costae bear rounded granules usually arranged in a single row, grading into finer, pointed spines at calicular edge and septal faces. Corallum white to light brown, the holotype bearing 3 concentric bands of light-brown pigment on its base, as well as having light-brown lower, outer septal edges.

Septa hexamerally arranged in 5 cycles; however, fifth cycle usually incomplete, 1 or more pairs of S5 often missing from various systems, resulting in coralla with 86–96 septa. The holotype contains 94 septa and only 1 specimen is known to have a complete fifth cycle of 96 septa. It is not unusual for 1 halfsystem to have all 4 S5 whereas the adjacent half-system has no S5. S1 only independent septa, extending about half distance to columella, and bordered by a large (1.5–1.9 mm wide) lamellar palus, which extends to the columella. S2 slightly less wide and also bear P2, which are equally as wide as P1 but slightly recessed from the columella. S3 slightly less wide than S2, each bearing a P3 equally as wide as the P1–2, the inner edges of each pair of P3 loosely fused to the inner edge of their common P2 near the columella. S4 less wide than S3 and bear tall pali, the inner edges of which are loosely fused to their adjacent P3. S5 rudimentary: finely dentate at calicular edge, quite slender (a row of spines) for most of their length, but near the columella joined to their adjacent S4 by a series of 4–6 slender trabeculae. Thus, 4 crowns of pali occur in each corallum (P1–4), each successive crown recessed slightly more from the columella and standing slightly higher in the fossa. Fossa shallow, containing an elliptical field of closely interconnected short granular papillae 0.2–0.3 mm in diameter.

TYPES: Holotype: BS581, MoNZ CO266. Paratypes: NZOI Stn I96, 3, P-1024, USNM 94171; Stn K826, 1, P-1025, NZOI; Stn K828, 2, P-1026, NZOI; Stn K870, 1, P-1027, NZOI; Stn P13, 1, P-1028, USNM 94172; Stn T214, 6, P-1029, USNM 94173; BS888 (O634), 1, MoNZ CO228.

TYPE LOCALITY: 29°13.96' S, 177°52.84' W (1800 m northwest of Napier Island, Kermadec Ridge), 530–567 m.

ETYMOLOGY: The species name *formosus* (Latin *formosus*, beautifully formed) is given to this handsome species.

REMARKS: Only two other species of *Deltocyathus* have five cycles of septa: *D. magnificus* Moseley, 1876 and *D. rotulus* (Alcock, 1898), both of which differ in having much larger coralla and serrate, ridged costae. *Deltocyathus magnificus* is further distinguished by having a flat to concave base and well-developed S5; *D. rotulus* differs in having a basal scar, a lanceted calicular edge, a columellar platform, and very reduced P3.

Conotrochus Seguenza, 1864

Corallum solitary, ceratoid to trochoid, and free or attached by a small pedicel that is often augmented by a lateral thecal attachment. Theca thick and covered with an epitheca such that costae are usually masked. Septa exsert, but upper, outer septal edges join theca below upper thecal edge, forming a circular thecal rim as exsert as septa. Paliform lobes may be present before S2; columella composed of twisted lamellae often fused to one another in pairs.

TYPE SPECIES: *Conotrochus typus* Seguenza, 1864, by original designation.

REMARKS: Two recent and two fossil species are known in this genus, the recent species being *C. funicolumna* (Alcock, 1902a) (see Cairns 1994) and *C. brunneus* (Moseley, 1881).

Conotrochus brunneus (Moseley, 1881)
(Plate 20, a, b)

Pleurocyathus brunneus Moseley, 1881: 159–160, pl. 2, figs 1a-c.
Phloeocyathus hospes Alcock, 1902b: 116–117.
Conotrochus brunneus: ?Gardiner & Waugh, 1938: 175–176, pl. 5, figs 11–12; Cairns & Parker, 1992: 22; Cairns & Keller, 1993: 246, pl. 4, figs F-G (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn K870, 3, NZOI; Stn U591, 1, USNM 94116; Stn U599, 1, USNM 94117; BS442, 3, MoNZ CO262; RV *Franklin* Stn 5/89/25, 1, AMS G15498. Previous Records: Types of *P. brunneus* and *P. hospes*.

DISTRIBUTION: New Zealand region: ridges north of New Zealand, including Lord Howe Rise, Three Kings Ridge, and the Kermadec Islands (off Raoul and Esperance) (Map 16); 486–1051 m. Elsewhere: off Madagascar; Indonesia; ?Maldives; southern West Australia; ?110–366–1089 m.

DESCRIPTION: Corallum ceratoid and relatively small, originally attached by a small (0.8-0.9 mm in diameter) pedicel, but invariably secondarily attached by lateral thecal adhesions near the pedicel, which tend to coalesce with the pedicel to produce an attachment up to 3 mm in diameter. Illustrated specimen (Plate 20, a, b) 7.8 mm in calicular diameter and 16.4 mm in height; largest New Zealand specimen (AMS G15498) 9.1 mm in calicular diameter. Epitheca covered with horizontal serrate ridges, which appear to have been the previous upper calicular edges of periodic incremental growth. Theca glistening and coarsely granular; vertical costae are faint or completely masked. Upper calicular edge forms a smooth circular rim about 0.4 mm thick that is as exsert as uppermost septa. Slightly lower in fossa the theca is reinforced with a thick layer of internal stereome, thickening the thecal wall up to 1.0 mm. Well-preserved coralla light brown in colour or bear longitudinal brown to black costal stripes.

Septa hexamerally arranged in 4 cycles, the fourth usually incomplete. Number of septa roughly a function of calicular diameter, the most common complement being 36 septa (e.g., specimens 6-8 mm in GCD have 1 pair of S4 in each system); however, smaller coralla (GCD = 5-6 mm) have only 24–28 septa, and the largest specimen (GCD = 9.1 mm) has only 38 septa. S1 most exsert (to level of upper theca) and have vertical, straight to slightly sinuous inner edges that extend to the columella. S2 equally exsert and about three-quarters width of S1. S3 that are unflanked by S4 about three-quarters width of an S2; S3 flanked by a pair of S4 are almost as wide as an S2. S4 equal in width to an unaccelerated S3. Inner edges of S2 often bear a small (0.5 mm wide) lamellar paliform lobe, virtually indistinguish-

able from the columellar elements except for its position. Inner edges of all septa thin (about 0.15 mm), but thecal edges quite thick (about 0.5 mm), forming a robust fusion with the thickened theca. Fossa relatively deep. Columella composed of several lamellar papillae.

TYPES: The holotype of *P. brunneus* is deposited at the BM(NH). The holotype of *P. hospes* is deposited at the ZMA (Coel. 1308).

TYPE LOCALITIES: *P. brunneus*: *Challenger* Stn 194, 4°34′ S, 129°57′30 E (off Banda Island). Moseley listed 60 fm (110 m) as the depth for this station, but the narrative for the cruise (Tizard *et al.*, 1885) lists 200 fm (366 m), which is more consistent with the known range for this species. *P. hospes*: *Siboga* Stn 150, 0°06′ N, 129°07.2′ E (Halmahera Sea), 1089 m.

REMARKS: *Conotrochus brunneus* differs from *C. funicolumna* in having a smaller corallum (≤ 9 mm GCD), fewer septa (usually 36, rarely as many as 48), internal stereome, and a brown theca. *Conotrochus brunneus* also appears to be found in slightly deeper water (366–1089 m) than *C. funicolumna* (165–600 m).

Squires (1958) reported the fossil species *Conotrochus typus* var. *australiensis* from the early Miocene of Mossburn, Southland, New Zealand.

Aulocyathus Marenzeller, 1904a

Corallum solitary, ceratoid, and free; most coralla showing evidence of budding from a longitudinally fragmented parent corallum. Costae poorly defined. Upper, outer septal edges join theca below upper thecal edge, usually forming a circular thecal rim. Slender paliform lobes occasionally present on S1–3; columella trabecular.

TYPE SPECIES: *Aulocyathus juvenescens* Marenzeller, 1904a, by monotypy.

REMARKS: Four species are known in this genus: *Aulocyathus matricidus* (Kent, 1871); *A. juvenescens* Marenzeller, 1904a; *A. recidivus* (Dennant, 1906); and *A. atlanticus* Zibrowius, 1980. The genus was partially reviewed by Cairns (1994).

Aulocyathus recidivus (Dennant, 1906)
(Plate 20, c-f)

Ceratotrochus recidivus Dennant, 1906: 159, 160, pl. 6, figs 1–2.

Paracyathus conceptus: Squires & Keyes 1967: 23 (in part: NZOI Stn C648, pl. 2, figs 7–8.

Aulocyathus recidivus: Cairns 1982: 25–26, pl. 7, figs 7–9, pl. 8, fig. 1 (synonymy); Cairns & Parker 1992: 22–24, pl. 6, figs d-e, g-h, map 6 (synonymy); Cairns & Keller 1993: 247, pl. 5, fig. C; Cairns, 1994: 59–60, pl. 26, figs a-b.

MATERIAL EXAMINED: New Records: NZOI Stn D159, 1, NZOI; Stn E749, 1, NZOI; Stn E793, 1, USNM 94118; Stn E797, 1, NZOI; Stn E852, 1, NZOI; Stn J659, 2, NZOI; Stn J660, 8, USNM 94119; Stn P120, 8, USNM 94120; Stn T243, 1, NZOI; Stn U584, 4, NZOI; BS819 (O564), 1, MoNZ. Previous Records: Specimens reported by Squires and Keyes (1967).

DISTRIBUTION: New Zealand region: widespread, from the Kermadecs to off Macquarie Island (Map 3); 245–1137 m (shallowest records occur in fiord area). Elsewhere: off Madagascar, South Australia, Victoria, Tasmania, and Japan; 128–1000 m.

TYPES: Five syntypes of *C. recidivus* are deposited at the NMV (F41516, F59348) (Stranks 1993).

TYPE LOCALITY: Off Cape Jaffa and Neptune Island, South Australia, 165–190 m.

REMARKS: Recent descriptions and figures of *A. recidivus* can be found in Cairns (1982, 1994) and Cairns and Parker (1992) and thus it need not be redescribed here. *Aulocyathus recidivus* is character-ised by having: an elongate, ceratoid corallum that is invariably budded from a fragment of a parent corallum; glistening, hollow costal granules; a serrate calicular edge; a very irregular septal symmetry and complement, resulting in 32–66 septa; slender paliform lobes (P3); and a deep fossa with a trabecular columella. Specimens from several lots (NZOI Stns D159, E852, J659, J660, and U584) were at first thought to represent a distinct, more robust species; however, they are more likely to be simply large specimens of *A. recidivus* that attain a GCD of up to 15 mm, a height of up to 41 mm, and have a thicker (and thus denser) theca and corallum. Their calicular margins are smooth, not serrate, and their columellar elements are fused into fewer, more robust elements.

Dasmosmilia Pourtalès, 1880

Corallum solitary, ceratoid to turbinate, and usually free — most coralla asexually budded from a frag-

ment of parent corallum. Theca and septa quite thin. Paliform lobes present before penultimate cycle of septa and occasionally also before lower cycle septa. Columella trabecular. Endotheca sparse or absent.

TYPE SPECIES: *Parasmilia lymani* Pourtalès, 1871, by subsequent designation (Wells 1936).

REMARKS: *Dasmosmilia* is very similar to *Aulocyathus*, differing in having better-defined costae and in lacking the calicular thecal rim. Only three species are known: *D. lymani* (Pourtalès, 1871), *D. variegata* (Pourtalès, 1871), and *D. valida* Marenzeller, 1907.

Dasmosmilia lymani (Pourtalès, 1871)
(Plates 20, g-i, 21, a)

Parasmilia lymani Pourtalès, 1871: 20, pl. 6, figs 8–10.
Goniocyathus pacificus Yabe & Eguchi, 1932a: 389, text-fig. 2.
Dasmosmilia lymani: Cairns 1979: 132–134, pl. 25, figs 1–3, 8–9 (synonymy); Zibrowius 1980: 70–71, pl. 28, figs A–L, pl. 29, figs A–L (synonymy).
Dasmosmilia pacifica: Cairns 1994: 63, pl. 27, figs f–i, pl. 41, figs f–g.

MATERIAL EXAMINED: New Records: NZOI Stn E879, 9, USNM 94138; Stn E883, 2, NZOI; Stn F877, 2, NZOI; Stn F896, 6, USNM 94139; Stn F909, 20, USNM 94137; Stn I21, 1, NZOI; BS707 (R65), 1, MoNZ CO284; BS763 (R121), 8, MoNZ CO244; BS831 (O576), 3, MoNZ CO278. Previous Records: Syntypes of *P. lymani* and *G. pacificus*.

DISTRIBUTION: New Zealand region: off northern New Zealand from off Gisborne to northwest of Kaipara Harbour (Map 8); 633–1002 m. Elsewhere: western Atlantic from Brazil to Massachusetts; eastern Atlantic between Portugal, the Azores and Spanish Sahara (48–366 m); off Japan (168–355 m). Pleistocene of Ryukyu Islands (Cairns 1994).

TYPES: The syntypes of *P. lymani* are deposited at the MCZ (Cairns 1979). The syntypes of *G. pacificus* are deposited at the TIUS (*see* Cairns 1994).

TYPE LOCALITIES: *P. lymani*: off Florida Keys, 128–269 m. *G. pacificus*: 34°17′45 N, 137°04′45 E (off Honshu, Japan), 168 m.

REMARKS: *Dasmosmilia lymani* is well described and illustrated by Cairns (1979, 1994) and Zibrowius (1980) and will only be diagnosed below. The species is characterised by having a very brittle, ceratoid to trochoid corallum, the theca being so thin that it easily fractures longitudinally into fragments from which complete new coralla asexually develop. Only 4 (8%) of the New Zealand specimens (Plate 20, h) have a pedicellate attachment to a substratum other than a parent corallum, which is assumed to be evidence of sexual reproduction. The pedicels of these specimens are quite narrow: 1.5–1.6 mm in diameter (PD: GCD = 0.10). Septa are somewhat irregularly arranged as 12–24 primaries, 12–24 secondaries, and 24–48 tertiaries, resulting in 48–96 septa. Coralla having 96 septa are rare, most coralla having 48–72 septa arranged in groups of four (1 primary, 1 secondary, and 2 tertiary septa). Broad paliform lobes occur before the secondary septa and the columella is fascicular. There is no endotheca.

In my revision of the North Pacific Scleractinia (Cairns 1994), I distinguished *D. pacifica* from *D. lymani* by its having a more serrate calicular edge, each primary septum and adjacent pair of tertiary septa forming a small lancet; the septa of *D. lymani* were reported not having lancets. The larger number of specimens available from the New Zealand region show that this character is variable, most of the New Zealand specimens having lanceted calicular margins but some not. Furthermore, some typical Atlantic *D. lymani* are known to have calicular lancets (*see* Zibrowius 1980: pl. 28, fig. L), although this condition is much less common in Atlantic populations. The New Zealand populations also differ in having a deeper bathymetric range than previously collected specimens: 633–1002 m vs 48–366 m for Atlantic and Japanese specimens. This is consistent with Keller's hypothesis (Keller 1978, 1989; Cairns & Keller 1993) that deeper-living specimens in nutrient-poor waters have more highly serrate calicular edges.

Desmophyllum Ehrenberg, 1834

Corallum solitary, cylindrical to trochoid, and fixed. Septotheca costate. Pali absent. Columella usually absent or expressed only in small coralla as rudimentarily fascicular. Endothecal dissepiments present in elongate coralla.

TYPE SPECIES: *Madrepora dianthus* Esper, 1794, by subsequent designation (Cairns 1994).

REMARKS: Although at least 11 species have been described in the genus *Desmophyllum*, most are junior synonyms of the cosmopolitan *D. dianthus*; several

other nominal species, such as *D. solidum* and *D. gracile*, belong to other genera. A second valid recent species is *D. striatum* Cairns, 1979, known from the western Atlantic at 130–823 m.

Desmophyllum dianthus (Esper, 1794)

(Plate 21, d-f)

Madrepora dianthus Esper, 1794: pl. 69, figs 1–3.

Desmophyllum cristagalli Milne Edwards & Haime, 1848a: 253, pl. 7, figs 10, 10a; Gardiner 1929: 125–126; Ralph 1948: 109, fig. 2 (bottom left); Ralph & Squires 1962: 9–10, pl. 3, figs 1–10; Squires 1965: 785–787; Squires & Keyes 1967: 25, pl. 3, figs 12–14; Squires 1969: 17, pl. 6, map 1; Dawson 1979: 28; Cairns 1979: 117–119, pl. 21, figs 7–8, pl. 22, fig. 8 (synonymy); Zibrowius 1980: 11–121, pl. 61, fig. A–O, pl. 62, figs A–M (synonymy); Cairns 1982: 29–30, pl. 8, figs 9–12, pl. 9, figs 1–3 (synonymy).

Desmophyllum dianthus: Cairns 1994: 26–27, pl. 9, fig. a–b (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn A910, 1, NZOI; Stn D5, 5, NZOI; Stn D6, 2, NZOI; Stn D39, 2, NZOI; Stn D899, 1, NZOI; Stn E313, 1, NZOI; Stn E756, 1, NZOI; Stn E792, 2, NZOI; Stn E803, 40, NZOI; Stn E821, 5, NZOI; Stn E830, 3, NZOI; Stn E852, 1, NZOI; Stn E860, 2, NZOI; Stn F81, 1, NZOI; Stn F143, 1, NZOI; Stn F146, 5, NZOI; Stn F868, 10, NZOI; Stn G3, 1, NZOI; Stn G172, fragment, NZOI; Stn G197, 1, NZOI; Stn G200, many, NZOI, 3, USNM 94064; Stn G941, 2, USNM 94065; Stn H923, 3, USNM 94066; Stn I676, 1, NZOI; Stn I685, many, NZOI; Stn I694, 1, NZOI; Stn I721, 10, NZOI; Stn J59, 1, NZOI; Stn J485, 23, USNM 94067; Stn J711, 2, NZOI; Stn K795, 1, NZOI; Stn K800, 8, NZOI; Stn K804, 1, NZOI; Stn K858, 5, NZOI; Stn M773, 1, USNM 94068; Stn M779, 1, USNM 94072; Stn P57, 1, NZOI; Stn Q102, 2, NZOI; Stn Q340, many, NZOI; Stn Q341, many, NZOI; Stn Q343, 20, NZOI; Stn Q741, 2, NZOI; Stn R437, 1, NZOI; Stn R438, 1, NZOI; Stn S22, 1, NZOI; Stn S25, 30, NZOI; Stn S27, 2, NZOI; Stn S28, 30, NZOI; Stn S29, 1, NZOI; Stn S30, 37, NZOI; Stn S53, 1, NZOI; Stn S99, 10, NZOI; Stn S125, 4, NZOI; Stn S126, 50, NZOI; Stn S127, 1, NZOI; Stn S248, 3, NZOI; Stn S260, 3, NZOI; Stn S565, 2, NZOI; Stn S573, 5, NZOI; Stn T8, 2, NZOI; Stn T214, 1, NZOI; Stn T256, 15, USNM 94069; Stn U573, 2, NZOI; Stn U582, 1, USNM 94070; Stn U599, 7, USNM 94071; Stn U602, 1, NZOI; Stn V365, 50, NZOI; Stn X152, 2, NZOI; Stn Z3943, 1, NZOI; Stn Z3948, 1, NZOI; BS300, 2, MoNZ CO224; BS310, 5, MoNZ CO80, 85; BS342, 2, MoNZ CO91; BS559, 10, MoNZ CO118; BS560, 7, MoNZ CO127; BS742 (R100), 1, MoNZ; Goal I., Doubtful Sound, 91 m, 4, MoNZ CO86; Hotto Bay, Snares I., MoNZ CO125; off Farewell Spit, 640 m, 1, MoNZ CO67; Cook Strait, 6, MoNZ CO63; FV *San Manukau*, 1, AIM 8314; off Castlepoint, 220 m, 1, NZGS; *Volcanolog* 64, 6, AUM; *Volcanolog* B3028, 11, AUM; Rumble II/*Tui*, 1, AUM; ENE of Otago Heads, 503 m, 2, Portobello Lab.; Papanui Canyon, 320–400 m, 1, Portobello Lab.; Taiaroa Canyon, 400–500 m, Otago University. Previous Records: Neotype of *D. dianthus;* holotype of *D. cristagalli;* specimens reported by Ralph and Squires (1962), Squires (1965), and Squires and Keyes (1967).

DISTRIBUTION: New Zealand: throughout entire region; 25–1750 m, the shallowest records from the fiords (Map 4). Elsewhere: cosmopolitan, except for off continental Antarctica and northern boreal Pacific; 35–2460 m.

TYPES: The neotype of *D. dianthus* is deposited at the USNM (92475). The holotype of *D. cristagalli* is deposited at the MNHNP.

TYPE LOCALITIES: *D. dianthus*: Sagami Bay, Honshu, Japan; depth unknown. *D. cristagalli*: Gulf of Gascogne; depth unknown.

REMARKS: Complete descriptions and illustrations of this common species are found in Ralph and Squires (1962), Cairns (1979, 1982, 1994), and Zibrowius (1980). Coralla are often found in deep-water bank environments (*see* remarks of *Goniocorella dumosa*), often attached to *G. dumosa*, *Madrepora oculata*, stylasterids, and isidid gorgonians; dead specimens often provide a substratum for *Stenocyathus vermiformis*.

The coral is quite variable in shape, ranging from serpentine to ceratoid and trochoid, depending on its environment. Individual coralla are sometimes clumped into quasicolonies. The largest corallum from the New Zealand region is 55 mm in calicular diameter, which, although quite large, is not the maximum diameter for the species, but some of the New Zealand specimens (e.g., NZOI Stn G197, G200, Q343, and V365) are extremely long (up to 190 mm), which is a record length for *D. dianthus*.

Its C1–3 are ridged and the theca finely granular. Septa are hexamerally arranged in five or six cycles according to the formula: S1–2>S3>S4>S5>S6, the S1–2 usually highly exsert. The fossa is deep and bears a rudimentary fascicular columella composed of 1–9 small elements, which is usually visible only in small specimens. Elongate specimens bear endothecal dissepiments, which significantly reduce the density of large specimens. The shallowest records in the New Zealand region (NZOI Stn Q741, S248, S260, M773, M779) occur in the Southland fiords, these specimens having broader pedicels than the deeper-water populations.

Thalamophyllia Duchassaing, 1870

Colonial corallum formed by extratentacular budding of ceratoid corallites from a thin common basal coenosteum resulting in reptoid to phaceloid coralla. Pali and columella absent; fossa deep. Endotheca absent.

TYPE SPECIES: *Desmophyllum riisei* Duchassaing & Michelotti, 1864 by monotypy.

REMARKS: *Thalamophyllia* differs from *Desmophyllum* in having a loosely integrated colonial corallum that is intermediate between reptoid and phaceloid. It is similar to *Hoplangia*, but differs primarily in the degree of corallite integration, the corallum of *Hoplangia* being intermediate between phaceloid and plocoid. The level of corallite integration of *Thalamophyllia* places it between *Desmophyllum* (solitary) and *Hoplangia* (phaceloid), the more advanced stage being *Lophelia* (sympodial). A similar progression is found among the dendrophylliid genera — *Balanophyllia* (solitary), *Rhizopsammia* (reptoid), *Cladopsammia* (phaceloid), and *Dendrophyllia* (sympodial). Four species are recognised in *Thalamophyllia* — *T. riisei* (Duchassaing & Michelotti, 1864), *T. tenuescens* (Gardiner, 1899), *T. gasti* (Döderlein, 1913), and *T. gombergi* Cairns, 1979.

Thalamophyllia tenuescens (Gardiner, 1899) n. comb.

(Plate 21, g-i)

Desmophyllum tenuescens Gardiner, 1899: 161–162, pl. 19, figs 1a-b.

MATERIAL EXAMINED: New Records: NZOI Stn K838, 5, USNM 94141; BS571, 1, MoNZ CO230; RV *Franklin* Stn 5/89/40, 1, AMS G15556; off Cebu, Mactan I., 22 m, 6, USNM 94142. Previous Records: 4 syntypes of *D. tenuescens*.

DISTRIBUTION: New Zealand region: Lord Howe Seamount Chain; Kermadec Islands (Map 19); 200–315 m. Elsewhere: Loyalty Islands; Philippines (reported herein); 22–73 m.

DESCRIPTION: Largest colony (USNM 94142) a cluster of 6 corallites united basally by thin coenosteum. Largest corallite from New Zealand region (NZOI Stn K838) 4.5 x 2.4 mm in calicular diameter and 20.8 mm in height, with a pedicel diameter of 2.4 mm. Corallites elongate-ceratoid and often broken from the basal coenosteum in collection, thus resembling a solitary corallum (e.g., *Desmophyllum*). C1 highly ridged; C2 slightly less ridged; C3 absent, even when S3 are present. Calice hexagonal in outline, each CS1 forming a corner of the polygon. Theca white, covered with low, rounded granules.

Septa hexamerally arranged in 3 cycles according to the formula: S1>S2>>S3; however, in elongate, well-preserved coralla, the S3 are absent in the upper 2–4 mm of the corallum, sometimes giving the impression of a corallum with only 12 septa. S1 exsert (0.6–0.7 mm), with straight inner edges and relatively narrow, but their lower, inner edges converge deep in fossa. S2 less exsert, about half width of an S1, also with straight inner edges that converge deep in fossa. S3 rudimentary, absent from upper corallum. Fossa quite deep.

TYPES: Four of the 7 syntypes of *D. tenuescens* are deposited at the BM(NH) (1950.1.10.113–116); two more are deposited at the University Museum of Zoology, Cambridge (H. Zibrowius, pers. comm.).

TYPE LOCALITY: Sandal Bay, Lifu, Loyalty Islands, 73 m.

REMARKS: Although similar to *T. riisei* and *T. gasti*, *T. tenuescens* appears to be distinguished by its rudimentary to absent S3, this cycle as well as some S4 being well developed in the other two species. This appears to be the first report of this species subsequent to its description in 1899.

Rhizosmilia Cairns, 1978

Phaceloid coralla formed by extratentacular budding from a thin common basal coenosteum. Corallite bases increase in diameter by adding exothecal dissepiments over raised costae producing concentric rings of partitioned chambers that resemble polycyclic development in cross section. Vesicular endothecal dissepiments present. Paliform lobes present before penultimate septal cycle (usually P3). Columella variable, including papillose, lamellar, and fascicular.

TYPE SPECIES: *Rhizosmilia gerdae* Cairns, 1978 by original designation.

REMARKS: Five species are recognised in this genus: *R. maculata* (Pourtalès, 1874); *R. gigas* (Van der Horst, 1931); *R. sagamiensis* (Eguchi, 1968); *R. gerdae* Cairns, 1978; and *R. robusta* Cairns, 1993.

Rhizosmilia maculata (Pourtalès, 1874)
(Plate 21, b, c)

Bathycyathus maculatus Pourtalès, 1874: 34-35, pl. 6, figs 5-6.
Caryophyllia maculata: Moseley 1881: 139–140 (in part: *Challenger* Stn 170, pl. 4, fig. 9, 9a); Hutton 1904: 315; Zibrowius 1974b: 755; Cairns, 1977a: 9–10, pl. 1, figs 1–3.
Not *Caryophyllia maculata*: Ralph 1948: 109, lower right figure (*C. profunda*).
Not *Caryophyllia* cf. *C. maculata*: Ralph & Squires 1962: 7, pl. 2, figs 1–2; Squires & Keyes 1967: 23, pl. 2, figs 5–6 (= *C. profunda*).
Rhizosmilia maculata: Cairns 1978: 216 (synonymy).

MATERIAL EXAMINED: New Records: None.

PREVIOUS RECORDS: Specimen reported by Moseley (1881) from *Challenger* Stn 170, BM(NH) (unregistered); holotype.

DISTRIBUTION: New Zealand region: one dubious record between Raoul and Macauley Islands, Kermadec Ridge; ?1152 m. Elsewhere: Western Atlantic from Florida to Brazil; 3–161 m (Cairns 1977).

TYPES: The holotype is deposited at the MCZ.

TYPE LOCALITY: Off Abrolhos, Brazil, 55 m.

REMARKS: The specimen reported as *Caryophyllia maculata* by Moseley (1881) from the Kermadec Islands is conspecific with typical western Atlantic specimens, but it is highly unlikely that a relatively shallow-water western Atlantic species would be present in the South Pacific, especially at the depth of 1152 m. It is also unlikely that the other specimen Moseley reported from off Brazil occurred as deep as 732 m. Furthermore, the record of *C. lamellifera*, also from *Challenger* Stn 170, is much deeper than all other records of this species from the Kermadecs (89–342 m). All this suggests a labelling error pertaining to the two lots of *C. maculata* and/or specimens from *Challenger* Stn 170. Some errors in *Challenger* station data have been noted before (Zibrowius 1980). I therefore do not consider *Rhizosmilia maculata* to occur in the New Zealand region.

Hoplangia Gosse, 1860

Colonial corallum formed by extratentacular budding of short cylindrical corallites from a common basal coenosteum or from lower theca corallites. Colonies phaceloid to plocoid. Pali and columella absent. Endotheca absent.

TYPE SPECIES: *Hoplangia durotrix* Gosse, 1860, by monotypy.

REMARKS: Only one species is known — *Hoplangia durotrix* Gosse, 1860.

Hoplangia durotrix Gosse, 1860 (Plate 22, a-d)

Hoplangia durotrix Gosse, 1860: 338, pl. 10, fig. 9; Zibrowius 1980: 123–125, pl. 64, figs A–L, pl. 65, figs A–L (synonymy).

MATERIAL EXAMINED: New Records: off Mokohinau Island, 15 m, 5 colonies, AU6097 (AUM); off White Island, Bay of Plenty, 110 m, 3 colonies, MoNZ CO243; L1056, 10 corallites, AIM AK76084; L2633, 10 colonies, AIM AK78002; L2641, 4 colonies, AIM AK78002; L2680, 5 colonies, AIM AK78100; L2712, 6 colonies, AIM AK78093; L2715, 3 corallites, AIM AK78096; L2925, 5 colonies, AIM AK78232; L2926, 2 colonies, AIM AK78233; L2929, 2 colonies, AIM AK78226; L3069, 11 colonies, AIM AK78394, 3 colonies, USNM 94586. Previous Records: Specimens reported by Zibrowius (1980).

DISTRIBUTION: New Zealand region: northeastern New Zealand from off Three Kings Islands to East Cape, including: Poor Knights Island, Mokohinau Island, Great Barrier Island, Mercury Island, and White Island (Map 8); 7–110 m, most records hand-collected by Fred Brook from cave environments. Elsewhere: Mediterranean and northeastern Atlantic between England and Canary Islands; 3–150 m (Zibrowius 1980).

DESCRIPTION: The New Zealand specimens are represented only by relatively small plocoid colonies, the largest (AIM AK78232) about 50 mm in diameter and containing about 50 corallites. Corallites cylindrical, up to 4.1 mm in diameter, and primarily attached to a common basal coenosteum, but also budded from the walls of other corallites. Calices circular to slightly elliptical (GCD: LCD = 1.0–1.25). Costae poorly defined; theca and coenosteum uniformly covered with coarse granules. Corallum white.

Septa hexamerally arranged in 4 cycles, the fourth never complete, 32–36 septa being the commmonest complement. All septa equally and only slightly exsert (about 0.3 mm) with moderately sinuous, smooth inner edges. S1 widest of septa, extending about three-quarters distance to centre of fossa in

upper corallum. The four lateral S1 are slightly wider than the two principal S1, their inner edges almost meeting in centre of fossa. S2 three-quarters to four-fifths width of S1; S3 about three-quarters width of S2; and S4 about three-quarters width of S3. Fossa deep, lacking a columella.

TYPES: The holotype is deposited at the BM(NH) (1934.12.5.6).

TYPE LOCALITY: Weymouth Bay, English Channel; depth unknown.

REMARKS: The discovery of a shallow-water Mediterranean to northeast Atlantic cave-dwelling species off northeastern New Zealand with no apparent intermediate records is perplexing. It is possible that the species was transported on ship hulls during or just after World War II, and thus represents an introduced species. One of the lots of New Zealand specimens (MoNZ CO243) was attached to an antipatharian axis at 110 m, but most of the other colonies were colleected from the roofs of caves or under overhangs at shallower depths of 7–53 m.

Goniocorella Yabe & Eguchi, 1932a

Corallum colonial and bushy, formed by extratentacular budding. Branch anastomosis common, the branches also united by slender, tubular coenosteal bridges. Pali and columella absent. Tabular endothecal dissepiments common and widely spaced.

TYPE SPECIES: *Pourtalosmilia dumosa* Alcock, 1902c, by original designation.

REMARKS: The virtually right-angled, extratentacular budding, the unique coenosteal bridges, and the widely spaced tabular dissepiments easily distinguish *Goniocorella* from all other coral genera. In the New Zealand region it might be confused with *Anomocora,* another elongate parasmiliid, but *Anomocora* bears paliform lobes, a columella, and lacks coenosteal bridges. *Goniocorella* might also be confused with *Solenosmilia,* but that genus has equal, dichotomous intratentacular budding.

The genus is monotypic.

Goniocorella dumosa (Alcock, 1902)

(Plate 22, e-h)

Pourtalosmilia dumosa Alcock, 1902c: 36–37, pl. 5, fig. 33.

Goniocorella dumosa: Squires 1960b: 197–198, pl. 33, figs 1-4; Ralph & Squires 1962: 11, pl. 4, fig. 1; Squires 1965: 785–788; Squires & Keyes 1967: 25, pl. 3, figs 15–16; Squires 1969: 17, pl. 6, map 2; Dawson 1979: 29; Cairns 1982: 31–34, pl. 9, figs 7–9, pl. 10, figs 1–2 (synonymy); Beu & Climo, 1974: 307; Beu, 1978: 395, figs 102; Wells 1986: 139–143; Cairns & Keller 1993: 250, pl. 6, fig. E; Cairns 1994: 63–64, pl. 27, fig. j (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn A502, NZOI; Stn D871, NZOI; Stn D899, NZOI; Stn E79, NZOI Stn E400, NZOI; Stn E731, NZOI; Stn E756, NZOI; Stn E870, NZOI; Stn E908, NZOI; Stn F10, NZOI; Stn F81, NZOI; Stn F762, NZOI; Stn F868, NZOI; Stn G32, NZOI; Stn G172, NZOI; Stn G184, NZOI; Stn G200, NZOI; Stn G208, NZOI; Stn H636, NZOI; Stn H914, NZOI; Stn H923, USNM 94074; Stn I19, NZOI; Stn I721, NZOI; Stn J55, NZOI; Stn J58, NZOI; Stn J59, NZOI; Stn J485, NZOI; Stn J657, NZOI; Stn J676, NZOI; Stn J678, NZOI; Stn J679, NZOI; Stn J680, NZOI; Stn J683, USNM 94075; Stn J711, USNM 94076; Stn P68, USNM 94077; Stn Q4, NZOI; Stn Q11, NZOI; Stn Q13, NZOI; Stn Q20, NZOI; Stn Q25, NZOI; Stn Q31, NZOI; Stn Q38, NZOI; Stn Q40, NZOI; Stn Q340, NZOI; Stn Q341, NZOI; Stn Q343, NZOI; Stn R437, NZOI; Stn S22, NZOI; Stn S25, NZOI; Stn S29, NZOI; Stn S30, NZOI; Stn S53, NZOI; Stn S122, NZOI; Stn S181, NZOI; Stn S565, NZOI; Stn T109, NZOI; Stn V365, NZOI; Stn X121, NZOI; Stn X122, NZOI; Stn Z3907, NZOI; Stn Z3924, NZOI; Stn Z3925, NZOI; Stn Z3928, NZOI; Stn Z3934, NZOI; Stn Z3936, NZOI; Stn Z3939, NZOI; Stn 3941, NZOI; Stn Z3941, NZOI; Stn Z3946, NZOI; Stn Z3947, NZOI; Stn Z3950, NZOI; BS842 (O588), MoNZ; BS668 (R26), MoNZ; BS672 (R30), MoNZ; BS697 (R55), MoNZ; BS709 (R67), MoNZ; BS742 (R100), MoNZ; *Volcanolog* Stn 64, AUM, AU12299; *Tui* (Rumble II), AUM; Papanui Canyon, 420 m, Portobello Lab.; Taiaroa Canyon, 540–620 m, Portobello Lab. Previous Records: specimens reported by Squires (1960b, 1965) and Squires and Keyes (1967).

DISTRIBUTION: New Zealand: widespread in region from Norfolk Island to Campbell Rise, especially the Chatham Rise (Map 1); 88–1488 m, but most records between 300–400 m. Elsewhere: off South Africa, Indonesia, and Japan; 100–760 m.

TYPES: Several syntypes are deposited at the ZMA (Coel. 1097).

TYPE LOCALITY: *Siboga* Stns 156, 259, Banda Sea, Indonesia, 469–487 m.

REMARKS: *Goniocorella dumosa* was adequately described and figured by Squires (1960b) and Cairns (1982, 1994). It is characterised by having large, bushy colonies, each branch bearing a terminal

corallite 3–4 mm in diameter. Most of its branches are reinforced by slender (1.0–1.5 mm diameter), hollow, tubular coenosteal bridges. C1–3 usually present. Three hexamerally arranged cycles of septa are present (S1>S2>S3), the S3 being quite rudimentary. All septa are nonexsert and relatively narrow. The fossa is deep and invariably sealed off by a thin, horizontal tabular dissepiment.

Large and numerous colonies of *G. dumosa* form the framework of deep-water (300–400 m) structures called "coppices" by Squires (1965). He reported three such structures on the Chatham Rise (NZOI Stns A910, D90) and Campbell Plateau (NZOI Stn D175); many more probably occur in the region. *Desmophyllum dianthus* is also abundant in these coppices, adding to their structural integrity. Because colonies of *G. dumosa* form a bushy interlocking network of branches, the hollow spaces formed within the colony provide numerous niches for a diverse assemblage of attached organisms, including the corals *Stenocyathus vermiformis* and *Flabellum knoxi*. Non-scleractinian members of this assemblage include various species of stolonifera, sponges, stylasterids, bryozoans, polychaetes, ophiuroids, asteroids, gastropods, bivalves, anemones, and foraminifera. Wells (1986) described a fossil coral thicket composed of *Goniocorella* from the late Mio-cene of Mount Bruce, northern Wairarapa, North Island. The distribution and characteristics of deep-water coral banks were reviewed by Cairns and Stanley (1982).

Anomocora Studer, 1878

Corallum subcylindrical and usually curved to serpentine in shape, often asexually budded from a parent corallum. Corallum considered to be colonial, although third-generation buds are rare. Paliform lobes usually present on S1–3; columella trabecular. Theca thin and tabular endothecal dissepiments present, both characters resulting in a light corallum.

TYPE SPECIES: *Coelosmilia fecunda* Pourtèles, 1871, by monotypy.

REMARKS: At least two species are known in this genus — *A. fecunda* (Pourtalès, 1871) and *A. carinata* Cairns, 1991. Specimens reported as *A. fœcunda* by Marenzeller (1904a), Gardiner and Waugh (1939), and Eguchi (1968) require re-examination. The New Zealand specimens are remarkably similar to *A. fecunda*, which is known only from the North Atlantic.

Anomocora cf. *fecunda* (Pourtalès, 1871)

(Plate 23, a–c)

?*Coelosmilia fecunda* Pourtalès, 1871: 21–22.
Anomocora sp. Cairns 1984: 18–19, pl. 3, fig. G.
Not *Anomocora fecunda*: Eguchi 1968: C42, pl. C10, figs 1–5, pl. C20, figs 10–11, pl. C23, fig. 3.

MATERIAL EXAMINED: New Records: NZOI Stn J683, 1, NZOI; Stn K825, many, NZOI; Stn K838, many, USNM 94140; Stn K842, 3, NZOI; Stn P16, 3, NZOI; BS571, 1, MoNZ CO230. Previous Records: Syntypes of *C. fecunda*.

DISTRIBUTION: New Zealand region: Norfolk and Kermadec Ridges; Bay of Plenty (Map 14); 145–388 m. Elsewhere: Hawaiian Islands (244–322 m); ?North Atlantic at 73–563 m, as *A. fœcunda* (*see* Cairns 1979, Zibrowius 1980).

DESCRIPTION: Corallum recumbent, curved to serpentine in shape, and invariably having a broken base resulting from budding from a parent corallum. Except for the three specimens from NZOI Stn P13, which are larger (GCD = 8.1 mm, length to 56 mm), all other New Zealand specimens reported herein have smaller calicular diameters (e.g., 3.1–4.9 mm), although they may attain a length of 61 mm. Their corallum size and shape is convergent with that of *Eguchiphyllia gaditana*, and both species co-occur at some stations. Each colony is represented by a primary axial corallite from which numerous (up to 20) corallites bud in an irregular fashion, often perpendicular to the axial corallite. Buds apparently begin development near the calicular edge, grow to a length of 8–13 mm simultaneously with an equal growth of the axial corallite, and ultimately detach, leaving a small scar on the parent corallum. Thus, an elongated (old) axial corallite may bear buds of progressively increasing length from the calice to 8–15 mm below the calice, below which the theca is studded with scars. Third-generation buds do not form. C1–2 represented by small ridges, the C3 being slightly broader and flat. Calicular margin serrate, a small triangular apex corresponding to the C1–2. Corallum white; theca quite thin, only about 0.1 mm.

Septa essentially hexamerally arranged in 4 cycles, the last cycle never complete. Small corallites (GCD about 3 mm) usually have only 3 cycles of septa (S1>S2>S3); but larger corallites (GCD = 4–5 mm) have a very irregular development of S4, some specimens having 1, 2, or no pairs of S4 in each system within the same corallite. Even in the largest axial corallites, 36 seems to be the maximum number of septa, achieved by having 1 pair of S4 in

each system. In well-preserved coralla, S1 are slightly exsert (about 1 mm), have slightly sinuous inner edges, and are rather thin, extending only about half distance to centre of calice. S2 are half as exsert and three-quarters as wide as an S1, each S2 bearing a thin paliform lobe about 0.5 wide. S3 rudimentary, unless flanked by a pair of S4, in which case the S3 is almost as wide as an S2 and bears a similarly shaped paliform lobe. S4 rudimentary. Widely spaced tabular dissepiments occur in elongate coralla, but are rarely seen in intact specimens, becoming obscured by paliform lobes and the trabecular columella.

Types: *The syn*types of C. fecunda are deposited at the MCZ (Cairns 1979).

Type Locality: Southern Straits of Florida, 124–576 m.

Remarks: The New Zealand specimens of Anomocora are extremely similar to typical populations from the North Atlantic, although colonies are clearly at the small end of the size variation spectrum; the larger specimens from NZOI Stn P16 are more consistent with typical A. fecunda. The only possibly significant difference in the New Zealand specimens is their relatively well-developed paliform lobes before the S2 and accelerated S3, often forming a distinct crown. In western Atlantic specimens these lobes are extremely irregular in shape, often present only as twisted, contorted ribbons, and never found in a regular crown.

Solenosmilia Duncan, 1873

Corallum colonial, dendroid to subphaceloid in shape, achieved by equal dichotomous intratentacular branching. Laciniate P4 sometimes present; columella trabecular or absent. Tabular endothecal dissepiments present.

*Type Species: Sole*nosmilia variabilis Duncan, 1873, by monotypy.

Remarks: Solenosmilia is distinguished from other azooxanthellate colonial caryophylliids by its equal, intratentacular branching, each corallite continuing to increase in length and branch again. Lophelia, a similar genus, differs in having unequal intratentacular budding, which leads to a sympodial corallum. Solenosmilia is **a monotypic genus.**

***Sole*nosmilia variabilis Duncan, 1873**

(Plate 23, d, e)

*Sole*nosmilia variabilis Duncan, 1873: 328, pl. 42, figs 11–18; Squires 1969: 18, pl. 6, map 2; Zibrowius 1980: 143–145, pl. 75, figs A–N (synonymy); Cairns 1982: 31, pl. 9, figs 4–5 (synonymy); Cairns & Parker 1992: 29–30, pl. 8, figs d-e; Cairns & Keller, 1993: 250, pl. 6, fig. D (synonymy).

Material Examined: New Records: NZOI Stn E719, USNM 94143; Stn E800, NZOI; Stn E852, USNM 94144; Stn F319, NZOI; Stn I674, NZOI; Stn I676, NZOI; Stn R439, NZOI; Stn S46, USNM 94145; Stn S571, NZOI; Stn S573, NZOI; Stn T243, NZOI; Stn U568, NZOI; Stn U573, NZOI; Stn U574, NZOI; *Stn Z3948*, NZOI; Volcanolog Stn B30-*28*, *AU11622*, AUM; Volcanolog Stn B30-*20/1*, AU11621, AUM; Tui (Rumble II), AUM. Previous Records: *Syntype*s of S. variabilis.

Distribution: New Zealand: throughout the region from Kermadec and Three Kings Ridge to Macquarie Ridge, but not common (Map 2); 509–1260 m. Elsewhere: worldwide, except for off continental Antarctic and the North and East Pacific but including the Austral Seamounts off Cook Islands, 847 m (reported herein, NZOI Stn F319); 220–2165 m (Cairns 1982).

*Types: Syntype*s of S. variabilis are deposited at the BM(NH): 1883.12.10.73, 74–76 (Zibrowius 1980).

Type Locality: Off southwestern Spain, 1190–*2003 m.*

*Remarks: Sole*nosmilia variabilis is fully described and illustrated by Zibrowius (1980) and Cairns (1979, 1982) and will not be redescribed here. It is distinguished from other colonial corals in the New Zealand region by its distinctive intratentacular budding, which produces equal, three-dimensional dichotomous branching. According *to Squires 91969*), S. variabilis is the most southerly distributed colonial sc*leractin*ian: i.e., Eltanin Stn 1422 (56°19' S, 158°29' E, Hjort Seamount.

Family TURBINOLIIDAE Milne Edwards & *Haime*, 1848a

Conocyathus d'Orbigny, 1849

Corallum solitary, conical, and free. Transverse division not present. Theca perforate, the perforations being regular, elliptical pores. Costae well developed, in some species double the number of septa. Prominent P2 present; columella a solid central fusion.

TYPE SPECIES: *Conocyathus sulcatus* d'Orbigny, 1849, by monotypy.

REMARKS: *Conocyathus* is distinguished from other perforate tubinoliids by having large P2 and smooth costae. The history and characteristics of this genus are fully discussed by Filkorn (in press) who lists six valid species in the genus, five of which are exclusively fossil (Oligocene to Miocene) and the sixth, *C. zelandiae*, known from Oligocene to recent.

Conocyathus zelandiae Duncan, 1876
(Plate 23, f-i)

Conocyathus zelandiae Duncan, 1876: 431, pl. 38, figs 1–3; Tenison Woods 1878a: 294, 295, 302; Hutton 1904: 315; Squires 1958: 59, pl. 9, figs 15–18; Wells 1959: 286; Ralph & Squires 1962: 17; Squires & Keyes 1967: 29; Filkorn in press.

Conocyathus scrobiculatus Dennant 1902: 260–261, pl. 6, figs 1a-b.

Trematotrochus zelandiae: Harrison 1911: 1029–1030, pl. 57, fig. 14, pl. 58, figs 15–17; Folkeson 1919: 14.

Turbinolia australiensis Gardiner, 1939: 332–333, pl. 21, figs 1–2.

MATERIAL EXAMINED: New Records (all from Australia): *Alpha Helix* Stn 79-M14, 7, USNM 80852; *Alpha Helix* Stn 79-M15, 4, USNM 80851; Watson's Bay, Port Jackson, NSW, depth unknown, 5, USNM 83011; "Western Australia", Verco Collection, depth unknown, 2, USNM 85713; Torquay, near Geelong, Victoria, Miocene, 2, USNM 67965 and 67979. Previous Records: Syntypes; fossil specimens reported by Squires (1958).

DISTRIBUTION: New Zealand region: Cook Strait; depth unknown (Duncan 1876); Oligocene of New Zealand (Squires 1958). Elsewhere: Persian Gulf; western Australia (Folkeson 1919); off New South Wales; Arafura Sea (reported herein); Eocene to Miocene of South Australia (Dennant 1902). No previous record of this species had reported a depth of capture. The two lots from the *Alpha Helix* were collected at 22–24 m.

DESCRIPTION (based on Australian specimens): Corallum conical, free, and quite small: the largest specimen examined (USNM 83011) only 3.4 mm in calicular diameter and 6.1 mm in height. Basal angle acute, 25–28°; calice perfectly circular. C1-2 equal in size and length, extending from calice to about 0.2 mm beyond the base, where they all meet at the epicentre. C1–2 0.12–0.15 wide for most of their length, but just below the origin of the C3 (i.e., lower 0.6–1.5 mm of corallum) they expand to almost twice that width. C3 originate 0.6–1.5 mm above the base and maintain a constant width (0.14–0.18 mm) to the calice. C4 originate 1.9–2.7 mm above base and also maintain a constant width of 0.10–0.12 mm to the calice; C4 do not correspond to septa. Costae covered with very low, rounded granules about 15 µm in diameter, producing a smooth costal texture. Intercostal furrows deep (about 60 µm) and equally wide (55–65 µm). Within each intercostal furrow are regularly spaced, circular (55–65 µm in diameter) pores. Corallum white.

Septa hexamerally arranged in 3 complete cycles (S1>S2>S3) with no traces of a fourth cycle even when C4 are well developed. S1 highly exsert (about 0.7 mm) and have straight, vertical inner edges that fuse with the columella low in fossa. S2 less exsert (about 0.5 mm) and about half the width of an S1, each bearing an enormous lamellar palus (P2) that is twice the width (about 0.6 mm) of its corresponding S2 and equally as exsert as an S1. S3 about 0.4 mm exsert and half the width of an S2, the inner edges of each pair of S3 firmly fused to its common S2 by 3 or 4 solid trabecular processes. Septal and palar faces covered with coarse granules 30–40 µm in height and 70–90 µm in diameter. Fossa shallow to absent. Columella a circular (0.6–0.8 mm in diameter), smooth, flat, encircled by and fused to the tall P2 palar crown and the lower, inner edges of the S1.

TYPES: The two syntypes of *C. zelandiae* are deposited at the BM(NH) (1890.2.27.2–3). The larger syntype measures 3.75 mm in calicular diameter and 7.8 mm in height. The holotype of *T. australiensis* is also presumed to be at the BM(NH). The holotype of *C. scrobiculatus* is deposited at the NMV (P27097).

TYPE LOCALITIES: *C. zelandiae*: Cook Strait, depth unknown. *T. australiensis*: Port Jackson, NSW, depth unknown. *C. scrobiculatus*: Eocene of Spring Creek, near Geelong, Victoria, Australia.

REMARKS: Although the type locality of *C. zelandiae* was given as "Cook Strait" by Duncan (1876), it has never again been reported in the recent fauna in the New Zealand region, which led Ralph and Squires (1962) and Squires and Keyes (1967) to doubt the authenticity of the type local

ity. It is true that Duncan described species from many different localities in his 1876 paper and that *C. zelandiae* is better known from off Australia and even the Persian Gulf; however, it should be noted that *C. zelandiae* has a very small corallum and could easily be overlooked. The description and illustrations provided above are based on Australian specimens, in the hope that additional specimens may be collected in the New Zealand region from 20–25 m.

Alatotrochus Cairns, 1994

Corallum solitary and cuneiform, with a rounded (unattached) base and prominent, costate thecal edge crests. Transverse division absent. Theca imperforate. Costae serrate, extending from calice to base, one costa corresponding to every septum and another to every interseptal space, resulting in twice as many costae as septa. Four cycles of highly exsert septa. Pali absent; columella linear-papillose.

TYPE SPECIES: *Platytrochus rubescens* Moseley, 1876, by original designation.

REMARKS: *Alatotrochus* differs from most other imperfortae tubinoliid genera in having twice as many costae as septa, although some species of *Cryptotrochus* and *Conocyathus* also share this characteristic. Other distinguishing characters of the genus are its highly exsert and widely spaced septa and large, costate thecal edge crests. Only one species is known in the genus.

Alatotrochus rubescens (Moseley, 1876) (Plate 24, a, b)

Platytrochus rubescens Moseley, 1876: 552.
Sphenotrochus rubescens: Moseley 1881: 157–159, pl. 6, figs 8, 8a; Fowler, 1888: 11–14, figs 9–12; Fadlallah, 1983: 132.
Alatotrochus rubescens: Cairns 1994: 68–69 , pl. 29, figs g-l.

MATERIAL EXAMINED: New Records: NZOI Stn E868, 1, NZOI; Stn P13, 1, USNM 94175. Previous Records: One syntype.

DISTRIBUTION: New Zealand region: known only from southern Norfolk Ridge midway between Norfolk Island and Three Kings Islands (Map 14); 449–751 m (based on dead coralla). Elsewhere: off Kyushu, Japan; Banda Sea; 193–236 m.

TYPES: Four syntypes are deposited at the BM(NH), one numbered 1880.11.25.163.

TYPE LOCALITY: *Challenger* Stn 192, 5°49'15 S, 132°14'15 E (Kai Islands, Banda Sea), 136 m.

REMARKS: This species was recently described and illustrated by Cairns (1994). The two New Zealand specimens were both dead when collected, the specimen from NZOI Stn E868 only a worn shell of a corallum. The better-preserved specimen (NZOI Stn P13) is 12.1 x 8.7 mm in calicular diameter and 12.9 mm in height and is typical of the species. The New Zealand records probably represent the southern limit of this species.

Sphenotrochus Milne Edwards & Haime, 1848a

Corallum solitary and cuneiform, with a rounded, unattached base. Transverse division lacking. Theca imperforate. Costae granular or smooth, one costa corresponding to each setum. Costae sometimes degenerate into discontinuous frag-ments. Pali absent; columella lamellar or com-posed of aligned papillae.

TYPE SPECIES: *Turbinolia crispa* Lamarck, 1816, by subsequent designation (Milne Edwards & Haime 1850: xvi).

REMARKS: This genus and its similarity to *Platytrochus* were discussed by Cairns (1989a). Approximately 35 species are recognized in the genus, which ranges from Eocene to recent, only 10 of which are known from the present day, at depths of 9–403 m. Two recent species are known in the New Zealand region.

Sphenotrochus (Sphenotrochus) Milne Edwards & Haime, 1848a

Sphenotrochus in which the costae are continuous from point of origin to calice.

REMARKS: Most of the species in the genus belong in the nominate subgenus, including eight of the ten recent species.

Sphenotrochus (S.) ralphae Squires, 1964
(Plates 24, c-e, 25, a-c)

Sphenotrochus n. sp. B: Ralph & Squires 1962: 9, pl. 2, figs 7–8.
Sphenotrochus raphae (sic) Squires, 1964b: 5–6, pl. 1, figs 1–4.
Sphenotrochus ralphae: Squires & Keyes 1967: 24–25, pl. 3, figs 8–9; Dawson 1979: 30; ?Hayward *et al.* 1982: 160; Not Brook 1982: 169, fig. 4a; ?Hayward *et al.* 1984: 159; 1985: 101.

MATERIAL EXAMINED: New Records: NZOI Stn B808, 1, NZOI; Stn C344, 1, NZOI; Stn E319, 1, NZOI; Stn E340, 6, NZOI; Stn E391, 1, USNM 94183; BS329, 1, MoNZ CO326; BS346, 2, MoNZ CO327; BS415, 1, MoNZ CO333; BS732 (R90), 2, MoNZ CO340; BS744 (R102), 13, MoNZ CO341; BS747 (R105), 5, MoNZ CO342; off Mayor Island, stomach of *Nemadactylus macropterus*, 64–165 m, 50, AIM AK76312, 22, USNM 94587; off Mayor Island, stomach of *N. macropterus*, 64–146 m, 68, AIM AK76313, 10, USNM 94593, southwest end of Slipper Island, 7 m, 1, AUM. Previous Records: Holotype and paratypes of *S. ralphae* (USNM and AIM); specimens reported by Ralph and Squires (1962) as *Sphenotrochus* n. sp. B.

DISTRIBUTION: Endemic to New Zealand: off North Island from Cape Egmont to Bay of Plenty, including off Three Kings Islands (Map 9); 7–104 m.

DESCRIPTION: Corallum small and triangular, with flat faces and rounded edges. Angle of thecal edges 20–25°; inclination of thecal faces, 14–16°. Largest specimen examined (AIM AK76312) 5.5 x 3.6 mm in calicular diameter; coralla never more than 9 mm in height. Calice elliptical: GCD: LCD = 1.50–1.63. Costae sharply ridged near base, but rounded and coarsely granular for upper two-thirds of corallum. One to 2 rows of large rounded granules up to 0.1 mm in diameter occur on the upper edges of the costae, whereas much smaller, pointed granules about 30 µm tall and 20 µm in diameter project from the lateral faces of the costae into the intercostal spaces. Near calice costae are 0.27–0.31 mm wide and separated by deep (0.35 mm at edge) intercostal furrows 0.11–0.12 mm wide. C1–2 continuous from base to calice; C3 originate within 1 mm of base; the C4 within 2.5 mm of base. Costae vertical in center of thecal face, but tend to be obliquely parallel to thecal edges toward the corallum edge. Corallum white and sometimes porcellanous.

Septa hexamerally arranged in 4 cycles, the last incomplete, according to the formula: S1–2>S3>S4. Almost all coralla examined between a GCD of 2.6 and 5.4 mm contain 32 septa, having 1 pair of S4 in each of the 4 end half-systems (6:6:12:8). Two coralla (GCD = 4.1 mm and 5.4 mm) have 34 septa, having an additional pair of S4 in one of the end half-systems, and another corallum (AIM AK76313) has 36 septa, having 2 additional pairs of S4. S1–2 highly exsert (about 0.7 mm) and have vertical to slightly concave lower inner edges, which fuse with the columellar elements deep in fossa. S3 less exsert (about 0.5 mm), one-third to half width of an S1–2, have finely dentate inner edges, and are rudimentary lower in fossa. S4 about 0.4 mm exsert and about half width of an S3. Fossa relatively shallow, containing an elongate, papillose columella composed of 5–8 finely granular, aligned elements. Alignment of columellar elements sometimes slightly irregular directly in centre of fossa, where 2 elements may be paired adjacent to the medial S2. Columellar elements interconnected basally and usually 0.2–0.3 mm in diameter. In some coralla the terminal columellar elements (those adjacent to the principal S1) are short lamellae.

TYPES: The holotype and 6 paratypes are deposited at the AIM. Seven paratypes are also deposited at the USNM (68262).

TYPE LOCALITY: Between Tryphena Harbour and Cape Barrier, Great Barrier Island; 44 m.

REMARKS: See the discussion of *S. squiresi* for comparisons to that closely related species. Because these two species are so similar, some of the previous reports are listed with a query in the synonymy, pending re-evaluation of those specimens.

In two (AIM AK76313) of the approximately 200 coralla examined, the calice was in the process of intratentacular division.

Sphenotrochus (S.) squiresi n. sp.
(Plates 24, f, g, 25, d-f)

Sphenotrochus intermedius: Gardiner 1939: 333 (in part: *Discovery* Stn 934).
?*Sphenotrochus (S.) ralphae*: Brook 1982: 169, fig. 4a.

MATERIAL EXAMINED: Types, q.v. Specimen reported

as *S. intermedius* by Gardiner (1939), *Discovery* Stn 934, BM(NH) 1939.7.20.473.

DISTRIBUTION: Known only from a very small region between Three Kings Islands and North Cape (Map 9); 66–318 m, but most records over 100 m.

DESCRIPTION: Viewed from the side, the lower 3–4 mm of a corallum is either U-shaped or triangular, the angle of the thecal edges ranging from 70–90°. However, above a corallum height of about 4 mm the thecal edges as well as the faces are parallel. Holotype 6.6 x 3.7 mm in calicular diameter and 10.0mm in height; largest specimen (BS905) 7.1 x 3.9 mm in calicular diameter and 11.4 mm in height. Calice elliptical, but elongate: GCD: LCD = 1.70–1.96. Costae rounded from calice to base and coarsely granular, some worn costae appearing to be moniliform. Costal granules triangular, up to 70 µm tall and 80 µm in basal diameter, projecting from both the upper and lateral edges of each costa. Costae orientated perfectly vertical, even those near thecal edge. Costae 0.20–0.25 mm wide and separated by deep (0.2 mm) intercostal furrows 0.07–0.20 mm wide. C5 do not originate from C4 trifurcations but independently from the edge costae about 3.5 mm above base. Corallum white.

Septa hexamerally arranged in 5 cycles, the fourth and fifth incomplete, according to the formula: S1–2>S3>S4>S5. Almost all coralla examined of GCD 3.6 to 6.6 mm contained 40 septa, having 1 pair of S4 and 1 pair of S5 in each end half-system (6:6:12:8:8). Very small coralla (GCD < 2.7 mm) have only 32 septa, whereas several coralla 5.2–7.1 mm in GCD (BS642, BS905) have 46 septa, including 3 additional pairs of S5 in the end systems. S1–2 highly exsert (about 0.8 mm) and have very sinuous, vertical inner edges that fuse with the columellar elements. S3 less exsert (about 0.6 mm), have dentate inner edges, and are about half the width of an S1–2, except for the 4 S3 in the end half-systems, which are almost as wide as the S1–2. S4, which are only present in the end half-systems, about half width of an accelerated S3; S5 about two-thirds width of an S4. Fossa shallow, containing an elongate, papillose columella. In the holotype, 5 columellar elements are present: 2 terminal lamellar elements and 3 central aligned papillae, which are pillar-shaped. Other coralla bear a medial row of coarse (0.18–0.20 mm in diameter), granular pillars, interconnected at their bases.

TYPES: Holotype: NZOI Stn C764, NZOI H-630. Paratypes: NZOI Stn C766, 2, P-1030, USNM 94184; Stn E274, 2, P-1031, NZOI; Stn E278, 1, P-1032, NZOI; Stn E302, 1, P-1033, NZOI; Stn E340, 1, P-1034, NZOI; Stn E387, 1, P-1035, NZOI; Stn E390, 1, P-1036, USNM 94185; BS392, 10, MoNZ CO329; BS394, 7, MoNZ CO331; BS395, 13, MoNZ CO332; BS631 (P441), 6, MoNZ CO334; BS632 (P449), 3, MoNZ CO335; BS635 (P475), 4, MoNZ CO336; BS637 (P485), 2, MoNZ CO330, 1, USNM 94187; BS638 (P487), 2, MoNZ CO354; BS641 (P571), 3, MoNZ CO338; BS642 (P574), 24, MoNZ CO274; BS893 (O639), 24, MoNZ CO343; BS895 (O641), 33, MoNZ CO307, 19, USNM 94186; BS898 (O644), 2, MoNZ CO289; BS899 (O645), 2, MoNZ CO301; BS902 (O648), 1, MoNZ CO346; BS904 (O650), 2, MoNZ CO344, 1, USNM 94188; BS905 (O651), 53, MoNZ CO345, 9, USNM 94189; BS911 (O657), 43, MoNZ CO347; BS912 (O658), 5, USNM 94190; BS913 (O659), 2, MoNZ CO349.

TYPE LOCALITY: 34°08.5′ S, 172°08.5′ E (off Three Kings Islands), 66 m.

ETYMOLOGY: This species is named in honour of Donald F. Squires, who has advanced our knowledge of New Zealand Scleractinia more than anyone.

REMARKS: *Sphenotrochus squiresi* differs from *S. ralphae*, the other recent *Sphenotrochus* from New Zealand, in two basic ways: corallum shape and number of septa. *Sphenotrochus squiresi* has parallel thecal edges and thus vertically oriented costae, whereas those of *S. ralphae* diverge at a constant angle and thus have obliquely orientated costae. Secondly, *S. squiresi* usually has 40 septa, *S. ralphae*, 32 septa. *Sphenotrochus squiresi* also differs in having a more compressed calice (GCD: LCD = 1.70–1.96 vs 1.50–1.63 for *S. ralphae*); sinuous inner septal edges of S1–2; and coarser columellar elements. Bathymetrically, *S. squiresi* is usually found deeper than 100 m, whereas the range of *S. ralphae* is 7–104 m.

Three fossil *Sphenotrochus* are known from New Zealand: *S. aschistus* Squires, 1958 (early Pliocene); *S. laculatus* Squires, 1962a (Tertiary); and *S.* sp. A of Squires (1962a) (Tertiary), all of which are easily distinguished from *S. squiresi* by their greater number of septa and different costal morphology. Among the ten other recent species in the genus (*see* Cairns 1989a; Cairns & Keller 1993), *S. squiresi* is most similar to *S. gardineri* Squires, 1961, known only from the subantarctic Magel-

lanic region at 9–403 m (Cairns 1982). Both species have vertically aligned costae, and small specimens of *S. gardineri* have the same configuration and number of septa as *S. squiresi*, but larger specimens have 48 septa. Furthermore, *S. gardineri* has a triangular shape (constantly divergent thecal edges); and thin, ridgelike, finely granular costae, not thick and coarsely granular as in *S. squiresi*.

Kionotrochus Dennant, 1906

Corallum solitary, often reproducing asexually by transverse division. Anthocaulus cylindrical; anthocyathus conical with a rounded base. Theca imperforate; costae finely granular, one costa corresponding to each septum. Septa 24–26. Poorly defined styliform paliform lobes (P2) present, often indistinguishable from the styliform columella.

TYPE SPECIES: *Kionotrochus suteri* Dennant, 1906, by monotypy.

REMARKS: *Kionotrochus* is compared to *Cryptotrochus* in the discussion of that genus, and the history of the genus *Kionotrochus* is discussed by Cairns (1989a). Only one species is recognised: *K. suteri*.

Kionotrochus suteri Dennant, 1906

(Plates 25, g, h, 26, a–f)

Kionotrochus suteri Dennant, 1906: 155-156, pl. 5, fig. 5a-b; Wells 1937: 239, pl. 1, figs 17–18; Cairns 1988: 710, figs 13–14; 1989a: 29.

Kionotrochus (K.) suteri: Squires 1960a: 283–287, figs 1–11; Ralph & Squires 1962: 8–9, pl. 2, figs 5–6; Squires 1964b: 6-7, pl. 2, figs 10–14; Squires & Keyes 1967: 25, pl. 3, fig. 10–11; Dawson 1979: 29; Brook 1982: 169–171, fig. 4b-e; Hayward, *et al.* 1985: 101.

MATERIAL EXAMINED: New Records: NZOI Stn C748, 1, NZOI; Stn C752, 10, NZOI; Stn C769, 27, NZOI; Stn C771, 10, NZOI; Stn C774, 7, NZOI; Stn C776, 10, NZOI; Stn C778, 1, NZOI; Stn C780, 20, NZOI; Stn C781, 22, USNM 94193; Stn C782, 3, NZOI; Stn C792, 20, USNM 94194; Stn C793, 100, USNM 94195; Stn E255, 2, NZOI; Stn E256, 6, NZOI; Stn E258, 3, NZOI; Stn E261, 13, NZOI; Stn E274, 2, NZOI; Stn E278, 1, NZOI; Stn E348, 1, NZOI; Stn E349, 3, NZOI; Stn E351, 3, NZOI; Stn E356, 1, NZOI; Stn E358, 4, NZOI; Stn E359, 5, NZOI; Stn E364, 7, NZOI; Stn E370, 1, NZOI; Stn E374, 1, NZOI; Stn E378, 1, NZOI; Stn E389, 3, NZOI; Stn E391, 1, NZOI; Stn F75, 14, USNM 94199; Stn F915, 1, USNM 94200; BS335, 2, MoNZ; BS362, 30, MoNZ; BS363, 30, MoNZ; BS369, 30, MoNZ; BS370, 10, MoNZ; BS372, 30, MoNZ; BS380, 10, MNZ; BS391, 8, MoNZ CO253; BS394, 1, MoNZ; BS395, 13, MoNZ CO350; BS631 (P441), 10, MoNZ CO351; BS632 (P449), 14, MoNZ CO352; BS633 (P461), 2, MoNZ CO269; BS634 (P465), 4, MoNZ CO271; BS635 (P475), 17, MoNZ CO353; BS636 (P476), 8, MoNZ; BS637 (P485), 20, MoNZ; BS638 (P487), 3, MoNZ CO354; BS639 (P515), 13, MoNZ CO355; BS641 (P541), 9, MoNZ; BS724 (R82), 10, MoNZ; BS733 (R91), 25, MoNZ; BS734 (R92), 15, MoNZ; BS747 (R105), 19, MoNZ CO356; BS756 (R114), 10, MoNZ; BS768 (R126), 8, MoNZ; BS833 (O578), 80, MoNZ CO286, 20, USNM 94201; BS881 (O627), 50, MoNZ CO280; BS893 (O639), 194, MoNZ CO357; BS895 (O641), 50, MoNZ CO306; BS898 (O644), 8, MoNZ CO291; BS905 (O651), 3, MoNZ CO358; BS910 (O656), 1, MoNZ CO293; BS911 (O657), 43, MoNZ CO360; BS912 (O658), 26, MoNZ CO359. Previous Records: 23 syntypes (USNM 94202); specimens reported by Wells (1937), Ralph and Squires (1962), Squires (1964), and Squires and Keyes (1967).

DISTRIBUTION: Endemic to New Zealand, from off East Cape to just north of Kaipara Harbour, including Three Kings Islands (Map 8); 44–622 m, but most records between 100–200 m.

DESCRIPTION: Fixed anthocaulus cylindrical, up to 2 mm in height and 2.0–2.7 mm in diameter, often attached to a bivalve shell. Anthocaulus polycyclic, the first thecal ring forming at a diameter of about 1.1 mm, the second at 2.0 mm, and the third, if present, at about 2.7 mm. The anthocaulus invariably contains 3 cycles of 24 (total) septa, a central columellar tubercle, and often 6 P2. Young anthocyathi (Plate 26, a, b) are tympanoid, matching the calicular diameter of the parent anthocaulus (i.e., 2.0–2.7 mm), have 24 septa and 6 P2, and usually show some evidence of a basal detachment scar. Anthocyathi soon cover over their detachment scar as they transform from a tympanoid to a conical corallum with a rounded base. Largest corallum examined (BS833) 6.8 mm in calicular diameter and 6.5 mm in height, the H:W of mature specimens often approximating 1.0. Costae 0.38–0.42 mm wide, rounded, and covered with fine, blunt granules 40–50 µm in height and width. Intercostal furrows deep and wide (0.15 mm), extending from base to calicular edge. Corallum white.

Septa hexamerally arranged in 3 or 4 cycles, the fourth cycle never complete, according to the formula: S1>S2>S3>S4. Coralla of 3.8–5.1 GCD may have only 24 septa, whereas the apparent maximum of 36 septa (1 pair of S4 in each system) occurs in specimens of 4.0–6.1 mm GCD; the largest calice of GCD 6.8 mm has only 34 septa. S1 about 0.8 mm exsert and quite wide, having vertical, slightly sinuous inner edges that reach far into the fossa. S2 equally exsert but only about four-fifths width of an S1. S3 less exsert than and about half width of an S2. S4, if present, about half width of an S3. Styliform paliform lobes usually present before S2, sometimes forming a crown of 6 pillars surrounding the columella; however, the expression of P2 is variable, the lobes sometimes indistinguishable from the central columella. Columella styliform, usually consisting of 1, but up to 3, pillars. Paliform lobes and columellar elements all about 0.5 mm in diameter and finely granular. Fossa shallow.

TYPES: Seventy syntypes of *K. suteri* were mentioned by Dennant (1906): the holotype and 39 paratypes are deposited at the NMV (F41513, F59350, respectively); 23 syntypes, including 8 anthocauli, are also deposited at the USNM (94202).

TYPE LOCALITY: 15 miles (24 km) off Great Barrier Island, New Zealand, 201 m.

REMARKS: *Kionotrochus suteri* is a commonly collected, relatively shallow-water coral in the New Zealand region and, as such, has been studied and redescribed several times — Squires (1960a, 1964b), Ralph and Squires (1962), and Brook (1982).

As Dennant (1906) observed in his original description, *K. suteri* asexually buds free (unattached) anthocyathi from a fixed (attached) anthocaulus, the latter also called the trophozoid in previous literature. Although the evidence for this mode of reproduction was circumstantial, it was generally accepted (Squires 1964b; Ralph & Squires 1962), the first and only example of an anthocaulus still attached to its anthocyathus being that figured by Brook (1982: fig. 4d). Anthocauli are not as common as anthocauli in the study material, constituting about 5% of the specimens examined.

Cryptotrochus Cairns, 1988

Corallum solitary, conical, and free, with a pointed base. Transverse division and asexual fragmen-tation lacking. Theca imperforate. Costae well developed, sometimes double the number of septa, i.e., 1 corresponding to each septum and each interseptal space. Four cycles of highly exsert septa. Prominent P2 present; columella papillose.

TYPE SPECIES: *Cryptotrochus carolinensis* Cairns, 1988, by original designation.

REMARKS: *Cryptotrochus* is most similar to *Kionotrochus*, but the latter differs in reproducing by transverse division, which results in a flat or bowl-shaped base, and in having much less developed (obscure) P2. Three species are recognised in the genus — *C. carolinensis* Cairns, 1988 (type species, from western Atlantic, 320–338 m); *C. javanus* Cairns, 1988 (Java Sea, 585 m); and *C. venustus* (Alcock, 1902a).

Cryptotrochus venustus (Alcock, 1902) n. comb.
(Plates 26, g-i, 27, a, b)

Ceratotrochus venustus Alcock, 1902a: 92; 1902c: 10, pl. 1, figs 5, 5a.

MATERIAL EXAMINED: New Record: NZOI Stn U584, 16, NZOI, 5, USNM 94178. Previous Record: Holotype of *C. venustus*.

DISTRIBUTION: New Zealand region: known only from one record on Three Kings Ridge (Map 15); 1137 m. Elsewhere: Kepulauan Kai, eastern Banda Sea, Indonesia; 397 m.

DESCRIPTION: Corallum conical, having a pointed base the edges of which diverge at an angle of 50–60° but in the upper corallum becoming almost parallel. Largest specimen examined (NZOI Stn U584) 13.3 x 13.2 mm in calicular diameter and 14.9 mm in height, which is larger than the holotype of 9.6 mm GCD. Calice circular to only very slightly elliptical: GCD: LCD = 1.01–1.14. Costae ridged, 0.15–0.25 mm in width, and finely spinose, the spines only about 23 µm in diameter. Twice as many costal ridges exist as septa (usually 96), one corresponding to each septum and a slightly narrower one corresponding to each interseptal space. Costae straight to slightly

crooked and discontinuous in lower third of corallum, each costa fragmenting into segments and thus not displaying distinct costal trifurcations characteristic of most other turbinoliids. Intercostal furrows relatively shallow and of equal width to costae. Corallum white.

Septa hexamerally arranged in 4 complete cycles according to the formula: S1>S2>S3>S4, only 1 corallum having an additional pair of S5 (50 septa). S1 highly exsert (about 3 mm) with straight, vertical inner edges that fuse to the columella. In one specimen each S1 appears to have a small paliform lobe directly adjacent to the columella. S2 also highly exsert (up to 2.5 mm), about four-fifths width of an S1, also with straight, entire edges, each of which is separated from its corresponding P2 by a deep, wide notch. P2 quite prominent (up to 4 mm tall) and variable in thickness, in some coralla (Plate 26, h) being quite slender (0.6 mm wide), tall, and pointed (lanceolate), but in other specimens being much wider (up to 1.5 mm) and thicker, with a blunt upper edge (lamellar). In all cases, the 6 P2 form a very distinct crown of pali that rises well above the columellar elements and reaches as high as the upper edges of the S3. S3 about 1.8 mm exsert, three-quarters width of an S2, and have straight to slightly concave inner edges. In many coralla a small P3 is also present on the inner edges of some or all S3 in a corallum, these P3 often fusing to the base of the adjacent P2. Presence of P3 variable, some coralla having none. S3 about 1.1 mm exsert, and about one-third width of an S3. Septal faces smooth and planar; whereas palar faces are coarsely granular. Fossa shallow, the paliform lobes extending above the calicular edge; columella composed of 2–7 granular papillae fused among themselves and to inner edges of S1 and P2.

TYPES: The holotype is deposited at the ZMA (Coel. 1184).

TYPE LOCALITY: *Siboga* Stn 256, 5°26.6′ S, 132°32.5′ E (eastern Banda Sea), 397 m.

REMARKS: Alcock's (1902a, c) characterisation of the holotype as having five cycles of septa was incorrect. The specimen does have five cycles of costae (actually only 88), but only four cycles of septa.

Cryptotrochus venustus is quite similar to *C. javanus* in corallum shape and size, and calicular characteristics (number and shape of septa and P2 crown). They are also found in the same geographic and bathymetric ranges, but *C. venustus* differs primarily in the number and morphology of its costae. It has twice as many costae as *C. javanus* (88–96 vs 48); the costae of *C. venustus* are narrower and less well defined, especially in the lower corallum; and *C. venustus* lacks costal trifurcations. Furthermore, the costal granulation of *C. venustus* is much finer and the intercostal furrows shallower.

Peponocyathus Gravier, 1915

Corallum solitary, globose to cylindrical. Transverse division present. Theca imperforate; costae serrate, one corresponding to each septum. Pali present before all but last cycle of septa; columella papillose.

TYPE SPECIES: *Peponocyathus variabilis* Gravier, 1915 (= *P. folliculus* (Pourtalès, 1868)) by original designation.

REMARKS: Re-examination of specimens from the Atlantic, off Japan, the Philippines, and those from New Zealand convince me that Zibrowius (1980, 1984: 84) was correct in assuming that *P. folliculus* could be distinguished from *P. stimpsonii* (= *P. australiensis*) by reproducing through transverse division. I had previously (Cairns, 1989a: 29) considered specimens of *P. folliculus* in the process of transverse division and those with flat bases to be the exclusive result of parricidal budding and rejuvenescence, as did Stolarski (1992). It is often difficult, if not impossible, to distinguish between the two processes in many specimens, but, in general, parricidal budding results in multiple coralla that remain attached to one another, and daughter coralla that have fewer septa than the parent. Furthermore, rejuvenescent coralla do not have costae continuous between parent and daughter. Transverse division results in anthocyathi that become free of the parent anthocaulus; coralla with horizontal basal scars with poorly formed costae; and daughter coralla with the same number of septa as the parent. In the rare cases in which an anthocyathus is still partially attached to its parent, it can be seen that costae are continuous from parent to daughter. Because anthocyathi can quickly regenerate the basal region and thus cover the detachment scar with well-developed costae, this character is best seen in small, young specimens or those just detached.

Stolarski (1992), I think correctly, decided that peponocyathid species that reproduce by transverse division should be generically distinct from those that do not undergo fission, proposing the name *Truncatocyathus* (type species *Discotrochus duncani* Reuss, 1871, Miocene of Poland) for those species. But, if *P. folliculus* is considered to be a transversely dividing species, *Truncatocyathus* becomes a junior synonym of *Peponocyathus*, since *P. variabilis* (= *P. folliculus*) is the type species of *Peponocyathus*. Another junior synonym of *Peponocyathus* is *Cylindrophyllia* Yabe & Eguchi, 1937. What is actually needed is a name for the peponocyathan species that do not undergo transverse division, for which two names are available — *Deltocyathoides* Yabe & Eguchi, 1932a, and *Paradeltocyathus* Yabe & Eguchi, 1937, both of which have been applied to the other recent peponocyathan species, *P. australiensis* (Duncan, 1870) (*see* Cairns 1989a). Species included in *Peponocyathus*, as emended, are: *P. variabilis* Gravier, 1915 (= *P. folliculus* (Pourtalès, 1868)); *P. duncani* (Reuss, 1871) (= ?*P. pseudoduncani* [Vašíček], 1946); *P. lecomptei* (Wells, 1937); *P. minimus* (Yabe & Eguchi, 1937); and *P. dawsoni*, n. sp.

Peponocyathus dawsoni n. sp.
(Plate 27, d-f, h-j)

?*Deltocyathus lens*: Gardiner 1939: 333.
Notocyathus (Paradeltocyathus) orientalis: Squires & Keyes 1967: 24, pl. 3, figs 2–7; Dawson 1979: 30.

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: New Zealand: throughout the region from Three Kings Ridge to off Auckland Island, but not common (Map 6); 87–988 m.

DESCRIPTION: Corallum variable in shape, often tympanoid, cylindrical, or onion-shaped, the calice often being smaller in diameter than midcorallum. Base (of anthocyathus) usually flat and poorly constructed, characteristic of separation from a basal anthocaulus; a distinct basal scar usually present. All specimens examined unattached, except for the holotype, which consists of two anthocyathi still attached, the parent corallum itself unattached. Largest specimen examined (NZOI Stn C510) 8.0 mm in calicular diameter, 5.5 mm in height, and 5.4 mm in basal scar diameter. Holotype 6.5 mm in diameter and 3.5 mm in height. Costae equal (0.10-0.12 mm) in width and finely granular, separated by deep intercostal furrows. Corallum white.

Septa arranged in 3 to 4 cycles, coralla as small as 3.4 mm having a complete fourth cycle. S1 exsert and quite broad, their inner edges extending well into fossa. S2 about four-fifths width of an S1; S3 about two-thirds width of an S2; S4 slightly wider than S3. A small paliform lobe occurs before each S1, a much larger palus before each S2, and a small palus before each S3. Each pair of S4 merge before its common P3, and each pair of P3 merge with its common P2 closer to the columella. Fossa quite shallow; columella papillose.

TYPES: Holotype: Chatham Island Expedition Stn 4, MoNZ CO245. Paratypes: NZOI Stn A910, 8 P-1037, USNM 81802; NZOI Stn C510, 1, P-1038; Stn D149, 4, P-1039; NZOI; Stn D173, 8 P-1040, NZOI; Stn E274, 1 P-1041, USNM 94182; Stn U582, 6, P-1042; USNM 94180; BS634 (P462), 5, MoNZ CO271; Chatham Island Expedition Stn 4, 7, MoNZ, 6, USNM 94181; MU76–139, 2, Portobello Marine Laboratory.

TYPE LOCALITY: 43°14′ S, 176°11′ E (north of Chatham Island), 366 m.

ETYMOLOGY: This species is named in honour of Elliot W. Dawson in recognition of his work on New Zealand natural history.

REMARKS: *Peponocyathus dawsoni* differs from other species in the genus by attaining a much larger size, having a squat shape (diameter usually larger than height), and in having four cycles of septa at a relatively small size.

Tropidocyathus Milne Edwards & Haime, 1848a

Corallum solitary and cuneiform to campanulate in shape, with a rounded (unattached) base and occasionally with alate lateral crests. Transverse division lacking but asexual fragmentation common in one species. Theca imperforate; costae serrate to granular and correspond to septa. Pali present in 3 crowns (P1–3) before all but last cycle. Columella papillose to lamellar.

TYPE SPECIES: *Flabellum lessoni* Michelin, 1842, by monotypy.

REMARKS: *Tropidocyathus* was discussed and its five species listed by Cairns (1989a). It is distinguished from other turbinoliid genera by its 3 well-developed palar crowns and its relatively large size.

Tropidocyathus pileus (Alcock, 1902)
(Plate 28, a–c)

Trochocyathus pileus Alcock, 1902a: 96–97; 1902c: 15–16, pl. 2, fig. 11, 11a.
Tropidocyathus pileus: Cairns 1989a: 34–35, pl. 17, figs a-h (synonymy); 1994: 68, pl. 29, figs d-e (synonymy).

MATERIAL EXAMINED: New Record: NZOI Stn P14, 1, USNM 94176. Previous Records: Syntypes of *T. pileus*.

DISTRIBUTION: New Zealand region: known only from one specimen collected on the southern Norfolk Ridge halfway between Norfolk Island and Three Kings Islands (Map 11); 319 m. Elsewhere: widespread in Indo-West Pacific from off Tanzania to off Japan (*see* Cairns 1994); 123–522 m.

TYPES: Four syntypes are deposited at the ZMA (Coel. 7352, 1326).

TYPE LOCALITY: *Siboga* Stn 95, 5°43′ N, 119°40′ E (Sulu Archipelago), 522 m.

REMARKS: The single specimen reported herein is 15.9 x 11.7 mm in calicular diameter and 16.3 mm in height; contains 56 septa (1 pair of S5 in each end half-system); and was dead and slightly damaged on collection. It is typical in size and morphology to previously described and illustrated specimens from off Japan and the Philippines (Cairns 1989a, 1994) and need not be redescribed here. This specimen represents the southernmost record of the species, which was previously 26°32′ S off Queensland (Cairns 1989a).

Notocyathus Tenison-Woods, 1880

Corallum solitary and conical, with a free, pointed base. Transverse division lacking. Theca imperforate; costae serrate, corresponding to septa. Septa slightly exsert. Pali present before all but last cycle, the P1–2 often suppressed in adult stage; pairs of P3 unite in V-shaped structures. Fossa shallow; columella papillose.

TYPE SPECIES: *Caryophyllia viola* Duncan, 1865, by subsequent designation (Felix 1927).

REMARKS: This genus and its similarity to *Peponocyathus* are discussed by Cairns (1989a). Five nominal species are known, including three from the Oligocene to Miocene of Australia and New Zealand, and two recent species — *N. conicus* and *N. venustus* (Alcock, 1902b).

Notocyathus conicus (Alcock, 1902)
(Plate 27, c, g)

Citharocyathus conicus Alcock, 1902b: 118–119; 1902c: 22, pl. 3, fig. 18, 18a; Yabe & Eguchi, 1941b: 212, figs 5a-b.
Sphenotrochus viola: Gerth 1921: 393.
Not *Notocyathus conicus*: Squires 1958: 54–55, pl. 9, figs 12–14 (= *N. euconicus* and *Peponocyathus* sp.); 1962a: 147 (= *Peponocyathus* sp.).
Notocyathus conicus: Cairns 1989a: 28, pl. 13, figs a-i (synonymy); 1994: 64–65, pl. 28, figs a-b.

MATERIAL EXAMINED: New Records: NZOI Stn G3, 2, NZOI; BS441, 5, MoNZ CO259, 3, USNM 94177. Previous Records: 2 syntypes.

DISTRIBUTION: New Zealand region: northern Norfolk Ridge; Kermadec Ridge off Raoul Island (Map 10); 402–710 m. Elsewhere: off Japan; Philip-pines; Indonesia; 34–923 m. Pleistocene of Ryukyu Islands (Yabe & Eguchi 1941b). Miocene of Java (Gerth 1921).

TYPES: Two syntypes of *C. conicus* are deposited at the ZMA (Coel. 1185).

TYPE LOCALITY: *Siboga* Stn 95, 5°43.5′ N, 119°40′ E (Sulu Sea), 522 m.

REMARKS: *Notocyathus conicus* was fully described and illustrated by Cairns (1989a, 1994) based on specimens from off the Philippines and Japan, respectively. The New Zealand specimens, particularly those from Stn BS441, are very similar to the syntypes from the Sulu Sea, the largest New Zealand specimen measuring 7.7 mm in calicular diameter and 8.1 mm in height. *Notocyathus conicus* is similar to *N. venustus*, based on a detailed comparison made by Cairns (1989a). An exclusively fossil species also occurs in New Zealand, *N. euconicus* Squires, 1962a (late Oligocene to middle Miocene), which is also similar to *N. conicus*, but appears to differ in having a narrower corallum with constantly

increasing calicular diameter, not constricted as in the case of larger *N. conicus*. Other fossil species of *Notocyathus* reported by Squires (1958) — *N. orientalis*, *N. cuspidatus*, and *N. pedicellatus* Tenison-Woods, 1880, are probably peponocyathans.

Thrypticotrochus Cairns, 1989a

Corallum solitary, small, and conical; transverse division absent, but regeneration from asexual fragmentation quite common. Theca imperforate; costae serrate, one corresponding to each septum. One to three narrow paliform lobes on inner edges of every S1–3. Columella papillose.

TYPE SPECIES: *Thrypticotrochus multilobatus* Cairns, 1989a, by original designation.

REMARKS: *Thrypticotrochus* is distinguished from other turbinoliid genera by having multiple (1–3) paliform lobes on every S1–2. Two species are known — the type species *T. multilobatus* Cairns, 1989a and *T. petterdi* (Dennant, 1906), from off New South Wales.

Thrypticotrochus multilobatus Cairns, 1989 (Plate 28, d-h)

Thrypticotrochus multilobatus Cairns, 1989a: 37, pl. 19, figs b–g; Cairns & Keller 1993: 254, pl. 7, figs F, I.

MATERIAL EXAMINED: New Records: NZOI Stn G1, 1, NZOI; Stn K818, 1, NZOI; BS438, 9, USNM 94179; BS570, 4, MNZ CO267; BS633 (P461), 2, MoNZ CO268; BS833 (O578), 4, MoNZ CO285; BS895 (O641), 2, MoNZ CO307; BS893 (O639), 1, MoNZ. Previous Records: Types.

DISTRIBUTION: New Zealand region: southern Norfolk Ridge; off Three Kings Islands; Kermadec Ridge (off Raoul Island); off East Cape (Map 11); 95–440 m. Elsewhere: southwest Indian Ocean (off Mozambique and Tanzania); South China Sea; off Philippines; off Queensland; 130–925 m.

TYPES: The holotype and 4 paratypes are deposited at the USNM (holotype, 81901). One syntype is also deposited at the MNHNP and another at the AMS (G15259).

TYPE LOCALITY: *Albatross* Stn 5576, 5°25'56 N, 120°03'39 E (Sulu Sea), 507 m.

REMARKS: This species was recently described and illustrated in the original account and need not be redescribed here. The New Zealand specimens represent the largest coralla known for this species, a specimen from Stn BS833 measuring 6.1 mm in calicular diameter and 6.9 mm in height (Plate 28, e, g). Coralla greater than about 4.5 mm in calicular diameter contain septa of the fifth cycle, up to about 72 septa. Of the 23 specimens reported herein, 21 had generated from a fragment of a parent corallum.

Superfamily Flabelloidea Bourne, 1905
Family GUYNIIDAE Hickson, 1910

Pedicellocyathus n. gen.

Corallum solitary, ceratoid, and firmly attached. Transverse division absent. Base reinforced with *12 symmetrically* arranged, hollow rootlets. A row of mural spots, pores, or internal depressions occurs in every interseptal space. Pali absent; columella a rudimentary fusion of lower, inner edges of S1–2.

TYPE SPECIES: ***Pedicellocyathus keyesi***, here designated.

ETYMOLOGY: The generic name Pedicellocyathus (Latin pedicellus, a small, slender stalk, dim. of pes, foot + cyathus, cup) is an allusion to the basal pedestal formed by the rootlets. Gender masculine.

REMARKS: AMONG THE 10 GUYNIID GENERA (eight listed by Cairns 1989a: table 3), Pedicellocyathus is most similar to Onchotrochus Duncan, 1870, which is known only from the Upper Cretaceous of England. Only these two genera lack both pali and columella, and do not repoduce by transverse division. Pedicellocyathus is distin-guished by having symmetrically arranged rootlets, a ceratoid (not cylindrical) corallum, and up to four (not two) cycles of septa.

Pedicellocyathus keyesi n. sp. (Plate 29, a-f)

Stenocyathus decamera Ralph & Squires, 1962: 11–12 (in part: specimen from off Mayor Island, pl. 4, fig. 6 and probably 2 specimens from Poor Knights Islands); Squires & Keyes 1967: 28 (in part: specimens from Victoria University #8 and Miscellaneous Stn 20).

MATERIAL EXAMINED: Types, q.v.

Distribution: Endemic to the northeastern coast, Three Kings Islands to East Cape (Map 9), 70–194 m.

DESCRIPTION: Corallum relatively small, straight, and ceratoid, the largest specimen examined (BS833) 9.2 x 8.1 mm in calicular diameter and 16.6 mm in height. Holotype 7.0 x 6.3 mm in calicular diameter and 16.1 mm in height, with a pedicel diameter of 3.5 mm. Corallum rejuvenescence common (see Ralph & Squires 1962: pl. 4, fig. 6). Calice slightly elliptical: GCD: LCD = 1.1–1.2. Basal 2–3 mm of corallum reinforced with 12 symmetrically arranged, hollow, contiguous rootlets (Plate 29, a, b, f), each rootlet 0.6–0.7 mm in width. The ring of rootlets forms a thick pedestal, which firmly anchors corallum to substratum. Epitheca above rootlets smooth and porcellanous, but studded with rows of circular pores or spots 0.06–0.07 mm in diameter, a row corresponding to each interseptal space. If not visible exteriorly, these regions of variable calcification are expressed within the calice as thecal depressions (Plate 29, c). Corallum white.

Septa hexamerally arranged in 4 cycles, coralla 5–6 mm in GCD having only 34–36 septa, the complete fourth cycle (48 septa) present only in the largest specimen of 9.2 mm GCD. Pairs of S4 usually first inserted in the 4 end systems, and subsequently in the 2 lateral systems. Septal formula: S1>S2>S3>S4. S1 have straight to very slightly sinuous inner edges and are quite wide, especially the 4 lateral S1, the inner edges of which almost meet in centre of fossa. S2 about four-fifths width of an S1, their lower, inner edges fusing with the columella. S3 only one-third to half width of an S3 and sometimes (especially in small coralla) have sinuous inner edges. S4 rudimentary. Septal faces covered with tall (about 0.1 mm), pointed granules. Fossa deep; columella a central, elliptical fusion of lower, inner edges of S1–2.

TYPES: Holotype: BS833 (O578), MoNZ CO285. Paratypes: NZOI Stn C804, 1, P-1043; Stn C814, 2, P-1044; USNM 94270; NZOI Stn E283, 1, P-1045; NZOI Stn E393, 1, P-1046; USNM 94269; BS833 (O578), 7, MoNZ CO285, 2, USNM 94268; BS881 (O627), 1, MoNZ CO282; BS911 (O657), 3, MoNZ CO294; off Mayor Island, 146–220 m, 1, S. *decamera* of Ralph & Squires (1962), MoNZ CO184.

Type Locality: 37°38.5′ S, 178°56.4 ′E (off East Cape, New Zealand), 143–153 m.

ETYMOLOGY: This species is named in honour of Ian W. Keyes, of the Institute of Geological and Nuclear Sciences, Lower Hutt.

REMARKS: Ralph and Squires (1962) included at least one specimen (off Mayor Island) of P. keyesi in their nontype material of *Stenocyathus decamera.* It is interesting to note that a label with that specimen reads "*Stenocyathus* (?)", but the author and date of this note are unknown. Although not examined, it is probable that their specimens from off the Poor Knights Islands are also P. keyesi. *Pedicellocyathus* resembles Stenocyathus in size, shape, and the possession of mural spots/pores, but there the resemblance stops. Pedicellocyathus differs in lacking pali and columella, having hollow basal rootlets, having a fourth cycle of septa, and in having internal thecal depressions.

Truncatoguynia Cairns, *1989a*

Corallum solitary, compressed-cylindrical, and elongate (often curved). Asexual reproduction by transverse division predominates. Anthocaulus unknown. Calicular margin smooth. Rows of thecal spots occur in every interseptal space, but appear to flank tertiary septa. Columella a fusion of the primary septa; pali absent.

TYPE SPECIES: *Truncatoguynia irregularis* Cairns, 1989a, by original designation.

REMARKS: Only one of the other nine guyniid genera has a truncate base resulting from transverse divison, i.e., *Temnotrochus,* distinguished by having a papillose columella, P1-2, and three size classes of septa. *Truncatoguynia* is monotypic.

Truncatoguynia irregularis Cairns, 1989
(Plates 29,g,h,30,a,b)

Truncatoguynia irregularis Cairns, 1989a: 43, pl. 22, figs f-g, pl. 23, figs a-c, f; 1994: 70, pl. 30, figs e-f.
Truncatoguynia sp. Cairns 1989a: 43, pl. 23, figs d-e.

MATERIAL EXAMINED: New Records: NZOI Stn C531, 10, USNM 81893; Stn K825, 1 NZOI; Stn P17, 1,

94272; BS438, 3, MoNZ CO256; BS891 (O637), 1, MoNZ CO292. Previous Records: Types.

DISTRIBUTION: New Zealand region: southern Norfolk Ridge; Kermadec Ridge (off Raoul Island) (Map 12): 133–248 m. Elsewhere: northern Ryu-kyu Islands; north of Pratas Islands, South China Sea; 80–161 m.

DESCRIPTION: Corallum an elongate, compressed (GCD: LCD = 1.4–1.5) cylinder up to 39 mm in length (BS434), longer coralla gently curved in plane of GCD. Multiple regenerations common in elongate specimens, the longest having a H: GCD = 7.7. Specimen with largest calice (BS434) 5.8 x 4.2 mm in diameter and 32.9 mm long. Coralla in the 3.2 mm GCD size range are also common. Rounded thecal edges and faces are virtually parallel, resulting in a calice equal in size to its truncate base. Rows of white thecal spots (about 0.1 mm in diameter) occur in every interseptal space, but appear to be paired across each tertiary septum. Theca light brown but lined with rows of white spots and longitudinally divided by very thin, shallow striae corresponding to each S1–2 or primary septa. Fine (25–50 μm wide), closely spaced transverse epithecal ridges cover the theca (Plate 30, a).

Septa irregularly arranged, but the most common formula is S1–2>S3 (24 septa), which is characteristic of most small coralla. Based on 50 well-preserved specimens, 21 have 24 septa (12:12), 2 have 26 septa (13:13), 13 have 28 septa (14:14); 10 have 30 septa (15:15); and 4 have 32 septa (16:16). The odd number of primary septa (i.e., 13 and 15) is caused by an asymmetry in the calicular ellipse, in which one side of the corallum is slightly larger than the other and thus accommodates an additional sector of septa. Primary septa (S1–2 of coralla having 24 septa) thick (about 0.1 mm) and sinuous, with highly spinose septal faces, the blunt spines up to 0.13 mm in height. Secondary septa (S3 of coralla having 24 septa) much smaller (0.05 mm in thickness), and rudimentary in width, with irregular, straight, dentate inner edges. Fossa of moderate depth, containing an elongate, rudimentary columella to which the lower, inner edges of the S1–2 are fused.

TYPES: The holotype (81890) and 10 paratypes are deposited at the USNM. One paratype is also deposited at the AMS.

TYPE LOCALITY: *Albatross* Stn 5311, 21°33′ N, 116°15 ′E (north of Pratas Island, S. China Sea), 161 m.

REMARKS: When I first described this species and genus, I referred to a second undescribed species from the Kermadec Islands (NZOI Stn C531) that had hexameral symmetry, a smaller calice, and a longer corallum. Having now examined over 100 specimens from six stations in the New Zealand region, I now consider the specimens from NZOI C531 to represent a population of *T. irregularis* that has small calices and thus only 24 septa. The 84 specimens from BS434 show that this species ranges from 3.2–5.8 mm in GCD and 24–32 septa/calice, the septal number depending on the size and shape of the calice. The corallum length seems to be simply a function of age and/or recency of transverse division.

Stenocyathus Pourtalès, 1871

Corallum solitary, cylindrical to ceratoid, and usually attached. Transverse division absent. Base and pedicel reinforced with a solid granular coenosteum. Calicular margin smooth. Rows of thecal spots, pores, or depressions occur in every interseptal space. Three cycles of septa; pali before S2; columella one twisted lath.

TYPE SPECIES: *Coenocyathus vermiformis* Pourtalès, 1868, by monotypy.

REMARKS: Only one widespread recent species is known in this genus: *S. vermiformis;* however, two fossil species are reported from the Paleocene and Eocene of Alabama and Tonga, respectively (Cairns 1979). *Stenocyathus* is distinguished from other guyniid genera by having a fascicular columella and P2.

Stenocyathus vermiformis (Pourtalès, 1868) (Plate 30, c–g)

Coenocyathus vermiformis Pourtalès, 1868: 133–134.

Stenocyathus vermiformis: Cairns 1979: 168–170, pl. 32, figs 8–10, pl. 33, figs 1–2 (synonymy); 1982: 52, pl. 16, figs 8–11 (synonymy); Cairns & Parker 1992: 42, pl. 14, figs b-c; Cairns & Keller 1993: 273, pl. 12, figs E–F.

Stenocyathus decamera Ralph & Squires, 1962: 11–12 (in part: pl. 4, figs 2–5; not specimen from Mayor Island); Squires & Keyes 1967: 28, pl. 6, figs 3–5; Squires 1969: 17, pl. 6, map 2; Dawson 1979: 30.

MATERIAL EXAMINED: New Records: NZOI Stn A910, 1, USNM 94264; Stn C510, 1, NZOI; Stn D149, 1, NZOI; Stn D166, 1, USNM 94265; Stn E291, 1, NZOI; Stn E855, 1, NZOI; Stn G941, 1, NZOI; Stn J659, 3, USNM 94266; Stn J711, 1, NZOI; Stn J716, 3, NZOI; Stn K527, 1, NZOI; Stn K795, 1, NZOI; Stn K800, 1, NZOI; Stn K830, 2, NZOI; Stn K840, 1, NZOI; Stn K858, 1, NZOI; Stn S572, 1, USNM 94368; Stn T256, 1, NZOI; Stn U599, 1, NZOI; *Matai*, 2, MoNZ CO89; *Tui* Stn AU2/53, 9, MoNZ CO249 and 250; BS441, 1, MoNZ CO258; Malaspina Beach, Doubtful Sound, 20–30 m, 1, USNM 94267. Previous Records: Types of *C. vermiformis* and *S. decamera;* specimens reported by Ralph and Squires (1962) and Squires and Keyes (1967).

DISTRIBUTION: New Zealand: widespread in the region, from Kermadec Islands to Macquarie Ridge (Map 2); 30–805 m, the shallowest record of 30 m from off Fiordland. Elsewhere: quite widespread in all oceans, except for eastern Pacific; 80–1229 m.

DESCRIPTION: Corallum cylindrical and elongate, straight or irregularly bent, the largest New Zealand specimen (NZOI Stn D175) 13 mm long and 5 mm in calicular diameter. Smaller coralla 2.5–3.5 mm in calicular diameter also common. Corallum usually firmly attached to a rock or dead coral skeleton, the latter including coralla of *Madrepora, Balanophyllia, Gardineria, Goniocorella,* and *Desmophyllum.* Base and lower 1–3 mm of pedicel often reinforced with solid, coarsely granular (granules about 0.1 mm in diameter) stereome that envelopes all or part of the base and continues to spread over the substratum up to 8 mm in diameter. Upper edges of the granular stereome often divided into narrow fingers about 0.3–0.4 mm wide (Plate 30, c). Theca distal to granular pedicel smooth and porcellanous, usually bearing 24 longitudinal rows of circular white spots 0.30–0.35 mm in diameter. Thecal spots eventually become external depressions and ultimately thecal pores as the coral gets older and dies.

Septa hexamerally arranged in 3 complete cycles (however, *see* Remarks) according to the formula: S1>S2>S3. S1 nonexsert, quite thick (0.13–0.16 mm), and have very sinuous inner edges. S2 about three-quarters width of an S1 and also have quite sinuous inner edges. S3 usually slightly wider than S2 but thinner and less sinuous. A crown of 6 massive, sinuous pali occurs before the S2, surrounding a single, tightly twisted fascicular columellar element.

TYPES: Thirty-eight syntypes of *C. vermiformis* are deposited at the MCZ (*see* Cairns 1979). The holotype of *S. decamera* and two specimens labelled as paratypes are deposited at the NZGS (CO1380 and 1381–2, respectively). Ralph and Squires (1962) mentioned at least 3 more nontype specimens from two other localities in their original account.

TYPE LOCALITIES: *C. vermiformis*: off Florida Keys, 110–1229 m. *S. decamera*: off Shelter Island, Doubtful Sound, Westland, New Zealand, 134 m.

REMARKS: The holotype and large paratype of *S. decamera*, as well as another specimen more recently collected from Doubtful Sound (USNM 94267) all have decameral symmetry: 10:10:20 (40 septa, 10 pali), although the calice of the holotype is now too damaged to determine its palar structure. The smaller paratype has hexameral symmetry and the nontype specimen from off Mayor Island is *Pedicellocyathus keyesi.* With only these three exceptions, all subsequently collected specimens of *Stenocyathus* from off New Zealand (approximately 67 specimens from 30 stations) are hexamerally symmetrical: 6:6:12 (24 septa, 6 pali). The three specimens from Doubtful Sound are therefore believed to represent a variation of the typical species, differing in having decameral symmetry and an unusually shallow depth range (30–134 m).

Temnotrochus n. gen.

Corallum solitary, compressed-cylindrical, and elongate. Asexual reproduction by transverse division predominates; anthocaulus unknown. Calicular margin smooth, expressed as a thin rim that extends beyond upper outer septal edges. Rows of thecal spots occur in every interseptal space. Columella papillose; paliform lobes before S1–2.

TYPE SPECIES: *Temnotrochus kermadecensis*, here designated.

ETYMOLOGY: The genus name *Temnotrochus* (Greek, *temno*, sever, cut + *trochos*, common suffix for coral generic names, literally meaning anything round) refers to the transverse division method of asexual reproduction. Gender masculine.

REMARKS: The generic placement of *Temnotrochus*

in Guyniidae is tentative, as only two of the eight specimens examined show evidence of thecal spots that are characteristic of that family. Within the Guyniidae, *Temnotrochus* is most similar to *Cyathosmilia* Tenison-Woods, 1878c, known only from the Eocene to Oligocene of South Australia. Of the ten known guyniid genera (Cairns 1989a: Table 3), these are the only two that have paliform lobes before the first two septal cycles. *Temnotrochus* is distinguished from the fossil genus by having transverse division, a papillose columella, and in lacking costae. Its possession of P1–2 also distinguishes it from flabellid genera only one flabellid genus *(Falcatoflabellum)* is known to have P2.

Temnotrochus kermadecensis n. sp.
(Plate 31, a-d)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Known only from off Raoul Island, Kermadecs; 366–402 m.

Description: Corallum quite small, with a straight corallum, and an elliptical calice (GCD: LCD = 1.32–1.40). Holotype only 1.78 x 1.35 mm in calicular diameter and 3.06 mm in length; largest specimen 4.22 mm long. Corallum rejuvenescence or incomplete transverse division not observed. Basal scar convex to V-shaped in profile, and equal in size to distal calice. Calice smooth (not serrate), rising about 0.3 mm above the upper outer septal edges, producing a delicate calicular rim. Epitheca porcellanous and relatively smooth, but bearing numerous very fine (10–20 µm wide), closely spaced growth ridges. Theca white and translucent near calicular edge. In two specimens small (20–30 µm in diameter), white thecal spots, slightly more opaque than surrounding theca, occur in rows in every interseptal space, seemingly paired across each S3. Spots also evidenced inside calice as small depressions of the same size (Plate 31, c).

Septa hexamerally arranged in 3 complete cycles (S1>S2–3, 24 septa) in all specimens examined. Although the upper, outer edges of the S1 do not reach the top of the calicular margin, their upper margins form exsert lobes that rise as much as 0.4 mm above the calicular rim. Inner edges of S1 quite sinuous. S2 about three-quarters width of an S1 and also have sinuous inner edges. S2 equal to width of an S2, but, because thay are less sinuous, appear to be much thinner. Inner edges of all 6 S2 and the 4 lateral S1 (excluding the principal S1) bear tall, slender, highly sinuous paliform lobes in one elliptical crown of 10 elements. In only 1 specimen does a rudimentary P1 occur before a principal S1. P2 0.20-0.25 mm wide, whereas P1 only about 0.11 mm wide and not quite as tall. Within the palar crown lies a papillose columella composed of 1–3 linearly arranged pillars similar in size and shape to the P1. Fossa shallow.

TYPES: Holotype: BS441, MoNZ. Paratypes: BS441, 3, MoNZ, 4, USNM 94287.

TYPE LOCALITY: 3.7 km off Nugent Island, Raoul Island, Kermadec Ridge; 366–402 m.

REMARKS: *Temnotrochus kermadecensis* is similar to *Idiotrochus kikutii* (Yabe & Eguchi, 1941a), a western Pacific species known from 143–645 m (Cairns 1989a). Both species have very similar calices, containing 24 septa of the same relative sizes, and 10 pali (2 usually absent from the principal S1). Furthermore, both species reproduce by transverse division and the theca of *I. kikutii* is often porcellanous, like that or a flabellid. But *I. kikutii* differs fundamentally in having faint costae, which alternate in position with its septa, and does not have thecal spots or pores.

Family FLABELLIDAE Bourne, 1905

Flabellum Lesson, 1831

Corallum solitary, fixed or free. Corallum ceratoid, campanulate, or highly compressed; base not reinforced with stereome. Wall epithecate, usually lacking costae but invariably bearing fine, chevron-shaped growth ridges that peak at major septa. Transverse division absent. Pali, dissepiments, and synapticulae absent. Columella rudimentary, consisting of a fusion of lower, inner edges of lower cycle septa.

Key to the Eight Species of *Flabellum* known from the New Zealand Region

1 Calice elliptical to strongly compressed (GCD:LCD > 1.4) 2
Calice slightly elliptical to circular (GCD: LCD < 1.3) ..... *F. impensum*

2 Thecal faces meet in a sharp edge that bears a crest 3
Thecal edges rounded and lack crests 6

3 Corallum highly compressed (GCD: LCD usually > 1.7); edge angle usually > 130°; thecal faces slightly concave (corallum constricted) 4
Corallum less compressed (GCD: LCD 1.4–1.7); edge angle usually < 130°; thecal faces slightly convex 5

4 Theca reddish-brown; edge angle 130–180°; tropical in distribution ..... *F. messum*
Theca white; edge angle usually >180°; temperate in distribution ..... *F. lowekeyesi*

5 Septa octamerally arranged in four size classes (e.g., large coralla have 16:16:32:64, = 128 septa); 16 primary costae ridged ..... *F. hoffmeisteri*
Septa hexamerally arranged in five complete cycles (96 septa); thecal faces smooth and porcellanous (not costate) ..... *F. aotearoa*

6 Corallum campanulate, GCD: LCD = 1.4-1.7; C1 and often C2 ridged; septa widely spaced; calicular margin lacerate ..... *F. apertum*
Corallum highly compressed, GCD: LCD > 2; thecal faces flat; septa more closely spaced; intact calicular margin smooth 7

7 Pedicel diameter 1.1–1.3 mm; corallum robust; columella rudimentary ..... *F. angiostomum*
Pedicel diameter 2.6–3.3 mm; corallum quite fragile; columella often well developed ..... *F. knoxi*

Flabellum (Flabellum) Lesson, 1831

Flabellum having a smooth and continuous (not jagged or lacerate) calicular edge.

TYPE SPECIES: *Flabellum pavoninum* Lesson, 1831, by monotypy.

REMARKS: Approximately 28 recent species are known in the nominate subgenus, half of which occur in the Indo-West Pacific (*see* Cairns 1989a), including three in the New Zealand region. Whereas one of these species, *F. knoxi*, is quite common and in fact characteristic of the southern New Zealand region, the other two species are rarely collected. *Flabellum impensum* is more characteristic of the Antarctic region and *F. angiostomum* is reported for the first time since its original description from off northwest Australia.

Flabellum (F.) knoxi Ralph & Squires, 1962
(Plates 31, e–g, 32, a)

Flabellum knoxi Ralph & Squires, 1962: 14-15, pl. 7, figs 1–2; Squires 1964a: 11–12, 19–20, pl. 1, figs 4–6, pl. 2, fig. 7, pl. 3, figs 3–5, pl. 4, figs 1–4; 1969: 18, pl. 6, map 4; Squires & Keyes 1967: 26–27, pl. 5, figs 1–2; Cairns 1982: 42–44, pl. 13, figs 4–7; 1989a: 46; Seilacher 1991: fig. 6.

MATERIAL EXAMINED: New Records: NZOI Stn D87, 4, NZOI; Stn D904, 2, NZOI; Stn E74, 27, NZOI; Stn E75, 3, NZOI; Stn E79, 2, NZOI; Stn E121, 4, NZOI; Stn E123, 2, NZOI; Stn E148, 1, NZOI; Stn E405, 2, NZOI; Stn E410, 1, NZOI; Stn E413, 1, NZOI; Stn E421, 5, NZOI; Stn E422, 4, NZOI; Stn E423, 5, NZOI; Stn E424, 60, NZOI; Stn E428, 3, NZOI; Stn E434, 1, NZOI; Stn E436, 1, NZOI; Stn E713, 5, NZOI; Stn E717, 1, NZOI; Stn E719, 11, NZOI; Stn F90, 1, NZOI; Stn F110, 3, NZOI; Stn F136, 1, NZOI; Stn F144, 1, NZOI; Stn F147, 10, NZOI; Stn F750, 1, NZOI; Stn F753, 1, NZOI; Stn G33, 5, NZOI; Stn G38, 1, NZOI; Stn G177, 1, NZOI; Stn G184, 3, NZOI; Stn G198, 1, NZOI; Stn G223, 1, NZOI; Stn G233, 1, NZOI; Stn G240, 1, NZOI; Stn G244, 1, NZOI; Stn G245, 1, NZOI; Stn G254, 2, NZOI; Stn G255, 1, NZOI; Stn G258, 1, NZOI; Stn G259, 2, NZOI; Stn G262, 1, NZOI; Stn G273, 1, NZOI; Stn G276, 1, NZOI; Stn G278, 1, NZOI; Stn G279, 10, NZOI; Stn G291, 2, NZOI; Stn G292, 19, NZOI; Stn G293, 1, USNM 94331; Stn G329, 1, NZOI; Stn G371, 2, NZOI; Stn G398, 1, NZOI; Stn G651, 6, NZOI; Stn G667, 1, NZOI; Stn G688, 1, NZOI; Stn G697, 4, USNM 94332; Stn G937, 9, USNM 94333, Stn G938, 2, NZOI; Stn H939, 2, NZOI; Stn H942, 1, NZOI; Stn H945, 2, NZOI; Stn H955, 1, NZOI; Stn I669, 2, NZOI; Stn I689, 10, NZOI; Stn I698, 1, NZOI; Stn I703, NZOI; Stn I707, 1, NZOI; Stn I716, 1, USNM 94334; Stn J485, 2, NZOI; Stn Q1, 1, NZOI; Stn Q6, 2, NZOI; Stn Q7, 2, NZOI; Stn Q8, 4, NZOI; Stn Q16, 1, NZOI; Stn Q19, 2, NZOI; Stn Q338, 4, NZOI; Stn Q341, 1, NZOI; Stn S22, 1, NZOI; Stn S27, 5, NZOI; Stn S29, 1, NZOI; Stn S42, 3, NZOI; Stn S48, 2, NZOI; Stn S52, 8, NZOI; Stn S142, 1, NZOI; Stn S148, 1, USNM 94335; Stn S157, 2, NZOI; Stn S159, 5, NZOI; Stn S160, 7, NZOI; Stn S168, 50, NZOI; Stn S173, 10, NZOI; Stn S174, 1, NZOI; Stn T38, 3, NZOI; Stn T48, 5, NZOI; Stn T88, 10, NZOI; Stn V386, 3, NZOI; Stn V387, 15, NZOI; Stn V388, 15, NZOI; Stn Z3909, 1,

NZOI; BS654 (R12), 1, MoNZ CO167; BS665 (R23), 1, MoNZ CO148; J9/15/77, 2, MoNZ; J17/2/84, 1, MoNZ CO177; JC10/57/71, 2, MoNZ; JC11/2/71, 2, MoNZ; *Azuchi Maru* Stn 96, 1, MoNZ; MU74/94, 3, Portobello Marine Lab.

PREVIOUS RECORDS: 2 paratypes of *F. knoxi*, MoNZ; specimen reported by Squires (1964a), and Squires and Keyes (1967).

DISTRIBUTION: Endemic to New Zealand region, but commonest on the Chatham Rise and Bounty and Campbell Plateaus (Map 5); 160–1167 m, but most commonly collected between 400–700 m.

DESCRIPTION: Corallum compressed (GCD: LCD = 2.0–4.5), never constricted, and light weight: theca and septa thin and quite fragile. Corallum wider than tall: GCD: H = 1.1–1.5. Angle of thecal edges bimodal, the lower edges (younger coralla) diverging at 60–70°, but increasing to 135–180° in larger coralla. Some coralla that appear to have been living in the prone position have lateral edges that virtually meet, forming an incomplete heart-shaped cavity below the pedicel (Plate 31, e). Although thecal edges are usually rounded, in some larger coralla the edges are slightly ridged, but never carinate. Inclination of lateral faces variable, ranging from 29° to 48°. Largest specimen examined (NZOI Stn D904) 128 x 54 mm in calicular diameter and 66 mm in height. Pedicel circular, 2.6–3.3 mm in diameter, the basal plate containing the 12 protosepta. Septa at calicular margin invariably broken, caused by dredging of such fragile coralla; however, in the rare case of an intact corallum, the calicular edge is perfectly smooth. Thecal faces virtually flat and somewhat coarse, a very narrow stria corresponding to each septum. Theca between lines covered with very fine transverse rugae (up to 12/mm) in a chevron-shaped arrangement, the apex of each row of chevrons peaking at the C1–5. Theca uniformly reddish-brown, entirely white, or white with narrow reddish-brown stripes corresponding to each septum.

Septa hexamerally arranged in 6 to 7 cycles. Four cycles (48 septa) attained at a GCD of about 14 mm; fifth cycle (96 septa) attained at about 21 mm; sixth cycle (192 septa) at about 37 mm; and as many as 400 septa (S7+) may be present in larger specimens. S1–4 (S1–5 of larger coralla) quite wide, sometimes fusing with the corresponding septa from the opposite face in centre of calice or even intercalating with those of the opposite face. S1–4 and S5 have quite slender, concave upper edges (SCI about 13). Inner edges of S1–4 vertical, the lower edges being extremely sinuous (SSI = 3.7–9.2) and contributing to a well-developed columella. S5 half to three-quarters width of an S1–4 (S5 same width as S1–4 in larger coralla) and also with sinuous inner edges. S6 rudimentary, only about one-fifth width of an S5, with straight inner edges. Septal faces somewhat corrugated and bear low, sparse granules. Fossa quite narrow and elongate, containing a well-developed trabecular columella about 2 mm wide consisting of a fusion of the sinuous lower inner edges of the S1–5. Columella so robust that it often remains intact after the remaining corallum has deteriorated (Plate 32, a).

TYPES: Ten specimens from three stations were reported in the original description, one designated as the holotype, the other nine herein considered to be paratypes. The holotype and most paratypes are presumed to be deposited at the Canterbury Museum; however, two paratypes from Stn 52 are deposited at MoNZ.

TYPE LOCALITY: Ralph and Squires (1962) did not specify which of the three Chatham Island stations yielded the holotype. Chatham Rise, 402–512 m.

REMARKS: Within the subgenus, *F. knoxi* is most similar to *F. magnificum* Marenzeller, 1904a, a western Pacific species known from 291–700 m (*see* Cairns 1989a). Both species have large coralla, often seven complete cycles of septa, a striped theca, and similarly shaped septa. *Flabellum knoxi* differs in having rounded lateral edges (not crested as in *F. magnificum*), a slightly larger pedicel, a less open corallum (face angle 29–48° vs 44–58° for *F. magnificum*), and a better-developed columella. *Flabellum knoxi* differs from another similarly-shaped species, *F. lamellulosum* Alcock, 1902a (western Pacific, 198–402 m), by lacking thecal edge crests, having a larger pedicel, and having a greater SSI.

Among the New Zealand fossil corals, *F. knoxi* is most similar to *F. laticostatum* Tenison-Woods, 1880, from the late Oligocene of Canterbury, this species reported as *F. pavoninum distinctum* by Squires (1958); *F. knoxi* appears to differ in having a larger face angle and in having rounded thecal edges.

Squires (1964a) should be consulted for an ecological analysis of the growth position of this species and an explanation for why certain coralla have recurved and/or reflexed coralla.

Flabellum (F.) angiostomum Folkeson, 1919
(Plate 32, d, f)

Flabellum angiostomum Folkeson, 1919: 5, pl. 1, figs 1–3; Cairns 1989a: 46.

MATERIAL EXAMINED: New Records: NZOI Stn I92, 9, USNM 94322; Stn I97, 15, NZOI, 20, USNM 94323; Stn U599, 1, NZOI.

DISTRIBUTION: New Zealand region: southern Norfolk Ridge; Three Kings Ridge (Map 13); 540–640 m. Elsewhere: off Cape Jaubert, near Dampierland, Western Australia; ?22 m.

DESCRIPTION: Corallum highly compressed (GCD: LCD = 2.1–3.1), never constricted, and robust. Corallum significantly wider than tall: GCD: H = 1.25–1.45. Thecal edges always rounded, never ridged or crested, with a bimodal angle of divergence — edges of lower 7–9 mm of corallum diverging at a relatively low angle (i.e., 60–80°), but gradually increasing to 125–180° in larger coralla. Inclination of lateral faces 26–39°. Largest specimen examined (NZOI Stn I97) 49.8 x 20.5 mm in calicular diameter and 33.8 mm in height. Pedicel small and circular, intact bases only 1.1–1.3 mm in diameter with 6 protosepta. Thecal faces flat and smooth, with no evidence of costae other than very fine striae that correspond to each septum. Theca usually reddish-brown with slightly darker pigmented stripes corresponding to C1–4.

Septa primarily hexamerally arranged in 6 complete cycles (192 septa), this stage attained by coralla as small as 25 mm GCD. Larger coralla, especially those with a high edge angle and thus longer calice, have as many as 268 septa (e.g., the holotype). Additional septa above the sixth cycle stage (193–268 septa) are not added as a smaller size class of septa. Instead, an S5 is enlarged to the width of an S1–4, an adjacent S6 is enlarged to the width of an S5, and a pair of S7 form flanking the accelerated S6, each about the size of a normal S6. In this way three size classes of septa are maintained. Septal formula: S1–4>S5>S6>S7. S1–4 concave and finely dentate near calicular edge (SCI about 5) with broad, quite sinuous (SSI = 5–7) inner edges that reach the columella. S5 about three-quarters width of an S1-4; S6 only half width of an S5 and extend only half way down theca. Fossa deep, elongate, and quite narrow, containing a rudimentary (about 1 mm wide) trabecular columella consisting of the lower inner edges of the S1–4 and accelerated S5.

TYPES: HOLOTYPE: Swedish Natural History Museum, Stockholm.

TYPE LOCALITY: 72 km WSW off Cape Jaubert (Western Australia), 22 m.

REMARKS: Among the Indo-West Pacific species of *Flabellum (Flabellum)*, *F. angiostomum* is quite similar to *F. knoxi* (especially when compared to young specimens of *F. knoxi*), including corallum shape, septal number, and pigmentation. But *F. angiostomum* differs in having a much more robust corallum (thicker theca and septa), a much smaller pedicel diameter with fewer protosepta, a less well-developed columella, a slightly more compressed corallum (lower edge angle), and more septa at a smaller corresponding GCD. Also, *F. knoxi* is not known to occur north of 38°S, whereas *F. angiostomum* is not known to occur south of 33°S.

Flabellum angiostomum also bears resemblance to the southeast Australian *F. australe* Moseley, 1881, the latter appearing to differ in having straight, crested thecal edges and rough, corrugated thecal faces.

Flabellum (Flabellum) impensum Squires, 1962
(Plate 32, b, c)

Flabellum impensum Squires, 1962b: 14, 17–19, pl. 2, figs 4–7; ?1969: 18, pl. 6, map 3; Cairns 1982: 38–41, pl. 10, figs 8–9, pl. 11, fig. 10, pl. 12, figs 1–8 (synonymy).
?*Flabellum* sp. A Cairns 1994: 28–29, pl. 10, figs a-b.

MATERIAL EXAMINED: New Record: NZOI Stn I666, 1, NZOI. Previous Records: Holotype; specimens reported by Cairns (1982, 1994).

DISTRIBUTION: New Zealand region: Bounty Plateau east of Bounty Island and southwest of the Antipodes Islands; ?Hjort Seamount (Squires 1969); 1165–2100 m. Elsewhere: circumpolar off continental Antarctica; ?off Aleutian Islands (Cairns 1994); 46–2260 m.

DIAGNOSIS OF SPECIMENS FROM *ELTANIN* STN 2143 (ANTIPODES ISLANDS): Corallum ceratoid; calice elliptical, GCD: LCD = 1.15–1.30. Largest corallum 27.7 x 24.0 mm in calicular diameter and 43.5 mm in height. Pedicel large, 2.1–3.7 mm in diameter.

Theca smooth and worn, each costa bordered by a very thin (about 20 μm) shallow, longitudinal stria, which delimit broad, flat costae. Corallum white. Septa hexamerally arranged in 5 cycles: S1–3>S4>S5. Septa not exsert, upper edges of septa quite narrow (about 0.5 mm) and finely dentate for upper 5 mm adjacent to calice, which results in a high SCI of 11–13. Lower in fossa the inner edges of each S1–2 gracefully arch into a broad septum having thickened, but not sinuous, vertical inner edges that fuse into a columella deep within the fossa. S3 half to three-quarters width of an S1–2; S4 one-third to half width of an S3; S5 rudimentary. Fossa deep, containing a rudimentary columella.

TYPES: The holotype is deposited at the NZOI (H3), but has been fractured subsequent to its original description.

TYPE LOCALITY: NZOI Stn A464, 73°20′ S, 174°00′ E (Ross Sea), 369–384 m.

REMARKS: The specimens from the Bounty Plateau represent one of the morphological extremes of the species, i.e., a form having a ceratoid corallum with a very low GCD: LCD. They also represent the northernmost range of a species otherwise known only from off continental Antarctica. Squires (1969) plotted a distributional record of *F. impensum* in the vicinity of Hjort Seamount, but this record was undocumented and no such specimen can be found in the collections of the NZOI or USNM. Squires' records of *F. impensum* from off South America are a mixture of *F. curvatum* and *F. impensum* (*see* Cairns 1982). I (Cairns 1994) reported several specimens very similar to ceratoid *F. impensum* from off the Aleutian Islands, which, if conspecific, would result in a bipolar distribution.

Flabellum (Ulocyathus) M. Sars, 1851

Flabellum having a jagged or lacerate calicular edge.

TYPE SPECIES: *Ulocyathus arcticus* M. Sars, 1851 (= *Flabellum macandrewi* Gray, 1849), by monotypy.

REMARKS: Jagged or serrate calicular edges result from the growth of small triangular thecal apices corresponding to the lower cycle septa (i.e., S1–3, 4). Lacerate calicular edges result from more prominent, apically pointed rectangular or triangular thecal projections that correspond to each lower cycle septum and the pair of higher cycle that flank them. These tall projections are herein termed "lancets".

Approximately 17 recent species are known in this subgenus (Cairns 1989a), 13 of which occur in the Indo-West Pacific, including five in the New Zealand region. Cairns (1989a) divided the subgenus into three groups of species based on their corallum shape: constricted, compressed, and campanulate. Two New Zealand species have constricted coralla (*F. lowekeyesi* and *F. messum*), two have laterally compressed coralla (*F. aotearoa* and *F. hoffmeisteri*), and one has a campanulate corallum (*F. apertum*). *Flabellum lowekeyesi*, *F. aotearoa*, and *F. apertum* are all common in the New Zealand region, the first two known only from this region, whereas *F. messum* and *F. hoffmeisteri* are rarely collected in the New Zealand region and known only from the northern ridges.

Flabellum (U.) lowekeyesi Squires & Ralph, 1965 (Plate 32, g-i)

Flabellum lowekeyesi Squires & Ralph, 1965: 259–261, figs 1–2; Squires & Keyes 1967: 27, pl. 6, figs 1–2; Cairns 1989a: 54; Cairns & Keller 1993: 262, pl. 10, figs D–E.

MATERIAL EXAMINED: New Records: NZOI Stn D136, 1, NZOI; Stn D224, 5, NZOI; Stn D225, 3, NZOI; Stn D226, 3, NZOI; Stn D227, 4, USNM 94314; Stn D228, 1, NZOI; Stn D230, 1, NZOI; Stn D231, 4, NZOI; Stn D235, 1, NZOI; Stn D244, 1, NZOI; Stn E121, 1, USNM 94315; Stn E772, 2, NZOI; Stn E825, 1, NZOI; Stn E826, 1, NZOI; Stn E873, 1, NZOI; Stn E879, 4, NZOI; Stn E880, 4, NZOI; Stn E884, 7, NZOI; Stn E889, 1, NZOI; Stn E890, 1, NZOI; Stn E894, 3, NZOI; Stn E899, 3, NZOI; Stn E902, 1, NZOI; Stn F100, 2, NZOI; Stn F135, 1, NZOI; Stn F144, 2, NZOI; Stn F872, 1, NZOI; Stn F877, 1, NZOI; Stn F909, 4, NZOI; Stn F913, 2, NZOI; Stn G817, 1, NZOI; Stn G818, 2, NZOI; Stn G819, 1, NZOI; Stn G820, 2, USNM 94317; Stn G822, 1, NZOI; Stn G825, 1, NZOI; Stn G893, 2, NZOI; Stn I25, 1, NZOI; Stn I34, 1, NZOI; Stn I352, 10, NZOI; Stn I353, 1, NZOI; Stn I366, 3, NZOI; Stn I664, 9, NZOI; Stn I667, 2, NZOI; Stn I686, 5, USNM 94318; Stn I699, 3, NZOI; Stn I702, 4, USNM 94319; Stn I704, 2, NZOI; Stn I715, 50, NZOI, 24, USNM 94320; Stn P120, 1, NZOI; Stn P942, 1, NZOI; Stn Q84, 8, NZOI; Stn S43, 1, NZOI; Stn S72, 1, NZOI; Stn T32, 30, NZOI; Stn Z3911, 1, NZOI; BS302, 1, MoNZ CO 90; BS707 (R65), 2, MoNZ; BS762 (R120), 5, MoNZ CO147;

BS806 (O550), 1, MoNZ; BS830 O575), 2, MoNZ; BS844 (O590), 1, MoNZ CO218; BS846 (O592), 1, MoNZ; JC19/9/84, 1, MoNZ; JC19/19/84, 2, MoNZ; FV *Cordilla*, 1, MoNZ; *Eltanin* Stn 1850, 14, USNM 82929; *Eltanin* Stn 1983, 6, USNM 94321; FV *Belinda*, 1, SAM H12598. Previous Records: Types and nontypes of Ralph and Squires (1965).

DISTRIBUTION: New Zealand region: widespread in region from Lord Howe Rise to the Endeavour Rise (Map 1); 381–1064 m, but most records between 600 to 900 m. Elsewhere: southwest Indian Ocean; off Tasmania (reported herein); 835–1050 m.

DESCRIPTION: Corallum compressed (GCD: LCD = 1.2–1.7–2.8), the lateral thecal faces being slightly concave medially resulting in an elongate but constricted or "pinched" calicular outline. Coralla extremely fragile, it being very unusual to obtain a specimen even with a partially intact calicular edge by conventional dredging techniques. Calicular edge deeply lacerate, each S1–2 producing a prominent triangular lancet, which includes itself and 2 or 3 septa to either side, each lancet separated by deep calicular notches. The most deeply incised notches separate the 2 principal S1 from the adjacent lateral face septa, this notch being as deep as 12 mm, effectively isolating the 2 principal septa and their adjacent 2 or 3 septa from the next half-system. Angle of straight thecal edges 180–240°; inclination of lateral faces (at point of constriction) 27–37°. Corallum approximately as tall as wide (GCD: H = 0.95–1.10–1.30). Lateral edges bear a prominent crest for entire length, their distal edges wrapping around the calice and continuous with the principal S1. Crests up to 4.7 mm high (gradually increasing toward calice), 0.15–0.20 mm wide, and often quite sinuous. Lateral edges quite short, the LEL: H ratio only 0.26–0.45. Largest specimen examined (NZOI Stn 134) 76 x 45 mm in calicular diameter and 59.5 mm in height. Pedicel elliptical, 2.2–2.5 x 1.7–1.9 mm in diameter; all coralla examined were unattached. Thecal faces bear the characteristic fine chevron-shaped growth ridges between intercostal striae, the theca also bearing a very fine granulation. All coralla examined white, some specimens having a light reddish-brown colour to the columella and lower, inner edges of the S1–3 adjacent to the columella.

Septa hexamerally arranged in 6 complete cycles (192 septa) according to the formula: S1–3>S4>S5>S6. Fourth cycle (48 septa) attained at a GCD of about 14 mm; fifth cycle at about 39 mm GCD; and only larger coralla of over 45 mm GCD having a full sixth cycle. S1–3 have straight, thickened inner edges that fuse with the columella low in fossa. S4 about three-quarters width of an S1–3, with straight but not thickened inner edges that reach the columella only quite low in fossa. Lower inner edges of S4 often fuse to those of S1–3. S5 about one-third width of an S4 and extend only about half distance down the theca. S6 rudimentary, extending only 10–15 mm down the theca, and have irregular inner edges. Septal faces covered by very fine granules. Fossa deep, containing a crescent-shaped trabecular columella about 2 mm wide, its curved shape following the underlying curvature of the corallum.

Polyps quite fleshy and cream-coloured with light-yellow tentacles (Squires & Keyes 1967).

TYPES: The holotype is deposited at the MoNZ (CO185). A paratype is also deposited at the USNM (45601).

TYPE LOCALITY: Marine Department prawn trawl 29, 42 km off Cape Brett, New Zealand, 732 m.

REMARKS: Among the 22 species known in the subgenus *Flabellum (Ulocyathus)* (*see* Cairns 1989a), four have constricted coralla: *F. alabastrum* Moseley, 1876; *F. messum* Alcock, 1902c; *F. lowekeyesi* Squires & Ralph, 1965; and *F. marcus* Keller, 1974. *Flabellum lowekeyesi* is compared to the very similar *F. messum* in the following account of that species. It differs from *F. alabastrum* (known only from the Atlantic Ocean) in having a much taller corallum (GCD: H = 0.95–1.3 vs about 1.5 for *F. alabastrum*) and in having much shorter, crested lateral edges (LEL: H = 0.26–0.45 vs about 0.9 for *F. alabastrum*, which also lacks crests). *Flabellum lowekeyesi* differs from *F. marcus* (central Pacific) in having six (not four) cycles of septa and in having a white (not brown) corallum.

Flabellum (U.) messum Alcock, 1902

(Plate 33, a-c)

Flabellum laciniatum var. *messum* Alcock, 1902c: 31.
Flabellum (U.) messum: Cairns 1989a: 58–59, pl. 30, figs. f-i, k (synonymy); Cairns & Keller 1993: 263, pl. 10, figs G–H.

MATERIAL EXAMINED: New Records: NZOI Stn T226, 8, USNM 94325; Stn T243, 1, NZOI. Previous Record: 1 syntype of *F. laciniatum messum.*

DISTRIBUTION: New Zealand region: Kermadec Ridge from off Macauley Island to north of Raoul Island (Map 22); 800–1035 m. Elsewhere: Indonesia, Philippines, Mascarene Plateau; 368–949 m.

DIAGNOSIS: Corallum compressed and constricted medially. Angle of straight, crested thecal edges 130–180°; inclination of concave lateral faces 36–44°. Largest New Zealand specimen (NZOI Stn T226) 45.1 x 22.7 mm in calicular diameter and 39 mm in height. Calice deeply lacerate. Pedicel elliptical in cross section: 2.4 x 2.8 mm. Thecal faces bear fine chevron-shaped growth ridges, but also a coarse granulation, which gives the theca a rough texture. C1–3 usually slightly ridged. Entire corallum reddish-brown, except for theca corresponding to C1–3 and edge crests, which are white. Septa hexamerally arranged in 5 cycles according to the formula: S1–3>S4>S5, S5 being quite rare and only occasionally found in the largest coralla. Fossa deep and narrow, containing a crescent-shaped columella composed of the fusion of the lower inner edges of the S1–3.

TYPES: Five syntypes of *F. laciniatum* var. *messum* are deposited at the ZMA (1214) (Van Soest 1979).

TYPE LOCALITY: *Siboga* Stns 45, 284, 314, Indonesia, 694-828 m.

REMARKS: *Flabellum messum* is extremely similar to *F. lowekeyesi*, the two taxa being perhaps sister species or subspecies of one species. When closely compared, *F. messum* differs in having: reddish-brown, rough-textured theca; a smaller maximum corallum size and correspondingly fewer septa (i.e., few, if any, S6); a smaller edge angle (i.e., usually < 180°); and a slightly more robust corallum. Although found at the same depths, *F. messum* is known only from tropical regions, *F. lowekeyesi* from more southerly temperate regions.

Flabellum messum is more fully described by Cairns (1989a) and therefore is only diagnosed above.

Flabellum (U.) aotearoa Squires, 1964
(Plate 33, d-f, i)

Flabellum aotearoa Squires, 1964b: 7–9, pl. 2, figs 15–18; Squires & Keyes 1967: 26, pl. 4, figs. 2–3; Dawson 1979: 28-29; Cairns 1989a: 54, 58.
Flabellum sp. cf. *F. deludens*: Wells 1984:2 15, pl. 4, figs 8–10.

MATERIAL EXAMINED: New Records: NZOI Stn I76, 1, NZOI; Stn I735, 1, NZOI; Stn I745, 2, NZOI; Stn J699,. 4,NZOI; Stn J699, 4, USNM 94337; Stn J976, 1, NZOI; Stn P14, 33, USNM 49233 and 94336; Stn P27, 1, NZOI; Stn T214, 1, NZOI; BS441, 5, MoNZ CO316; BS723 (R81), 1, MoNZ; BS833 (O578), 1, MoNZ CO287; BS866 (O612), 1, MoNZ; BS878 (O624), 6, MoNZ CO225; BS881 (O627), MoNZ CO281. Previous Records: Types and nontypes of Squires (1964b); specimens reported by Wells (1984) as *F.* sp. cf. *F. deludens*, USNM 71859.

DISTRIBUTION: New Zealand region: Lord Howe Seamount Chain; Norfolk Ridge; Kermadec Ridge; off northeastern North Island from North Cape to East Cape (Map 16); 130–565 m. Elsewhere: off Chesterfield Islands; 1300 m (reported herein); Late Pleistocene of Vanuatu (Wells 1984).

DESCRIPTION: Corallum compressed (GCD: LCD = 1.40–1.75), having sharp, carinate thecal edges. Angle of thecal edges (exclusive of crests) 80–140°; inclination of thecal faces 38–43°, the higher range characteristic of larger specimens. Largest specimen examined (NZOI Stn P14) 31.7 x 22.7 mm in calicular diameter and 28.7 mm in height. Thecal edges bear thin (about 0.25 mm) crests up to 2.5 mm in height that are usually continuous from just above the pedicel to the calice, but are occasionally disrupted; crests straight and slightly sinuous. Pedicel small and elliptical: 1.8–2.1 x 0.9–1.3 mm in diameter, the longer axis always aligned with the GCD. Calicular margin moderately scalloped, the S1–2 and adjacent S5 forming a relatively low, triangular lancet 1.1–1.5 mm in height; smaller lancets about 0.7 mm in height correspond to the S3. Thecal faces only slightly convex. Theca quite smooth, covered by numerous very fine granules, producing a glistening and slippery texture. Well-preserved specimens display reddish-brown thecal stripes adjacent to every septum, the theca overlaying the septa being a transluscent white. Poorly-preserved specimens have a uniformly opaque white colour.

Septa hexamerally arranged in 5 cycles according to the formula: S1–2>S3>S4>>S5, specimens as small as 15 mm GCD having a full fifth cycle of 96 septa. Only one specimen is known to have more than 96 septa, the holotype, which has 5 pairs of S6 in its end half-systems, resulting in 104 septa. S1–2 slightly exsert, with highly sinuous inner edges that solidly fuse with the columella. S3 less exsert, about 0.8 as wide as an S1–2, and also have quite sinuous inner edges that reach the columella. S4 about half width of an S3 and have only moderately sinuous inner edges. S5 rudimentary, only one-fifth to one-quarter width of an S4, and have straight inner edges. Septal faces bear small granules that are aligned with trabeculae that radiate outward from the thecal wall. Fossa deep and narrow, containing an elongate, rudimentary columella composed of the lower, inner edges of the S1–3.

TYPES: The holotype from *Ikatere* Stn B26 is deposited at AIM. A paratype from *Ikatere* Stn B26 is also deposited at the USNM (68261), but the deposition of the paratype from *Ikatere* Stn B27 is unknown.

TYPE LOCALITY: 35°04′ S, 174°23.2′ E (northeast entrance to Bay of Islands, near Cape Brett), 184 m (corrected depth in Squires & Keyes 1967).

REMARKS: In his original description of *F. aotearoa*, Squires remarked that it was closely related to an undescribed species from the Philippines, which was probably *F. marenzelleri* Cairns, 1989a, the type series of which were available to him at that time. *Flabellum marenzelleri* is quite similar, but differs in having octamerally arranged septa; much higher, rectangular calicular lancets; a uniform thecal colouration; and a coarser thecal granulation. *Flabellum planus* Squires, 1962a, described from the Altonian (early Miocene) of the North Island, is also remarkably similar to *F. aotearoa*. Examination of the type specimens of *F. planus* (USNM and NZGS) and 20 topotypic specimens collected by the author (USNM) indicates that the only difference between the two species is that *F. planus* has few septa: having S5 adjacent to each S3 but invariably lacking S5 adjacent to the S2, which results in 62 septa.

Flabellum (U.) hoffmeisteri Cairns & Parker, 1992
(Plate 33, g, h)

Flabellum japonicum: Hoffmeister 1933: 7, pl. 1, figs 1–2; Cairns 1989a: 56, 57, pl. 29, figs j-k.
Flabellum (U.) hoffmeisteri Cairns & Parker, 1992: 47–48, pl. 16, figs d-f, map 18.

MATERIAL EXAMINED: New Records: NZOI Stn K804, 11, NZOI; Stn K828, 1, NZOI; Stn K829, 16, USNM 94324; Stn K830, 1, NZOI; Stn P947, 1, NZOI. Previous Records: Types.

DISTRIBUTION: New Zealand region: Kermadec Ridge off Raoul Island; northern Colville Ridge (Map 22); 440–646 m. Elsewhere: off Victoria and Tasmania; 110–660 m.

DESCRIPTION: Corallum robust and laterally compressed (GCD: LCD = 1.35–1.75), with evenly convex thecal faces. Angle of thecal edges 63–105°, the edges bearing a thin crest up to 3.0 mm in height and extending from the pedicel to several mm below calicular edge. Inclination of lateral faces 50–60°. Largest New Zealand specimen examined (NZOI Stn K829) 47.6 x 35.4 mm in calicular diameter and 37.4 mm in height, with a pedicel diameter of 2.5 mm. Calicular edge only moderately lacerate, a small triangular apex about 1.5 mm tall corresponding to each of the 16 primary septa and much smaller apices corresponding to the secondary and tertiary septa. Only the 2 principal costae are crested, the 14 lateral primary costae expressed as low, rounded ridges that radiate upward from the pedicel to the calicular edge apices associated with each primary septum. Theca constituting primary costae brownish-black.

Septa octamerally arranged in 4 size classes (16:16:32:32–64 = 96–128 septa), only the largest specimen (NZOI Stn K829) having a complete fourth size class, as well as 4 pairs of septa of a fifth size class, resulting in 136 septa. Most specimens, however, have a variable and incomplete fourth size class of septa, the quaternaries often occurring in pairs flanking the secondary septa (but not the primary septa), resulting in a calice with 96 septa. Sixteen primary septa quite broad, with thickened, sinuous inner edges. Secondary septa about three-quarters width of primaries and also quite sinuous, but do not reach the columella. Tertiaries about half width of secondaries and also with sinuous inner edges. Quaternaries rudimentary and usually quite short. Fossa deep and elongate, containing a rudimentary trabecular columella composed of the lower, inner edges of the primary septa.

TYPES: The holotype is deposited at the SAM (H642); paratypes are deposited at the USNM, NMV, and SAM.

TYPE LOCALITY: *Soela* Stn 27, 37°59′ S, 150°05′ E (off Victoria), 452 m.

REMARKS: Among the five species of *Flabellum (Ulocyathus)* that have laterally compressed coralla (*see* Cairns 1989a), only two have octameral septal symmetry: *F. marenzelleri* Cairns, 1989a and *F. hoffmeisteri* Cairns & Parker, 1992. *Flabellum marenzelleri* is distinguished from *F. hoffmeisteri* by having a much more compressed corallum (face angle only 39–47°) and in having a deeply lacerate calicular margin, each primary septum projecting up to 4 mm as a prominent rectangular lancet. *Flabellum marenzelleri* is known only from the Philippines at 247–315 m.

Flabellum hoffmeisteri is also similar to *F. tuthilli* Hoffmeister, 1933, an octamerally symmetrical campanulate species known from South Australia at 400–800 m. A detailed description of that species is given by Cairns and Parker (1992).

Flabellum (U.) apertum apertum Moseley, 1876
(Plate 35, a-c)

Flabellum apertum Moseley, 1876: 556 (in part: *Challenger* Stn 145); 1881: 167–168 (in part: *Challenger* Stn 145), pl. 6, figs 7a-c; Squires & Keyes 1967: 26, pl. 4, figs 4–5; Squires 1969: 16, 18, pl. 6, map 4; Keller 1974: 205–208 (in part: Subantarctic records); Dawson 1979: 19; Cairns 1982: 44–46, pl. 13, figs 8–11, pl. 14, figs 1–4 (synonymy).

Not *Flabellum apertum apertum*: Squires 1958: 68, pl. 13, fig. 13.

Flabellum patagonichum Moseley, 1881: 166–167, pl. 15, figs 1–7.

Flabellum deludens: Ralph & Squires 1962: 12, pl. 4, figs 7–8 (= holotype of *F. raukawaensis*).

Flabellum raukawaensis Squires & Keyes, 1967: 27, pl. 4, figs 8–9; Cairns 1989a: 54.

Not *Flabellum* cf. *apertum*: Yabe & Eguchi 1942b: 136, pl. 12, figs 3a-c.

Flabellum apertum apertum: Cairns 1994: 74.

MATERIAL EXAMINED: New Records: NZOI Stn D836, 9, USNM 94288; Stn E399, 1, USNM 94289; Stn E707, 1, NZOI; Stn E713, 3, NZOI; Stn E714, 29, NZOI; Stn E715, 1, NZOI; Stn E718, 1, NZOI; Stn E719, 6, NZOI; Stn E725, 11, USNM 94290; Stn E753, 1, NZOI; Stn E757, 3, USNM 94 291; Stn E782, 2, NZOI; Stn F110, 2, USNM 94292; Stn F112, 1, NZOI; Stn F123, 1, NZOI; Stn F128, 1, USNM 94293; Stn F764, 5, NZOI: Stn F767, 1, NZOI; Stn F873, 8, NZOI; Stn F874, 8, NZOI; Stn F878, 3, NZOI; Stn G665, 1, USNM 94294; Stn G666, 2, NZOI; Stn G701, 5, USNM 94295; Stn G703, 2, USNM 94297; Stn G947, 1, NZOI; Stn G955, 1, NZOI; Stn I694, 1, NZOI; Stn K873, 5, NZOI; Stn S46, 1, NZOI; Stn S154, 1, USNM 94298; Stn S166, 1, NZOI; Stn U573, 2, NZOI; BS353, 1, MoNZ; BS649 (R7), 3, MoNZ; BS762 (R120), 1, MoNZ CO146; BS771 (R129), 3, MoNZ; *Eltanin* Stn 1403, 1, USNM 82011. Previous Records: Types of *F. apertum*, *F. patagonichum*, and *F. raukawaensis*; specimens reported by Squires and Keyes (1967) and Squires (1958).

DISTRIBUTION: New Zealand region: widely distributed from Three Kings Islands to Hjort Seamount (Map 4); 322–1575 m. Elsewhere: circum-Subantarctic; 220–1500 m (Cairns 1982).

DESCRIPTION: Corallum campanulate and compressed (not constricted), with a GCD: LCD of 1.3–1.7. Angle of thecal edges bimodal: for lower 10–12 mm of corallum, edges diverge at a 130–170° angle above which they are inflected upward at a much narrower angle. Lateral faces similarly inflected, resulting in a full, campanulate corallum. Largest specimen examined (NZOI Stn G947) 70 x 41 mm in calicular diameter and 40 mm in height. Pedicel 2.0–3.5 mm in diameter and often eroded. Calice deeply lacerate, a tall triangular lancet up to 6 mm in height corresponding to each S1–2 and their adjacent pair of S4, and a smaller lancet up to 1.6 mm in height corresponding to each S3. Principal costae ridged and often crested from pedicel to calice; 4 lateral C1 also ridged or crested at point of thecal inflection. Often the 6 C2 are also ridged or crested (up to 2 mm) beginning slightly above the lateral C1 ridges. Corallum usually white and porcellanous, but some coralla a uniform light reddish-brown.

Septa hexamerally arranged in 4 cycles at a GCD as small as 24 mm according to the formula: S1–2>S3>>S4. Large specimens (GCD 55–60 mm) often have some rudimentary S5, the largest specimens (GCD > 65 mm) having a full fifth cycle. When the fifth cycle is incomplete, S5 are first inserted as pairs flanking the S1–2 (between S1–2 and adjacent S4) and only later in the interseptal position between the S3 and S4. S1–2 with straight, thickened inner edges that come close to fusing with inner edges of septa from opposite face. S3 half to three-quarters width of an S1–2, becoming wider in larger coralla until their inner edges reach the columella. S4 about

one-third width of an S3. S5, if present, rudimentary. All septa thin (0.20–0.35 mm) and well separated from one another by a distance of 3.0–3.5 mm. Fossa deep and open, containing a rudimentary elongate columella composed of a fusion of the lower, inner edges of the S1–3.

TYPES: The lectotype (designated by Cairns 1982) and 7 paralectotypes of *F. apertum* are deposited at the BM(NH), as are the syntypes of *F. patagonichum*. The holotype of *F. raukawaensis* is deposited at the MoNZ (CO186).

TYPE LOCALITIES: *Flabellum apertum*: *Challenger* Stn 145, 46°40 'S, 37°50' E (off Prince Edward Island), 567 m. *Flabellum patagonichum*: *Challenger* Stn 305, 47°48.3' S, 74°47' W (off Penguin Island, Patagonia, Chile), 220 m. *Flabellum raukawaensis*: 41°33' S, 174°55' E (off Palliser Bay, New Zealand), 695 m.

REMARKS: Keller (1974) synonymised *F. japonicum* Moseley, 1881, *F. deludens* Marenzeller, 1904a, and *F. raukawaensis* Squires & Keyes, 1967 with *F. apertum*. Although I believe the first two species to be distinct (Cairns 1989a), I agree that *F. raukawaensis* is a junior synonym of *F. apertum*. The holotype of *F. raukawaensis* differs from most specimens in having an almost complete fifth cycle of septa at the relatively small GCD of 45 mm. Another virtually topotypic specimen from *Eltanin* Stn 1403 has the same characteristics, but both specimens are believed to represent precocious septal development.

The New Zealand Tertiary specimen reported as *F. apertum apertum* by Squires (1958) differs from *F. apertum* in having a fifth cycle of septa at the very small size of 20 mm GCD, having a laterally compressed (not campanulate) corallum, and having equally developed C1–2.

Flabellum apertum is distinguished from other species in the subgenus by its costal morphology; having a full, campanulate corallum; and its widely spaced septa. Subspecies *F. apertum borealis* was described by Cairns (1994) from off Japan at 307–1141 m. The typical subspecies was more fully described and figured by Cairns (1982).

Monomyces Ehrenberg, 1834

Corallum turbinate, ceratoid, or laterally compressed. Transverse division lacking. Pedicel usually reinforced with asymmetrically arranged, contiguous rootlets. Four to six cycles of septa, the lower cycle septa often having concave upper edges. Calicular edge smooth. Fossa deep; pali absent; columella rudimentary.

TYPE SPECIES: *Monomyces anthophyllum* Ehrenberg, 1834, by subsequent designation (Wells 1936).

REMARKS: Three species are known in *Monomyces:* the type species *M. pygmaea* (Risso, 1826), Mediterranean; *M. rubrum* (Quoy & Gaimard, 1833); and the Italian Miocene *M. deperditus* (Michelotti, 1871).

Monomyces rubrum (Quoy & Gaimard, 1833)

(Plate 34, a–i)

Turbinolia rubra Quoy & Gaimard, 1833: 188–189, pl. 14, figs 5–9.

Flabellum nobile Holdsworth, 1862: 198–199, pl. 28, figs 4–5.

Flabellum latum Studer, 1878: 630, pl. 1, figs 3a-b.

Desmophyllum gracile Studer, 1878: 629–630, pl. 1, figs 2a-b; 1889: 180.

Cylicia vacua Tenison-Woods, 1879: 134, pl. 12, figs 4a-b.

Flabellum rugulosum Tenison-Woods, 1880: 12–13, figs 8a-b; Ralph 1948: 108, fig. 1.

Not *Flabellum rubrum*: Gardiner 1902: 463; 1904: 125; Folkeson 1919: 4; Faustino 1927: 50; Gardiner & Waugh 1938: 174; Yabe & Eguchi 1942a: 96; 1942b: 132 (*see* Cairns 1989a).

Flabellum harmeri Gardiner 1929: 122–123, pl. 1, figs 19–20.

Flabellum rubrum: Powell 1947: 8, fig. 16 (= typical form); Ralph 1948: 108; Ralph & Squires 1962: 13–14, pl. 5, figs 1–18, pl. 6, figs 1–9; Squires 1963: 11–41, pls 1–2 (synonymy!); Squires & Keyes 1967: 27–28, pl. 5, figs 3–8 (= *latum* form); Squires 1964b: 7; Morton & Miller 1968: 160, pl. 7, fig. 5; Squires 1969:1 8, pl. 6, map 3; Dawson 1979: 29; Grace & Grace 1976: 99; Brook 1982: 171–172.

Flabellum rubrum rubrum: Squires 1958: 65–66 (in part: pl. 12, figs 1–2, 4–5).

Flabellum rubrum campanulatum: Squires 1958: 67, pl. 14, figs 1–8.

Flabellum gracile: Wells 1958: 269; Ralph & Squires 1962: 1 2–13, pl. 4, figs 9–10; Squires & Keyes 1967: 26, pl. 4, figs 6–7 (not NZOI Stn C810).

Flabellum campanulatum: Squires 1960c: 1–2.

Monomyces rubrum: Cairns 1989a: 79.

MATERIAL EXAMINED: New Records/Typical form: NZOI Stn B482, 2, NZOI; Stn B653, 10, USNM 80140; Stn B808, 2, NZOI; Stn C821, 1, USNM 79793; Stn I14,

NZOI; Stn I15, 1, NZOI; Stn I47, 15, NZOI; Stn I52, 5, NZOI; Stn I53, 6, USNM 94348; Stn I56, 1, USNM 94349; Stn I343, 2, NZOI; Stn J362, 3, NZOI; Stn J672, 5, USNM 94350; Stn 674, 4, USNM 94351; Stn J951, 18, USNM 94352; Stn M774, 1, USNM 94353; Stn M775, 3, USNM 94354; Stn M776, 2, NZOI; Stn M782, 2, NZOI; Stn M793, 1, USNM 94355; Stn O.849, 2, NZOI; Stn Q105, 2, NZOI; Stn Q174, 2, NZOI; Stn Q738, 5, NZOI; BS770 (R128), 15, MNZ; Doubtful Sound, 4-7 m, USNM 76303; Taranaki Bight, 2, USNM 80133. Forma *nobile*: NZOI Stn C758, 1, NZOI; Stn C777, 6, NZOI; Stn E291, 6, NZOI; Stn E848, 30, USNM 94341; Stn E849, 1, NZOI; Stn E876, 2, USNM 94342; Stn F923, 1, NZOI; Stn F924, 1, USNM 94343; Stn F933, 2, USNM 94344; Stn J953, 1, USNM 94345; Stn J954, 7, NZOI; Stn J959, 11, NZOI; Stn J966, 3, USNM 94346; Stn J969, 1, NZOI; Stn J970, 2, USNM 94347; BS895 (O641), 19, MoNZ CO307; BS896 (O642), 14, MoNZ CO232; BS897 (O643), 1, MoNZ CO223; BS898 (O644), 3, MoNZ CO289; BS899 (O645), 4, MoNZ CO298; BS906 (O652), 5, MoNZ CO297; BS910 (O656), 5, MoNZ CO227. Forma *latum*: NZOI Stn B205, 10, USNM 80139; Stn E254, 1, NZOI; Stn E261, 1, NZOI; Stn E368, 2, NZOI; Stn F933, 1, NZOI; Stn I50, 3, NZOI; Stn I67, 4, NZOI; Stn I370, 1, NZOI; Stn I371, 22, USNM 94338; Stn J966, 1, NZOI; Stn N369, 3, NZOI; Stn P64, 3, NZOI; BS401, 1, MoNZ; BS833 (O578), 8, MoNZ CO287; BS881 (O627), 1, MoNZ CO281; BS909 (O655), 1, MoNZ CO238; *Eltanin* Stn 370, 2, USNM 80131. Previous Records: Type of *D. gracile*; specimens reported by Squires and Keyes (1967), Ralph and Squires (1962).

DISTRIBUTION: The typical form of *M. rubrum* has the widest distribution, extending from Three Kings Islands to Stewart Island (Squires & Keyes 1967: fig. 1), although, as Squires and Keyes noted, it is absent from four coastal regions: East Cape to Castlepoint, between North Cape and Raglan, from Karamea Bight to Jackson's Head, and Timaru to Stewart Island. Otherwise, this form is quite common off New Zealand at depths of 0–201 m, most particularly at depths of 10–50 m. This relatively shallow range is consistent with Squires' (1963) thesis that the typical form, which has a robust polycyclic base, is adapted to areas of unstable substrate and/or turbulent water. Squires (1960c, 1963) should be consulted for the fossil record of this species.

Despite 21 records, forma *nobile* is known from the very restricted geographic region of Three Kings Islands to Cape Brett (Map 6) at depths of 70–410 m; however, most specimens were collected at 150–300 m making it the "deep-water" form of the species. Squires (1963: 31) suggested that its unique form of basal reinforcement was an adaptation to attach to objects lying above the seafloor, such as antipatharian axes and other corals "where increasing weight of the corallum may result in bending or breaking of the substrate". In fact, many of the specimens of this form are attached to dead coralla of the same species.

Forma *latum* also has a circumscribed distribution, known only off the North Island from North Cape to East Cape, Cook Strait, and one isolated record on the extreme western Chatham Rise (Map 6). The depth range of specimens examined is 59–163 m; however, dead specimens are known from much deeper (e.g., 549 m, Gardiner 1929). This flabellate form, which has a large, but non-reinforced pedicel, was considered by Squires (1963) to be the "deep-water" form, the implication being that in calmer, deeper water basal reinforcement would not be required. In general, this is true, but Brook (1982) has reported this form from as shallow as 1 m in sheltered habitats.

DESCRIPTION: Typical form: Corallum compressed (GCD: LCD = 1.3–2.5), with straight, rounded thecal edges, and flat thecal faces. Angle of thecal edges 52–75°; inclination of lateral faces 20–27°. Specimens relatively small, rarely larger than 28 mm in GCD or height (i.e., GCD: H ≤ 1), the lectotype of *Turbinolia rubra* being one of the larger representatives of this form. Pedicel circular: 2.0–2.7 mm in diameter. Asymmetrical polycyclic development present, but invariably confined to only one edge (about one-quarter of base) of corallum. Up to 4 layers of polycyclic chambers may be present at basal edge, increasing area of corallum attachment up to 20-fold. Theca usually heavily encrusted with bryozoans, foraminiferans, calcareous worm tubes, and/or coralline algae. Unencrusted theca relatively smooth, covered with very fine longitudinal costal striae and closely spaced chevron-shaped growth striae. Corallum white.

Septa arranged in 4 size classes, the total number of septa roughly correlated with GCD, as graphed by Squires (1963: fig. 4). A corallum of 12 mm GCD has about 12 primary, 12 secondary, 24 tertiary, and a variable number of quaternary septa; a corallum of 15–19 mm GCD has about 16 primary septa; 20–22 mm GCD, about 18 primary septa; and larger coralla of 20–28 mm GCD, 20–22 primary septa, but a total that rarely exceeds 124. Primary septa with slightly convex upper edges and straight, thickened lower edges

that attain the columella. Secondary septa half to four-fifths width of a primary, but do not fuse with the columella. Tertiaries much smaller than secondaries, and quaternaries are rudimentary. Fossa deep, containing an elongate trabecular columella about 1 mm wide.

Forma *nobile*, described by Holdsworth (1862) as a separate species and again by Studer (1878) as *Desmophyllum gracile*, differs from the other two forms in having a tall, almost ceratoid corallum, usually 2–3 times the GCD in height. (The other two forms have a GCD: H of 1.0–1.5). Also characteristic of this form is its method of basal reinforcement, referred to as the "second type" or by "talons" by Squires (1963). At a height of 21–25 mm the corallum produces a tubular epi-thecal chamber (a "talon") 3–4 mm in diameter near the calicular margin. This tube grows downward and gradually spreads around the circumference of the pedicel, such that at the corallum base it has encompassed the pedicel and usually forms a V-shaped junction on the opposite side of the corallum where its leading edges meet. This tube, or rootlet, is one layer thick (not poly-cyclic as in the typical form) and contiguous with the pedicel, increasing the pedicel diameter of 2.5–3.5 mm to about 7 mm. The GCD: LCD of this form is similar to that of the typical form (1.3–2.2), but less than that of forma *latum*. Large specimens typically have 22 primary septa, 22 secondary septa, 44 tertiary septa, and up to 88 quaternary septa, the largest specimen examined being 32 x 20 mm in calicular diameter and 68 mm in height, with a pedicel diameter of 6.3 mm. Small specimens of this form are often bent in growth form, have hexameral symmetry and sinuous inner septal edges, but may not have yet formed the accessory rootlets. Such a specimen formed the basis for Studer's (1878) description of *D. gracile*.

The third form, forma *latum*, is characterised by lacking any kind of basal rootlet reinforcement. Originally described by Studer (1878) as *Flabellum latum*, this form was also described as *Cylicia vacua* Tenison Woods, 1879, *F. rugulosum* Tenison Woods, 1880, and *F. harmeri* Gardiner, 1929. Aside from lacking basal reinforcement, specimens of forma *latum* tend to have larger, flabellate coralla up to 135 mm in GCD (BS401); have a GCD: LCD up to 4.8; and an edge angle of 50–80°, but as great as 120° in the extreme case. Consistent with their large size, there are often more septa, larger specimens having up to 48 primary septa and the corresponding number of secondary to quaternary septa, although quaternary septa are quite irregularly developed. This form may also have a larger pedicel, up to 4.0 mm in diameter. Not all specimens lacking basal reinforcement have large, highly flabellate coralla; many are similar to the typical form in shape but simply lack rootlets. Also, some perfectly typical flabellate *latum* forms have basal rootlets. Given this wide variation and inter-gradation of characteristics, I agree with Squires (1963: 17–18, 31) in assuming that the presence or absence of rootlets is variable within a population and probably correlates to he local environmental conditions and the substratum to which the coral is attached.

TYPES: The lectotype and paralectotype (designated by Squires 1963) of *Turbinolia rubra* are deposited at the MNHNP. The deposition of the two syntypes of *F. nobile* is unknown. The holotype of *D. gracile* and presumably that of *F. latum* are deposited at the ZMB (*D. gracile*, #1880). The deposition of the two syntypes of *C. vacua* is unknown. The lectotype (designated by Ralph 1948) and two paralectotypes of *F. rugulosum* are deposited at NZGS (CO555–557). Four syntypes of *F. harmeri* are deposited at the BM(NH).

TYPE LOCALITIES: *Turbolina rubra*: Cook Strait, 46 m. *Flabellum nobile*: "New Zealand". *Desmophyllum gracile*: According to the label with the holotype and a later publication by Studer (1889), the holotype was obtained from *Gazelle* Stn 24, 20°07′ S, 57°26.5′ E (off Port Louis, Mauritius), 75–411 m; however, the type locality given by Studer (1878) was 34°09.9′ S, 172°35.8′ E (off Three Kings Islands), 165 m. *Flabellum latum*: 34°16′ S, 172°59.6′ E (off North Cape), 82 m. *Cylicia vacua*: off Wellington. *Flabellum rugulosum*: Ngaruroro River, Hawke's Bay, Nukumaruan (early Pleistocene). *Flabellum harmeri: Terra Nova* Stn 91, off Great King Island, 549 m (dead).

REMARKS: Squires (1963) provided an exhaustive account of the synonymy, morphology, ontogeny, phylogeny, ecology, and distribution of *Flabellum (= Monomyces) rubrum*. I am in general agreement with the taxonomic conclusions of Squires, i.e., *M. rubrum* is a variable species endemic to New Zealand that has great variation in corallum shape and pedicel morphology that is probably dependent on the environment. I have separated the mophological variation into three forms, having some but remarkably little

overlap in shape and distribution.

Monomyces rubrum is the most commonly collected scleractinian in New Zealand waters, being quite conspicuous (reddish-orange polyp, yellow tentacles) and one of the few intertidal species. Although the synonymy presented above is long it is not complete, but does include all junior synonyms and significant references; Squires (1963) should be consulted for a more complete synonymy.

The typical and *nobile* forms of *M. rubrum* are easily distinguished from all other New Zealand Scleractinia by their characteristic method of basal reinforcement, but specimens of forma *latum* are quite similar in size and shape to *F. knoxi*. Forma *latum* differs in having: a robust, dense corallum (that of *F. knoxi* is light and fragile); a smaller edge angle (usually 50–80° vs 135–180° for *F. knoxi*); a rudimentary columella; and thickened, straight inner edges of the primary septa (S1–4 of *F. knoxi* are highly sinuous). Furthermore, although there is a slight overlap in the geographic and depth ranges, forma *latum* occurs off the North Island and Cook Strait at depths of 59–163 m, whereas *F. knoxi* occurs predominantly on the Chatham Rise and Bounty and Campbell Plateaus at depths of 160–1167 m (mostly at 400–700 m).

Polymyces Cairns, 1979

Corallum solitary; ceratoid to trochoid; and attached to substratum by a pedicel reinforced with symmetrically (6 pairs around circumference) or asymmetrically (2 pairs on corallum edge) developed, contiguous exothecal rootlets. Four to five cycles of septa; calicular margins lacerate to serrate. Pali absent; columella rudimentary.

TYPE SPECIES: *Rhizotrochus fragilis* Pourtalès, 1871, by original designation.

REMARKS: *Polymyces* is quite similar to *Monomyces*, differing primarily in the character implicit in their names, i.e., specimens of *Polymyces* have 4–12 contiguous rootlets, whereas specimens of *Monomyces* have only one massive rootlet or asymmetrical polycyclic development. *Polymyces* also differs in having serrate to lacerate cali-cular margins, *Monomyces* has smooth upper edges. Only three species are known in the genus: the type species *P. fragilis* (Pourtalès, 1868), from the western Atlantic at 75–796 m (Cairns 1979); *P. montereyensis* (Durham, 1947) (= *P. tannerensis* (Durham & Barnard, 1952)), known from off southern California and Peru at 69–212 m (Cairns 1994); and *P. wellsi*.

Polymyces wellsi Cairns, 1991 (Plate 35, d-f)

Polymyces wellsi Cairns, 1991a: 22, pl. 8, figs f, i, pl. 9, figs a-b.

MATERIAL EXAMINED: New Records: NZOI Stn E731, 3, USNM 94304; Stn G941, 1, NZOI; Stn K806, 3, NZOI; Stn X138, 2, USNM 94305; BS342, 2, MoNZ CO91. Previous Records: Type series of *P. wellsi*.

DISTRIBUTION: New Zealand region: off northeastern New Zealand (Bay of Plenty and off Hawke Bay), Kermadec Islands (north of Raoul Island) (Map 10); 355–1165 m. Elsewhere: Galápagos Islands; 391–813 m.

DESCRIPTION: Corallum ceratoid, with a slightly flared calice; theca and septa thin and brittle; calice quite fragile. Largest specimen (NZOI Stn X138) 50 mm in GCD and 40 mm in height. Calicular edge highly lacerate. GCD: LCD = 1.2–1.5. Pedicel strongly reinforced by asymmetrically developed rootlets, which increase the pedicel diameter up to 5.5–6.0 mm About 7–10 mm above the base, 4 narrow (about 0.7 mm in width), flattened exothecal rootlets develop, two corresponding to each half-system adjacent to one of the principal septa. These 4 rootlets grow downward, ultimately encircle the base and fuse, the edges of the combined chamber meeting itself on the opposite edge of the corallum in a U- or V-shaped junction near the base. These rootlets continue to encrust the surrounding substratum, thus not only increasing the pedicel diameter but also increasing the substratum attachment, giving greater stability to the corallum. Theca smooth, glistening, and reddish-brown in colour, the C1–2 sometimes slightly raised and pigmented a darker shade. Rootlets and coenosteum covering substratum white.

Septa hexamerally arranged in 4 to 5 cycles, the fourth cycle attained at the relatively small GCD of about 10 mm and persisting to at least a GCD of about 30 mm (e. g., the holotype). Larger coralla, however, show a development of a fifth cycle, a specimen 40 mm in GCD (NZOI Stn

E731) having 6 pairs of S5 (60 septa) and the largest specimen of 50 mm GCD (NZOI Stn X138) having a full fifth cycle of 96 septa. Septal formula: S1–2>S3>S4>S5. S1–2 highly exsert, forming slender triangular lancets up to 5 mm tall at calicular edge, with straight, thickened inner edges that extend so far into fossa that they almost meet their counterparts from the opposite face. S3 also form smaller (1.0–1.5 mm in height), exsert lancets; are three-quarters width of an S1–2; and have thin, finely sinuous inner edges. S4 not exsert, about one-third width of an S3, and have finely sinuous inner edges. If pairs of S5 are present, they take the dimensions of an S4, the S4 are increased in width to a typical S3, and the S3 are accelerated to about four-fifths the width of an S1–2. Fossa deep and narrow, containing a rudimentary columella formed by the fusion of the thickened lower, inner edges of the S1–2.

TYPES: The holotype and 10 of 11 paratypes are deposited at the USNM. One paratype is also deposited at the Harbor Branch Oceanographic Museum, Fort Pierce, Florida.

TYPE LOCALITY: *Johnson-Sea-Link* Stn 1916, 1°18.7′ S, 89°48.8′ W (northwest of Española, Galápagos), 545–562 m.

REMARKS: *Polymyces wellsi* is easily distinguished from the two other species in the genus by its asymmetrical rootlet development, the other species both having six pairs of symmetrically placed rootlets. In addition, *P. wellsi* differs from *P. fragilis* in having up to five cycles of septa and straight (not sinuous) inner septal edges of the S1–2; and from *P. montereyensis* in having a much more lacerate calicular margin and a pigmented corallum.

The method of basal reinforcement and resultant effect on *P. wellsi* is similar to that of *Monomyces rubrum* forma *nobile*, differing only in that the rootlet of *M. rubrum* originates as a single, massive root, whereas in *P. wellsi* four smaller rootlets seem to appear simultaneously. *Polymyces wellsi* is further distinguished from *M. rubrum* forma *nobile* by its lacerate calicular edge, hexameral symmetry, smaller GCD: LCD, and pigmented corallum, as well as occurring in much deeper water.

Rhizotrochus Milne Edwards & Haime, 1848a

Corallum solitary; ceratoid, trochoid, or compressed; and attached. Pedicel small and not reinforced, but corallum attachment to substratum augmented with 2 to over 20 discrete (free standing, noncontiguous) rootlets that anchor theca to substratum. Three to 6 or even 7 cycles of nonexsert septa; calicular margin smooth. Pali absent; columella rudimentary.

TYPE SPECIES: *Rhizotrochus typus* Milne Edwards & Haime, 1848, by monotypy.

REMARKS: *Rhizotrochus* is most similar to *Polymyces*, both genera reinforcing their attachment to the substratum by rootlets, but in different ways. *Rhizotrochus* produces 2 to over 20 discrete (free standing), slender rootlets, each of which inde-pendently fuses to the substratum, whereas in *Polymyces* the rootlets are contiguous with the pedicel. In addition, the calicular edge of *Rhizo-trochus* is smooth, that of *Polymyces* is ser-rate to lacerate.

Four species are known in *Rhizotrochus*: the type species *R. typus* Milne Edwards & Haime, 1848a (Indo-West Pacific, 20–1048 m) (*see* Cairns 1994), *R. levidensis* Gardiner, 1899 (Loyalty Islands, 192 m); *R. tuberculatus* (Tenison-Woods, 1879) (off South Australia and Tasmania, *see* Cairns & Parker 1992); and *R. flabelliformis*. The genus is further discussed by Cairns (1989a) and Cairns and Parker (1992).

Rhizotrochus flabelliformis Cairns, 1989
(Plates 35, g-i, 36, a, b)

Flabellum latum: Alcock 1902c: 31.
Rhizotrochus flabelliformis Cairns, 1989a: 81, pl. 41, figs k-l, pl. 42, figs b, d.

MATERIAL EXAMINED: Previously known only from one specimen, the holotype, *R. flabelliformis* is herein reported from 37 additional specimens from 12 localities: NZOI Stn I374, 1, USNM 94299; Stn I375, 5, NZOI; Stn J679, 8, USNM 94300; Stn J709, 1, USNM 94301; Stn K795, 6, USNM 94302; Stn K844, 1, NZOI; Stn P10, 6, USNM 94303; BS715 (R73), 2, MoNZ CO221; BS720 (R78), 4, MoNZ CO162; BS843 (O589), 1, MoNZ CO215; RV *Franklin* Stn 5/89/47, 1, AMS G15561; *Volcanolog* Stn 64, 1, AUM 12299. Previous Records: Holotype.

DISTRIBUTION: New Zealand region: Lord Howe Seamount Chain (Britannia Seamount); southern Norfolk Ridge; off northeastern New Zealand; Kermadec Ridge (Map 17); 228–419 m. Elsewhere: Sulu Archipelago, Philippines; 275 m.

DESCRIPTION: Corallum robust and highly laterally compressed (GCD: LCD = 2.4–3.4), with flat (not constricted) thecal faces and rounded thecal edges. Angle of thecal edges variable, ranging from 30–115°; inclination of lateral faces, 25–35°. Largest specimen known (NZOI Stn P10) 67 x 28 mm in calicular diameter and 63 mm in height. Pedicel circular and quite small: 1.2–1.5 mm in diameter. Early in ontogeny (e.g., height 3–4 mm, GCD 13–14 mm, septal complement 96) the theca associated with the two narrow calicular edges curves downward (Plate 36, a, b), eventually contacting and fusing with the substratum on either side of the pedicel. Gradually these two thecal extensions form tubes (rootlets) usually 4–5 mm in diameter (in some cases up to 9 mm in diameter) and the thecal edges resume their normal upward growth. Each tube contains the rudiments of the principal septum (S1) and the 3–5 adjacent septa to either side. The two rootlets confer much greater stability to the massive corallum than the relatively small original pedicel. Theca smooth but invariably heavily encrusted with foraminiferans, serpulids, and/or bryozoans. Corallum a light reddish-brown, young coralla having more intense C1–2 pigmentation.

Septa hexamerally arranged in 6 to 7 cycles, the fifth cycle complete at a GCD as small as 14 mm (S1–4>S5), the full sixth cycle attained at a GCD of about 45 mm (S1–4>S5>S6), and only part of the seventh cycle (246–284 septa) attained even in the largest coralla. S1–4 have concave (SCI up to 8), sometimes sinuous, upper edges and moderately to very sinuous lower, inner edges, which almost meet their counterparts from the opposite face in the upper fossa. S5 about three-quarters width of an S1–4, also quite thin near the calicular edge, but with straight inner edges. S6 small, only about one-third width of an S5, and extend only partially toward base of corallum. Fossa deep and narrow, not affording a view of the rudimentary columella in an intact specimen.

TYPE: The holotype is deposited at the ZMA (Coel. 1216).

TYPE LOCALITY: *Siboga* Stn 105, 6°08′ N, 121°19′ E (Sulu Archipelago, Philippines), 275 m.

REMARKS: *Rhizotrochus flabelliformis* is easily distinguished from its three congeners by having a flabellate corallum and only two massive rootlets that are aligned with the GCD. All other species have elliptical coralla and a variable number of smaller rootlets associated with the C1–2. In the New Zealand region, *R. flabelliformis* might be confused with the *latum* form of *M. rubrum*, but is distinguished by its smaller pedicel diameter and its large, discrete rootlets. The latter character would also serve to distinguish it from the forms of *M. rubrum* that possess contiguous rootlets or polycyclic development. The distribution of *R. flabelliformis* overlaps the northern range of *M. rubrum*, but it is much more widespread in the tropical western Pacific.

Gardineria Vaughan, 1907

Corallum solitary, trochoid to turbinate, attached by a polycyclic base and short, contiguous basal rootlets. Epitheca transversely wrinkled. Upper, outer septal edges separated from calicular edge by a deep notch. Fossa shallow; paliform lobes usually present before S2; columella papillose or absent.

TYPE SPECIES: *Gardineria hawaiiensis* Vaughan, 1907, by original designation.

REMARKS: Five species are recognised in this genus: *G. hawaiiensis* Vaughan, 1907; *G. paradoxa* (Pourtalès, 1874); *G. simplex* (Pourtalès, 1878); *G. minor* Wells, 1973; and *G. philippinensis* Cairns, 1989a.

Gardineria hawaiiensis Vaughan, 1907

(Plate 36, c-f, i)

Gardineria hawaiiensis Vaughan, 1907: 65–66, pl. 4, fig. 1; Cairns 1984: 23.
Gardineria musorstomica Cairns, 1989a: 82–83, pl. 42, figs c, e-g.

MATERIAL EXAMINED: New Records: NZOI Stn E731, 1, USNM 94306; Stn E859, 4, NZOI; Stn E861, 1, NZOI; Stn I97, 2, USNM 94307; Stn K826, 3, NZOI; Stn K830, 3, USNM 94308; Stn K840, 2, NZOI; Stn K858, 1, NZOI; Stn P14, 1, USNM 94310; Stn T256, 1,

NZOI; Stn U591, 1, NZOI. Previous Records: types of *G. hawaiiensis* and *G. musorstomica*.

DISTRIBUTION: New Zealand region: southern Norfolk Ridge; Kermadec Islands; Bay of Plenty (Map 13); 142–602 m. Elsewhere: Hawaiian Islands; Philippines; 192–541 m.

DESCRIPTION: Corallum trochoid to turbinate, having a basal angle ranging from 32–85°: the wider angle characteristic of the large holotype of *G. hawaiiensis* and an equally large specimen from NZOI Stn I97; the narrower basal angle characteristic of the small holotype of *G. musorstomica*. Largest specimen examined (holotype of *G. hawaiiensis*) 32.6 in calicular diameter and 20.3 mm in height, having regenerated from a smaller calice of the parent corallum. Pedicel robust (PD: GCD = 0.3–0.4), formed by polycyclic development, the outermost thecal ring often generating short, contiguous, accessory rootlets at base of corallum. Epitheca bears fine, transverse striae and usually rises well above the upper, outer septal edges as a thin circular lip. Corallum white.

Septa hexamerally arranged in 4 cycles, but fourth cycle never complete. Specimens up to 15 mm GCD have only 3 cycles (24 septa), whereas the largest specimens of GCD = 30–32 mm have up to 36–44 septa, and a specimen of 20 mm GCD (NZOI Stn P14) has the intermediate complement of 30 septa. S1 thick with straight inner edges that fuse deep in fossa. S2 about three-quarters width of an S1, each bearing a broad, lamellar paliform lobe on its lower, inner edge. S3 about three-quarters width of an S2, unless flanked by a pair of S4, in which case they are equal in width to an S2 and also bear an equal-sized paliform lobe. S4 equal in width to an unflanked S3. Thus, there are only 3 size classes of septa: S1; S2 and flanked S3; and S4 and unflanked S3. All septa are well separated from one another by a distance of about 1.5 mm at calicular edge. Fossa shallow. Columella may consist of 1–3 papillae or be absent.

TYPES: The holotype of *G. hawaiiensis* is deposited at the USNM (20731). The holotype of *G. musorstomica* is deposited at the MNHNP.

TYPE LOCALITIES: *G. hawaiiensis*: *Albatross* Stn 3991, 22°15'25 N, 159°23'15 W (Kauai, Hawaiian Islands), 497–541 m. *G. musorstomica*: MUSORSTOM Stn 2–32, 13°40.5' N, 120°53.9' E (Philip-pines), 192–220 m.

REMARKS: One of the dangers in describing a species based on only one specimen is that it may be a juvenile or aberrant specimen. This seems to have been the case for both Vaughan (1907) and myself (Cairns 1989a). Vaughan's unique specimen of *G. hawaiiensis* is unusually large, has a very open calice, and was a product of rejuvenescence, thus not affording a characterisation of its pedicel and attachment. The holotype of *G. musorstomica* of 13.5 mm GCD is a juvenile specimen, having only 3 cycles of septa, and is somewhat worn. Given the intermediate variation represented by the New Zealand specimens, *G. hawaiiensis* and *G. musorstomica* would appear to be the same species.

Gardineria sp. (Plate 36, g, h)

MATERIAL EXAMINED: NZOI Stn I96, 1, NZOI; Stn I735, 1, USNM 94311; Stn I743, 2, USNM 94312; Stn P10, 1, NZOI.

DISTRIBUTION: South of Chesterfield Islands; Lord Howe Seamount Chain; southern Norfolk Ridge (Map 17); 291–378 m.

REMARKS: The five specimens listed above are extremely similar to *G. hawaiiensis*, but differ in having more septa at a corresponding GCD (neotenic). Specimens of 17–21 mm GCD already have 48 septa and a specimen from NZOI Stn I96 of 19 mm GCD has 58 septa. Furthermore, the septa are arranged in four size classes (S1>S2>S3>S4) and are much more closely spaced (only 0.3–0.5 mm apart vs 1.3–1.5 mm for *G. hawaiiensis*). Finally, the P2 of *Gardineria* sp. A are narrower and slightly pointed, not broad and rounded as in *G. hawaiiensis*.

The specimens reported as *Gardineria* sp. by Gardiner (1929) from off North Cape (*Terra Nova* Stn 96) belong to the genus *Crispatotrochus* and are discussed further in the account of that genus.

Javania Duncan, 1876

Corallum solitary, subcylindrical to turbinate, and attached by a pedicel that is strongly reinforced with numerous layers of dense stereome. Three to five cycles of highly exsert septa present, resulting in a lacerate calicular edge. Pali absent; columella rudimentary or absent.

TYPE SPECIES: *Javania insignis* Duncan, 1876, by monotypy.

REMARKS: *Javania* is similar to *Rhizotrochus* and *Polymyces* in having a basal reinforcement, but differs in that its pedicel is modified by concentric layers of dense coenosteum (stereome), not by hollow rootlets. Eleven species are known in the genus: eight are listed by Cairns (1989a) in his review of the genus; *J. borealis* and *J. californica* were described recently by Cairns (1994); and *J. pachytheca* is described herein. Of the eight recent species, four have five cycles of septa, three have four cycles of septa, and one species has only three cycles of septa.

Javania lamprotichum (Moseley, 1880)
(Plate 37, b, c)

Desmophyllum lamprotichum Moseley, 1880: 41-42, figs 1-2.
Javania lamprotichum Cairns 1984: 21, pl. 4, figs D–E.

MATERIAL EXAMINED: Previously known only from 5 specimens from 2 localities, herein are reported an additional 13 specimens from 3 localities: NZOI Stn K846, 4, NZOI; Stn K858, 2, USNM 94283; Stn T256, 7, USNM 94282. Previous Records: Holotype; specimen from off Hawaii (Cairns 1984).

DISTRIBUTION: New Zealand region: Kermadec Ridge off Macauley and Curtis Islands (Map 20); 465–710 m. Elsewhere: off Molokai, Hawaiian Islands and Johnston Atoll; 244–322 m (Cairns 1984).

DESCRIPTION: Corallum robust and ceratoid, with a slightly flared, serrate calicular margin and a GCD: LCD of 1.25–1.35. Largest specimens known (*SANGO* Stn 13-13 (Cairns 1984) and NZOI Stn T256) 42 x 32 mm in calicular diameter and 39 mm in height. Pedicel robust and elliptical in cross section, composed of numerous thin concentric layers of translucent to opaque white, dense stereome, which attains a diameter of 3.5–10 mm, depending on age of corallum. Pedicel stereome spreads over substratum, further strengthening the attachment. Theca smooth and porcellanous, the theca and septa being a uniform shade of reddish-brown; however, basal stereome white. Well-preserved coralla often display a more intense pigmentation (longitudinal stripes) associated with the C1–2; however, most specimens were dead when collected and covered with a thin black coating.

Septa hexamerally arranged in 5 cycles, the complete fifth cycle attained as early as 9–10 mm GCD and not exceeded even in the largest coralla. S1–2 about 3 mm exsert and quite wide, having thick, vertical, sinuous inner edges that extend almost to their counterparts on the opposite face. Septal sinuosity less evident in large specimens, being replaced with a uniform inner septal thickness. S3 about 2.5 mm exsert, three-quarters width of an S1–2, and also have sinuous inner edges. S4 only about 1 mm exsert, about half the width of an S3, and have sinuous inner edges. S5 rudimentary, only one-third to half width of an S4. Fossa deep and elongate, containing a rudi-mentary columella composed of the fused lower edges of the S1-2.

TYPE: The holotype is deposited at the BM(NH).

TYPE LOCALITY: Unknown (specimen bought from a dealer).

REMARKS: Aside from *J. lamprotichum*, three of the eleven species in this genus are characterised by having five cycles (96) of septa in the adult stage: *J. insignis* Duncan, 1876 (Indo-West Pacific, 46–825 m, *see* Cairns 1994); *J. antarctica* (Gravier, 1914) (off continental Antarctica, 53–1280 m, *see* Cairns 1982); and *J. borealis* Cairns, 1994 (Aleutian Islands, 247–348 m). *Javania lamprotichum* is most similar to the North Pacific *J. borealis*, but is distinguished by having a slightly flared calice, a reddish-brown corallum, sinuous inner septal edges, and, in general, a more robust corallum with thicker theca and septa resulting in less space between adjacent septa.

In the New Zealand region, *J. lamprotichum* could be confused with *Polymyces wellsi* based on size, shape, and colour. *Javania lamprotichum* is distinguished by having a solid, stereome-reinforced pedicel (not rootlets), sinuous S1–2 edges, a less highly lacerate calicular edge, and the acquisition of S5 at a much smaller size.

Javania pachytheca n. sp.
(Plates 36, j-l, 37, a)

Javania sp. Cairns 1989a: 76 (in part: USNM 82014).

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: New Zealand region: Lord Howe

Seamount Chain; Norfolk Basin; Kermadec Ridge; off northern North Island (Map 17); 360–1045 m. Elsewhere: off Chesterfield Islands (NZOI Stn T182); 672 m.

DESCRIPTION: Corallum tall and slender (ceratoid to subcylindrical), having a slightly elliptical calice, GCD: LCD = 1.1–1.2. Largest specimen (holotype) 11.7 x 9.7 mm in calicular diameter, 29.1 mm in height, and 5.8 mm in pedicel diameter. Calicular margin serrate, produced by the exsert S1–3. Pedicel thickened with concentric layers of dense stereome, producing a strong shaft and base of support. Thecal walls also quite robust, up to 2.3 mm thick in some specimens. Exterior of theca glistening and finely granular, the individual granules 30–40 µm in diameter. C1–2 sometimes expressed as low ridges. Corallum usually white but may be light brown in some specimens.

Septa hexamerally arranged in 4 complete cycles according to the formula: S1–2>S3>>S4. S1–2 relatively highly exsert (2.0–2.3 mm) and have straight to slightly sinuous inner edges that extend well into fossa. S3 also exsert (1.1–1.4 mm), about three-quarters width of an S1–2, and have slightly sinuous inner edges. S4 not exsert and often not even present at calicular edge, but deep within the calice S4 are one-third to half the width of an S3 and have slightly sinuous inner edges. Fossa deep and narrow; columella not detected.

TYPES: Holotype: NZOI Stn K846, H-631. Paratypes: NZOI Stn C527 P-1047, 10, USNM 82014; NZOI Stn J716, 1 P-1048; NZOI Stn P57 P-1049, 1; NZOI Stn Q68 P-1050, 1; NZOI Stn S562 P-1051, 1, USNM 94284; NZOI Stn T182, 1 P-1052, USNM 94285; NZOI Stn T226, 1 P-1053, USNM 94286; RV *Franklin* Stn 5/89/40, 1, AMS G15502.

TYPE LOCALITY: 30°13.1′ S, 178°32.0′ W (off Macauley Island, Kermadecs), 610 m.

ETYMOLOGY: The species name *pachytheca* (Greek *pachys*, thick + *theke*, case or box) refers to the thick theca of this species.

REMARKS: Among the 11 species of *Javania*, only three have four cycles of septa: *J. cailleti* (Duchassaing & Michelotti, 1864); *J. pseudoalabastra* Zibrowius, 1974d; and *J. pachytheca*. The latter is most similar to the widespread and variable *J. cailleti* (*see* Cairns 1984) and may represent only a subspecies or form of that species, but differs from *J. cailleti* by having a smaller, subcylindrical corallum and a very thick theca. In shape, *J. pachytheca* resembles *J. duncani* Wells, 1977 (Eocene of Tonga), but that fossil species appears to differ in having only three cycles of septa. However, the preservation of the holotype of *J. duncani* is not sufficient to distinguish S4 even if they were present.

Truncatoflabellum Cairns, 1989a

Corallum solitary and usually highly compressed. Asexual reproduction by transverse division quite common, resulting in a distal anthocyathus budded from a basal anthocaulus. Calicular margin smooth to slightly serrate. Most species bear one or more pairs of thecal edge spines or edge crests on the anthocyathus and one or more pairs of edge spines on the anthocaulus. Pali absent; columella rudimentary.

TYPE SPECIES: *Euphyllia spheniscus* Dana, 1846, by original designation.

REMARKS: Species of *Truncatoflabellum* differ from the subgenus *Flabellum (Flabellum)* in their propensity to asexually propagate by transverse division and in having thecal edge spines. Cairns (1989a, c) explained the philosophical rationale for distinguishing these genera. Approximately 33 species are known in the genus, 27 of which are listed by Cairns (1989a: 61). More recently described or previously overlooked species include: *T. dens* (Alcock, 1902a); *T. truncum* (Cairns, 1982); *T. gardineri* Cairns *in* Cairns & Keller, 1993; *T. multispinosum* Cairns *in* Cairns & Keller, 1993; *T. phoenix* n. sp.; and *T. arcuatum*, n. sp.

Truncatoflabellum paripavoninum (Alcock, 1894) (Plate 37, d, e)

Flabellum paripavoninum Alcock, 1894: 187; 1898: 21, pl. 2, figs 3a, b.
Truncatoflabellum paripavoninum: Cairns 1989a: 72–73, pl. 37, figs j-l, pl. 38, fig. a (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn K805, 1, NZOI; Stn T241, 1, NZOI; Stn T243, 1, USNM 94278; Stn T244, 1, NZOI; Stn T259, 2, USNM 94279.

Distribution: New Zealand region: Kermadec

Ridge between Raoul and Macauley Islands (Map 21); 1035–1450 m. Elsewhere: Laccadive Sea, Philippines, Indonesia; 476–1163 m (*see* Cairns 1989a).

DIAGNOSIS OF ANTHOCYATHUS: Angle of thecal edges quite variable, ranging from 57–135°; inclination of thecal faces 32–62°. Largest New Zealand specimen (NZOI Stn T243) only 23.3 x 13.0 mm in calicular diameter and 22.0 mm in height, with a basal scar of 8.1 x 4.3 mm, but specimens exist up to 49 mm in GCD (Cairns 1989a). Thecal faces meet in acutely angled edges, but thecal edges not carinate or spinose. Basal scar quite variable in size: 6.8–14.5 x 4.1–6.8 mm. C1–2 sometimes slightly raised as rounded ridges. Corallum white to light brown. Septa hexamerally arranged in 6 cycles, but sixth cycle does not begin to appear until a GCD of about 26 mm and thus is absent from all New Zealand specimens examined. Septal formula of small specimens: S1–2>S3>S4>S5, but as the corallum increases in size, S3 become as wide as the S1–2 and ultimately S6 are added. Fossa deep; columella well developed, consisting of a relatively wide (2.0–2.2 mm) trabecular mass fused to the lower, inner edges of the S1–3.

TYPES: The holotype is presumed to be deposited at the Indian Museum, Calcutta.

TYPE LOCALITY: *Investigator* Stn 177, 13°47'4 N, 73°07' E (off Pedro Bank, Laccadive Sea), 1163 m.

REMARKS: There exist three closely related Pacific species of *Truncatoflabellum* characterised by having non-spinose thecal edges, costate thecal faces (C1–2), well-developed columellas, and that occur in relatively deep water (> 1000 m): *T. trapezoideum* (Keller, 1981b) (Marcus-Necker Ridge, central Pacific, 1630 m); *T. truncum* (Cairns, 1982) (eastern Pacific from Peru to Chile and Falkland Plateau, 595–1896 m); and *T. paripavoninum*. *Truncatoflabellum paripavoninum* differs from the other two in having thecal faces that meet in a sharp edge, the other two species having rounded thecal edges. However, *T. trapezoideum* is known from only one specimen and *T. paripavoninum* is a variable species, which might allow for the eventual synonymy of these two species. The Kermadec Ridge specimens reported herein are intermediate in corallum shape between *T. trapezoideum* and *T. paripavoninum*, having a relatively low edge angle characteristic of the former and the sharp thecal edges characteristic of the latter. *Truncatoflabellum paripavoninum* is more fully described and discussed by Cairns (1989a).

Truncatoflabellum dens (Alcock, 1902), n. comb.
(Plate 37, f-h)

Flabellum dens Alcock, 1902a: 106–107; 1902c: 32, pl. 4, figs 30, 30a; Cairns 1989a: 54, pl. 28, figs g-k (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn K800, 1, USNM 94275; Stn K858, 1, USNM 94274; Stn P16, 1, NZOI; BS441, 57, MoNZ CO 261, 11, USNM 94276. Previous Records: Types of *F. dens*.

DISTRIBUTION: New Zealand region: Kermadec Ridge off Raoul and Curtis Islands; Norfolk Ridge south of Norfolk Island (Map 12); 320–555 m. Elsewhere: Sulu Archipelago, 522 m (Alcock, 1902c).

DESCRIPTION: Corallum small and highly compressed (GCD: LCD = 1.7–2.3), the inclination of lateral faces only 14–18°. Angle of thecal edges usually bimodal, at a height of 5–6 mm changing from 58–80° to a narrower 21–35°. Largest New Zealand specimen (NZOI Stn K858) 12.7 x 7.8 mm in calicular diameter and 14.8 mm in height, not much smaller than the largest syntype of 13.8 mm GCD. Sixty-two of the 68 New Zealand specimens from Stn BS441 originate in a small pedicel 1.3–1.4 mm in diameter containing 12 protosepta. Their lower thecal edges are sharp to carinate, their upper edges rounded and non-spinose. The remaining six specimens are anthocyathi that resulted from transverse division and thus have a trapezoid shape (Plate 37, f). Separated anthocyathi are similar in shape to pedicellate coralla as viewed from above the thecal edge inflection, and usually have 2 or 3 pairs of edge spines and a basal scar diameter of 3.3–3.7 x 2.2–2.6 mm. All septa nonexsert, producing a smooth calicular margin. Well-preserved coralla have a smooth, porcellanous theca bearing reddish-brown stripes corresponding to every interseptal space.

Septa hexamerally arranged in 3 to 5 cycles, the last cycle never complete. Small coralla of 6–7 mm GCD often have only 4 pairs of S4, one pair in each end half-system, resulting in 32 septa. As corallum increases in size (e.g., 7–9 mm

GCD), additional pairs of S4 form in the 2 lateral half-systems until a full fourth cycle is achieved (48 septa). In larger coralla of 8–10 mm GCD, pairs of S5 occasionally occur in end half-systems before the fourth cycle is complete. Largest coralla (GCD 10–13 mm) have a full fourth cycle and 4 pairs of S5, for a total of 56 septa. S1–2 have extremely sinuous inner edges, the sinuosity extending from calicular edge to columella. S3 about half width of an S1–2 and have less sinuous inner edges. S4 about half width of an S3 and have straight inner edges. Upper edges of all septa quite narrow and broadly concave near calicular edge (SCI about 10). Fossa deep and elongate, containing a trabecular columella 0.7–0.8 mm wide composed of the inner edges of the S1–2.

TYPES: Nine syntypes of *F. dens* are deposited at the ZMA (Coel. 1209).

TYPE LOCALITY: *F. dens*: *Siboga* Stn 95, 5°43.5′ N, 119°40′ E (Sulu Archipelago), 522 m.

REMARKS: Previously known from only nine worn syntypes, 71 additional specimens of *T. dens* are herein reported from four localities, many of these specimens alive when collected. The population of 68 specimens from BS441 show that the species may asexually reproduce by transverse division, but that most specimens remain intact and do not divide. The syntype series of nine specimens are all in the latter category and thus I had placed the species in *Flabellum (Flabellum)* (Cairns 1989a), but because the species occasionally reproduces by transverse division, it is perhaps better placed in *Truncatoflabellum*, as Zibrowius (1974d) earlier implied.

Among the approximately 33 species in the genus, *T. dens* is distinguished by its unique tooth-like shape; its relatively small corallum; and its low number of adult-stage septa (48–56). It is quite similar to but differs from *T. pusillum* Cairns, 1989a (Philippines, 143–146 m) in having a more elongate calice (GCD: LCD = 1.7–2.3 vs 1.4–1.7 for *T. pusillum*), a larger corallum, and a lesser tendency to divide transversely. It is also similar to *T. zuluense* Cairns (*in* Cairns & Keller, 1993), which is known from the southwest Indian Ocean at 62–84 m, both species having a tendency to remain intact and to lack edge spines; however, *T. dens* differs in having a more highly compressed (lower face angle), a more elongate calice (higher GCD: LCD), a bimodal edge angle, and a smaller pedicel diameter.

Truncatoflabellum phoenix n. sp.
(Plates 37, i, 38, a-f)

Truncatoflabellum sp. B: Cairns 1994: 79 , pl. 33, figs i, l.

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: New Zealand region: Kermadec Ridge between Raoul and Macauley Islands (Map 21); 145–179 m. Elsewhere: northern Ryukyu Islands; 80–88 m (as *Truncatoflabellum* sp. B Cairns, 1994).

DESCRIPTION: Corallum an elongate, compressed (GCD: LCD = 1.3–2.3) tube, having parallel thecal edges and faces, resulting in a basal scar equal in size to calice. Holotype 4.3 x 2.7 mm in calicular diameter and 7.4 mm long; however, another specimen from the same lot and same GCD is 17.5 mm long (H: GCD = 4.1). Long coralla characterised by multiple regeneration events, the daughter corallum usually smaller in diameter than the parent, at least initially. Calicular edges rounded, with 1–6 pairs of slender, cylindrical, downward-curved edge spines, the number proportional to length of corallum. Calicular edge smooth. Theca smooth and por-cellanous, pigmented periodically with transverse brown bands about 2.5 mm thick.

Septa hexamerally arranged in only 3 cycles: S1–2>>S3. Several specimens from the Ryukyu Islands have pairs of S4 in their end half-systems for a total of 32 septa. S1–2 not exsert, with quite sinuous inner edges and spinose faces. S3 only one-third to half width of an S1–2, much thinner, and rudimentary lower in fossa. Fossa of moderate depth, containing a relatively well-developed columella about 0.6 mm in width composed of a fusion of the lower, inner edges of the S1–2.

TYPES: Holotype: NZOI Stn C531, H-632, USNM 94616. Paratypes: NZOI Stn C531, 6, P-1054, USNM 82010; NZOI Stn K825, 1, P-1055, USNM 94277; TM (KT9202, YT1), 1, USNM 92811.

TYPE LOCALITY: 29°14′40 S, 178°02 W (south of Raoul Island), 179 m.

ETYMOLOGY: The species name *phoenix* (Latin *phoenix,* having regenerative powers) refers to the elongate coralla of this species characterised by multiple events of regeneration.

REMARKS: *Truncatoflabellum phoenix* is most similar to *T. dens*, but differs from it and all other species in the genus by having parallel thecal edges and faces and a slender, elongate corallum characterised by multiple regeneration events. It also has the least number of septa of all species.

Truncatoflabellum arcuatum n. sp.
(Plate 38, g-i)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Known only in the New Zealand region, from southern Norfolk and Kermadec Ridges and off Cape Egmont (Map 12); 350–364 m.

DESCRIPTION OF ANTHOCYATHUS: Corallum shaped like a tall isosceles triangle with a truncate tip. Angle of thecal edges 14–15°; inclination of thecal faces 8–11°. Corallum straight or, in large specimens, slightly curved in axis of LCD, the height of the corallum up to 3.5 times the GCD. Calicular edges straight and acute, the holotype having several very low (0.3 mm) edge crests, but no edge spines. Calicular edge smooth and slightly arched in side view and quite laterally compressed (GCD: LCD = 1.8–2.6). Holotype 12.0 x 6.1 mm in calicular diameter and 24.3 mm in height, with a scar diameter of 5.9 x 2.7 mm; however, largest specimen (NZOI Stn C640, dead) 12.2 x 5.9 mm in calicular diameter and 40.1 mm in height. Basal scar 3.3–5.9 x 2.1–2.7 mm. Theca smooth, porcellanous, and always white. Corallum dense. Anthocaulus unknown.

Septa hexamerally arranged in 4 cycles, larger specimens having some pairs of S5 in end half-systems (e.g., the holotype has 6 pairs of S5 for a total of 60 septa). Septal formula: S1–2>S3>>S4. S1–2 not exsert and have very sinuous inner edges. S3 one-third to half width of an S12 and have slightly sinuous inner edges that sometimes reach the columella deep in fossa. S4 rudimentary, expressed only in upper half of corallum. Fossa of moderate depth, containing a well-developed trabecular columella that fuses to the inner edges of the 12 S1–2 and various accelerated S3 in those half-systems having S5.

TYPES: Holotype: NZOI Stn I96, NZOI H-633. Paratypes: NZOI Stn C640, 3, P-1056, USNM 94280; NZOI Stn K795, 3, P-1057, USNM 94281.

TYPE LOCALITY: 32°10.8′ S, 167°21.2′ E (southern Norfolk Ridge between Norfolk Island and Three Kings Islands), 356 m.

ETYMOLOGY: The species name *arcuatum* (Latin *arcuatus,* bent like a bow) refers to the slight curvature of the corallum of larger specimens.

REMARKS: Among the approximately 33 species in this genus, *T. arcuatum* is distinguished by its highly compressed (face angle 8–11°), elongate (H: GCD up to 3.5) corallum, and its lack of thecal edge spines. It is perhaps most similar to *T. dens*, but can be distinguished by its larger size; acute, crested thecal edges; and larger basal scar.

Placotrochides Alcock, 1902b

Corallum solitary and compressed. Asexual reproduction by transverse division predominates, resulting in a distal anthocyathus and basal anthocaulus. Anthocaulus base reinforced with stereome. Calicular margin smooth. Thecal edge spines and crests absent. Pali absent; columella well developed.

TYPE SPECIES: *Placotrochides scaphula* Alcock, 1902b, by subsequent designation (Wells 1936).

REMARKS: *Placotrochides* differs from *Truncatoflabellum* by having a stereome-reinforced anthocaulus base. It differs from most species of *Truncatoflabellum* by lacking thecal edge spines and crests, having a relatively small edge angle, and in having widely spaced septa. Only two species are attributed to this genus: *P. frusta* Cairns, 1979 (Atlantic, 497–1300 m) and *P. scaphula*.

Placotrochides scaphula Alcock, 1902
(Plates 38, j, 39, a)

Placotrochides scaphula Alcock, 1902b: 121–122; 1902c: 34, pl. 4, figs 32, 32a; Cairns 1989a: 78–79, pl. 40, fig. l, pl. 41, figs a-e (synonymy); Cairns & Parker 1992: 48–49, fig. 15h, i; Cairns & Keller 1993: 272–273, pl. 12, figs D, G; Cairns 1994: 79–80, pl. 34, figs f-h.

MATERIAL EXAMINED: New Record: NZOI Stn G941, 2, NZOI, 2, USNM 94273. Previous Records: Holotype; specimens reported by Cairns (1989a, 1994) and Cairns and Keller (1993).

DISTRIBUTION: New Zealand region: only known from one station off Hawkes Bay (Map 9); 665 m. Elsewhere: off Japan; Philippines; Flores Sea; southwest Indian Ocean, Victoria, Australia; 80–1628 m.

DIAGNOSIS OF SPECIMENS FROM NZOI STN G941: Corallum shaped like that of *T. arcuatum*, but not quite as compressed (GCD: LCD = 1.4–1.6). Angle of thecal edges 10–11°; inclination of lateral faces 9–10°. Corallum elongate: H: GCD up to 2.3. Calicular edges straight, the faces meeting at an acute angle but not crested or spinose. Calicular edges smooth and slightly arched. Largest specimen examined 11.8 x 8.1 mm in calicular diameter and 26.6 mm in height, with a scar diameter of 7.5 x 4.5 mm. Theca smooth, but appearing worn (not porcellanous), marked by very thin longitudinal striae 0.05–0.10 mm thick that correspond to each C1–3 and delimit flat costae about 0.1 mm wide. Septa hexamerally arranged in 4 complete cycles (48 septa) according to the formula: S1–2>S3>>S4. S1–2 not exsert, with moderately sinuous inner edges. S3 only half width of S1–2 in upper corallum but their lower, inner edges reach the columella. Septa rudimentary, extant only in upper corallum. Fossa of moderate to great depth, containing a well-developed trabecular columella about 1.5 mm in width.

TYPES: The holotype is deposited at the ZMA (Coel. 1094).

TYPE LOCALITY: *Siboga* Stn 212, 5°54.5′ S, 120°19.2′ E (Flores Sea), 462 m.

REMARKS: The holotype is a small specimen only 6.9 mm in GCD having scarcely over three cycles of septa (28). Much larger specimens have been reported from off the Philippines (Cairns 1989a, i.e., 13 mm GCD) and of Japan (Cairns 1994, i.e., 10 mm GCD). Although the New Zealand specimens are not the largest known in calicular diameter (11.8 mm), they are by far the longest known specimens (up to 26.6 mm long), having a H: GCD up to 2.3 compared with a H: GCD of ≤ 1 for most previously reported specimens. The New Zealand specimens also have a full complement of 48 septa, not achieved by even the larger Philippine coralla. *Placotrochides scaphula* is thus assumed to reach a maximum GCD of about 12–13 mm and a septal complement of 48 septa after which it increases in size by adding to its length.

In the New Zealand region, *P. scaphula* could easily be confused with *Truncatoflabellum arcuatum*, both species having convergent corallum shape and size. *Placotrochides scaphula* is distinguished by having a fuller corallum (i.e., a lower GCD: LCD), a better developed columella, a nonporcellanous theca; and less sinuous and more widely spaced septa.

Falcatoflabellum n. gen.

Corallum solitary, elongate, and cylindrical; corallum slightly curved and compressed. Asexual reproduction by transverse division predominates; anthocaulus unknown. Calicular margin slightly serrate. Thecal edge spines and crests absent. Columella fascicular; paliform lobes occasionally present before S2.

TYPE SPECIES: *Falcatoflabellum raoulensis*, here designated.

ETYMOLOGY: The genus name *Falcatoflabellum* (Latin *falcatus*, curved like a sickle + *flabellum*, fan) refers to the gently curved nature of the corallum of the type species. Gender: neuter.

REMARKS: Among the twelve genera recognised within the Flabellidae (Cairns 1989a: table 4), *Falcatoflabellum* most closely resembles *Conosmilia* Duncan, 1865, both genera having relatively small coralla with only three size classes of septa and a fascicular columella. [Most flabellid genera have a rudimentary fused columella, two have lamellar columellas, and one has a papillose columella.] *Falcatoflabellum* differs from *Conosmilia* in reproducing by transverse division; it also has a cylindrical corallum, whereas that of *Conosmilia* is ceratoid. Also, *Falcatoflabellum* has predominantly hexameral symmetry (24 septa), whereas *Conosmilia* has predominantly octameral symmetry (32 septa). *Conosmilia* is known only from the upper Eocene to Miocene of South Australia (Duncan 1865, 1870).

Among the four flabellid genera that have transverse division (Cairns 1989a: table 4) *Falcato-*

flabellum is most similar to *Placotrochides*, both genera having cylindrical, slightly compressed coralla with basal scars, but *Falcatoflabellum* differs in having a fascicular columella and paliform lobes.

Falcatoflabellum raoulensis n. sp.
(Plate 39, b-g)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Known only from off Raoul Island, Kermadec Islands; 366-402 m.

DESCRIPTION: Corallum cylindrical and only slightly compressed (GCD: LCD = 1.1–1.2), elongate specimens gently curved up to 45° in plane of GCD. Holotype 2.62 x 2.17 mm in calicular diameter and 9.8 mm in height (H: GCD = 3.7). Elongate specimens often display evidence of regeneration or rejuvenescence, a smaller-diameter corallum issuing from the calice of a slightly larger parent corallum. Some elongate coralla also evidence incomplete divisions, represented by a transverse weakness of the corallum that untimately breaks after death or upon collection, resulting in "middle" fragments that have no distinct calice. Basal scar planar and usually of equal size to calice. Calice not arched, but flat and slightly serrate, the S1–2 rising to small triangular apices. Epitheca porcellanous and smooth, but on higher magnification (Plate 39, b) one observes broad (0.25–0.30 mm), flat costae separated by very thin (about 30 µm) longitudinal rows of irregularly shaped, shallow pores, which constitute the intercostal striae. Corallum white to translucent. Anthocaulus stage unknown.

Septa of most specimens hexamerally arranged in 3 complete cycles (S1>S2>S3); however, 6 specimens (7.1% of specimens examined) have heptamerally arranged septa (i.e., 7:7:14 = 28 septa) and one specimen has pentamerally arranged septa (i.e., 5:5:10 = 20 septa). S1 about 0.3 mm exsert, with extremely sinuous inner edges. S2 slightly less exsert, about three-quarters width of an S2, also with sinuous inner edges. S3 not exsert, about half width of an S2, and much thinner than other septa. Faces of S1–2 bear tall (up to 80 µm), pointed granules. Fossa shallow, containing a well-developed columella composed of 2-4 broad (0.25–0.40 mm), loosely twisted fascicular elements. Often 4 columellar elements are arranged in a diamond shape, 2 aligned with the principal septa and the other 2 aligned with the opposing S2 in the lateral systems. Occasionally several lobes are present before the S2; however, they may be entirely absent from a corallum, and, when present, never occur before all 6 or 7 S2. Paliform lobes lamellar or fascicular in shape, but invariably smaller than columellar elements.

TYPES: Holotype: BS441, MoNZCO258. Paratypes: BS441, 63, MoNZ CO258, 20, USNM 94313.

TYPE LOCALITY: 3.7 km off Nugent Island, Raoul Island, Kermadec Ridge, 366-402 m.

ETYMOLOGY: This species is named for its type locality, Raoul Island.

REMARKS: See remarks on genus.

Suborder DENDROPHYLLIINA
Family DENDROPHYLLIIDAE Gray, 1847

Balanophyllia S. Wood, 1844

Corallum solitary, ceratoid to trochoid, fixed or free. Synapticulotheca often costate and/or covered with epitheca. Septa arranged in a Pourtalès Plan. Pali/paliform lobes may or may not be present; columella papillose to spongy.

TYPE SPECIES: *Balanophyllia calyculus* S. Wood, 1844, by monotypy.

REMARKS: Approximately 53 recent species of *Balanophyllia* are known, at least 31 of which are recorded from the Indo-West Pacific realm. Whereas the Atlantic and eastern Pacific species are relatively well known (Cairns 1977b, 1994, Zibrowius 1980), the Indo-West Pacific species are in need of revision, several species known only from their type specimens and many reported only a few times. Three species are reported from the New Zealand region; however, over a dozen lots remain unidentified either because of poor preservation or because they are unique specimens not referrable to any known species.

Balanophyllia chnous Squires, 1962
(Plate 40, a-e)

"*Thecopsammia*, sp.? *Balanophyllia*, sp.?" Gardiner 1929: 126–127.

Balanophyllia chnous Squires, 1962b: 13, 21–22, pl. 1, fig. 17, pl. 2, figs 1–3; 1969: 17–18, pl. 6, map 2; Cairns 1982: 54–57, pl. 16, figs 1–3.

MATERIAL EXAMINED: New Records: NZOI Stn E278, 7, USNM 94222; Stn E841, 6, NZOI; Stn E848, 8, USNM 94223; Stn F924, 2, USNM 94221; Stn F928, 1, NZOI; Stn F933, 1, NZOI; Stn J953, 2, USNM 94224; Stn J959, 4, NZOI; BS396, 1, MoNZ CO106; BS642 (P574), 1, MoNZ CO289; BS881 (O627), 9, MoNZ CO282; BS895 (O641), 20, MoNZ CO307 and 313; BS896 (O642), 6, MoNZ, 3, USNM 94225; BS897 (O643), 16, MoNZ CO223, 2, USNM 94226; BS898 (O644), 4, MoNZ CO289; J01/56/71, 1, MoNZ CO242. Previous Records: Holotype of *B. chnous*.

DISTRIBUTION: Known only from a small region between Three Kings Islands and North Cape (Map 8); 140–549 m, although most records are shallower than 300 m.

DESCRIPTION: Corallum ceratoid and elongate; straight to irregularly bent; and attached by a robust pedicel (PD: GCD = 0.43–0.51). Largest specimen examined (MoNZ CO242) 17.4 x 13.3 mm in calicular diameter and 48 mm in height. Coralla often attached to dead coralla of *Monomyces rubrum* forma *nobile*, as well as to bivalve shells, echinoid tests, and rocks. Pedicel and base appear to be polycyclic, and occasionally a specimen appears to have a contiguous rootlet. Most coralla have a thick epitheca that reaches to within 5–8 mm of calicular edge. Epitheca usually heavily encrusted with foraminiferans, serpulid tubes, bryozoans, sponges, and juveniles of *B. chnous*. Corallum above epitheca composed of a very porous, non-costate synapticulotheca. Corallum white.

Septa hexamerally arranged in 4 cycles at a GCD of 6–9 mm, additional pairs of S5 present in larger coralla, up to a maximum complement of 72 septa in the largest coralla examined. S1 only slightly exsert and have straight, vertical, entire inner edges that reach the columella. S2 slightly less exsert, about four-fifths width of an S1, and have entire inner edges that reach the columella only if the columella is quite large. S3 small (about one-quarter width of an S2) and porous, with laciniate inner edges. Pairs of S4 fuse before their common S3 and continue to columella as a single septum, sometimes loosely merging with inner edges of the other S4 within the system. S4 also porous, with laciniate inner edges. Fossa shallow to moderate in depth, containing a discrete, convex, elongate columella composed of numerous fine papillae. In some coralla the width of the columella is as much as one-third the LCD, but it is usually somewhat smaller.

TYPES: The holotype (1929.10.22.25) and five paratypes (1929.10.22.22–24, 26–27) are deposited at the BM(NH). They are the same specimens reported by Gardiner (1929) as: "*Thecopsammia*, sp.? *Balanophyllia*, sp?".

TYPE LOCALITY (corrected): *Terra Nova* Stn 91, "from Summit, Great King, Three Kings Islands, S. 10°W, 25 miles", 549 m (*see* Remarks).

REMARKS: I earlier suggested that there may have been a labelling error concerning the type locality of *B. chnous* (Cairns 1982). *Terra Nova* Stn 191 (Bay of Whales, Ross Sea) is given as the collection locality for this species by Gardiner (1929) at the beginning of his species account, in the general introduction, and on the label of the holotype. However, *Terra Nova* Stn 91 (off Three Kings Islands) is given as the locality at the end of Gardiner's species account, four other species also reported by Gardiner from this same *Terra Nova* station. No additional specimens of *B. chnous* have been collected in the Antarctic, despite extensive collections made in the Ross Sea (Cairns 1982). Nonetheless, the matter was left unresolved by Cairns in 1982. In this paper many additional specimens of *B. chnous*, some virtually identical to the holotype, are reported from 16 stations all in the vicinity of Three Kings Islands (i.e., near *Terra Nova* Stn 91). There is little doubt that the type series of *B. chnous* originated from the Three Kings Islands region (*Terra Nova* Stn 91, not 191) and that a mislabelling occurred after collection.

Balanophyllia chnous is distinguished from the other two New Zealand *Balanophyllia* by having a relatively small, ceratoid corallum with a heavily encrusted basal epitheca and a relatively well-developed columella. It is also known from a very restricted geographic range.

Balanophyllia gigas Moseley, 1881

(Plate 40, f-h)

Balanophyllia gigas Moseley, 1881: 193; Cairns 1994:

83, pl. 35, figs j-l (synonymy).

Balanophyllia alta: Ralph & Squires 1962: 15 (in part: pl. 8, figs 2–3, specimen from Cook Strait).

Dendrophyllia japonica: Ralph & Squires 1962: 15–16, pl. 8, figs 4–5; Squires & Keyes 1967: 28 (in part: miscellaneous stations 44, 56, C627).

Balanophyllia hawaiiensis Vaughan, 1907: 148–149, pl. 44, figs 4–5 (new synonymy).

Material Examined: New Records: NZOI Stn J686, 6, USNM 94219; Stn J705, 7, NZOI; Stn J971, 2, NZOI; Stn J976, 1, USNM 94220; BS630, 4, MoNZ CO123; *Tui* (Rumble IV Seamount), 1, AU11141, AUM. Previous Records: Holotype of *B. gigas* and syntypes of *B. hawaiiensis;* specimens reported as *B. alta* and *D. japonica* by Ralph and Squires (1962); specimens reported as *D. japonica* by Squires and Ralph (1967).

Distribution: New Zealand region: off coastal New Zealand (Map 7); 148–640 m, although most records shallower than 300 m, the shallowest off Fiordland. Elsewhere: off Japan; Kai Islands, Banda Sea; off Hawaii; 90–348 m.

Description: Corallum ceratoid and elongate; usually straight but some coralla slightly curved; and attached by a robust pedicel (PD: GCD = 0.42–0.57). Largest specimen examined (*D. japonica* of Ralph & Squires, 1962: AIM AK33937) 33.3 x 27.5 mm in calicular diameter and 79 mm in height, with a pedicel diameter of 16.5 mm. Clumping of solitary coralla may superficially resemble a rudimentary colonial structure. Synapticulotheca of homogeneous, nonepithecate porosity, with poorly defined costae only on lower pedicel of some coralla and/or expressed as slight elevations of the C1–3 in upper corallum. Corallum white.

Septa hexamerally arranged in 5 cycles, the fourth cycle complete at a GCD of about 12 mm, the fifth at a GCD of about 21 mm, and the largest circular corallum of 33 mm GCD has half of the sixth cycle, resulting in 144 septa. S1–2 slightly exsert (about 1 mm) and quite wide, their inner edges almost meeting their counterparts from the opposite face. Inner edges of S1–2 vertical, straight, entire, and often slightly thickened, their size and characteristics making them easily distinguished. S3 also slightly exsert and about four-fifths width of an S1–2, equal to S1–2 in width if S6 are present in a half system. S4 small, each flanked by a pair of laciniate S5, which fuse before each S4 and extends to columella. In large coralla a broad paliform lobe occurs on inner edge of each S5 that lies adjacent to an S1 or S2, a pair of P5 occurring near the inner edge of each S3. Septal faces minutely spinose, appearing smooth. Fossa deep and narrow, containing a rudimentary trabecular columella.

Types: The holotype of *B. gigas* is deposited at the BM(NH) (1880.10.11.23). Four syntypes of *B. hawaiiensis* are deposited at the USNM (20823).

Type Localities: *B. gigas*: "Japan", depth unknown. *B. hawaiiensis*: *Albatross* Stn 4059, 19°48′ N, 154°48′ W (off Hawaii), 348–532 m.

Remarks: Ralph and Squires (1962) identified *B. gigas* as both the Miocene *B. alta* and recent *Dendrophyllia japonica*. Although similar in size and robustness to *D. japonica*, *B. gigas* is distinguished by having a solitary, attached corallum; lacking discrete costae; having prominent S1–2 and a full fifth cycle at a GCD of only 21 mm; and in having a narrower fossa and corresponding smaller columella.

The New Zealand specimens of *B. gigas* differ slightly from Japanese specimens in lacking an epitheca and in having less well-defined costae. *Balanophyllia gigas* is the largest of all species in the genus, the New Zealand specimens being the largest known specimens of the species.

Balanophyllia crassitheca n. sp.
(Plates 40, i, 41, a, b)

Material Examined: Types, q.v.

Distribution: Known only from the New Zealand region off Lord Howe and Norfolk Islands; the Kermadec Ridge; and off northeastern North Island (Map 18); 190–508 m.

Description: Corallum ceratoid to trochoid; usually straight; and firmly attached by a thick pedicel (PD: GCD = 0.30–0.56). Largest specimen examined (NZOI Stn J686) 17.8 x 14.4 mm in calicular diameter and 46 mm in length, with a pedicel diameter of 9.2 mm; holotype 19.0 x 15.1 mm in calicular diameter, but only 29 mm in height, the pedicel being broken. Coralla usually attached to rocks or dead coralla of same species. Lower half to two-thirds of corallum epithecate and covered with encrusting organisms. Synapticulotheca near calice quite porous and only weakly costate, bearing poorly-defined, shallow

intercostal striae. Theca extremely thick, in some coralla up to 4.2 mm in width. Corallum white.

Septa hexamerally arranged in 4 complete (48 septa) cycles, occasionally with an incomplete fifth cycle, the largest calice having 72 closely spaced septa. S1–2 equal in size; only very slightly exsert (about 1 mm); with straight, entire inner edges that change to coarsely dentate in vicinity of columella. In half systems lacking S5, S3 are about half width of S1–2 and flanked by a pair of S4 that have very coarsely dentate inner edges, each pair merging before its common S3 and continuing to the columella as a single septum. In half systems with one pair of S5, the S4 adjacent to the S2 and the S5 adjacent to the S1 are of equal width, with coarsely den-tate inner edges (rectangular teeth), their inner edges often fusing near the columella. In some half systems 2 pairs of S5 are present. Fossa of moderate depth, containing a small, elongate, non-discrete (flat to slightly concave, merging with inner edges of S1–2,4,5) columella composed of very fine papillae.

TYPES: Holotype: BS715 (R73), MoNZ CO222. Paratypes: NZOI Stn C527, 1, P-1058, USNM 94227; NZOI Stn J686, 12, P-1059, USNM 94228; NZOI Stn J705, 4, P-1060, USNM 94229; NZOI Stn J971, 1, P-1061, NZOI; Stn K844, 1, P-1062, NZOI; Stn P35, 1, P-1063, NZOI; Stn P85, 1, P-1064; MoNZ BS571, 1; MoNZ BS715 (R73), 1, MoNZ CO222, 2, USNM 94230; BS843 (O589), 3, MoNZ CO216 and 276.

TYPE LOCALITY: 37°17.0'S, 176°51.0'E (Rangatira Knoll, northwest of White Island, Bay of Plenty), 251–308 m.

ETYMOLOGY: The species name *crassitheca* (Latin *crassus*, thick + *theca*, container) refers to the thick theca of this species.

REMARKS: Given the confused state of the taxonomy of the Indo-Pacific *Balanophyllia*, it may seem foolhardy to describe yet another species, but *B. crassitheca* appears to differ from all other species in having a very thick theca, crowded septa, and coarsely dentate inner septal edges. It was directly compared to over half of the Indo-Pacific species based on voucher specimens deposited in the USNM, and to the other species through the literature.

Endopachys Lonsdale, 1845

Corallum solitary, cuneiform, and free, with alate edge crests on lower corallum. Asexual reproduction by budding from thecal edges common. Synapticulotheca weakly costate and highly porous. Septa arranged in a Pourtalès Plan. Paliform lobes (usually P4) present; columella rudimentary to spongy.

TYPE SPECIES: *Turbinolia maclurii* Lea, 1833, by subsequent designation (Milne Edwards & Haime 1850: lii).

REMARKS: *Endopachys* is quite similar to *Balanophyllia*, but differs in the cuneiform shape of its corallum and its propensity to bud from its thecal edges, although *B. stimpsonii* and *B. carinata* also bud coralla from their theca. The latter species is intermediate in corallum shape between the two genera. One recent and five fossil species are recognised (Wells 1975).

Endopachys grayi Milne Edwards & Haime, 1848 (Plate 41, c-h)

Endopachys grayi Milne Edwards & Haime, 1848b: 82–83, pl. 1, figs 2, 2a; Cairns 1984: 27, pl. 5, fig. E (synonymy); Cairns & Keller 1993: 276; Cairns 1994: 84–85, pl. 36, figs e, h, pl. 37, fig i (synonymy).
Endopachys oahense Vaughan, 1907: 147–148, pl. 44, fig. 3.

MATERIAL EXAMINED: New Records: NZOI Stn E864, 85, USNM 94208; Stn I743, 3, NZOI; Stn K818, 1, NZOI; Stn K819, 1, NZOI; Stn P1, 17, USNM 94209; Stn P2, 9, USNM 94210; Stn P5, 1, NZOI; BS434, 10, MoNZ; BS833 (O578), 37, MoNZ CO287; BS882 (O628), 13, MoNZ CO283; BS883 (O629), > 100, MoNZ. Previous Records: Holotype of *E. oahense*.

DISTRIBUTION: New Zealand region: southern Norfolk Ridge; south of Three Kings Islands; Kermadec Ridge off Raoul Island; off East Cape (Map 13); 95–143 m. Elsewhere: widespread in tropical and warm temperate Indo-Pacific from off South Africa to Japan and Gulf of California, including south of Chesterfield Islands (New Caledonia) (reported herein); 37–386 m.

DESCRIPTION: Corallum triangular, with a highly compressed, rounded base. Edge angle a relatively constant 25–30°, but face angle only 15-25° for basal 9–10 mm, above which the faces di

verge at a much higher angle (i.e., 42–57°) resulting in an almost circular to diamond-shaped calice having a GCD: LCD of only 1.1–1.2. One of the largest New Zealand specimens (NZOI Stn E864) is 19.9 x 17.7 mm in calicular diameter and 27.8 mm in height. Thecal edges of basal thick and bulbous, up to 3 mm thick. Thecal faces above this swollen crest meet in an acute angle and invariably support several buds or scars of bud detachment. Asexually generated buds rarely maintain a connection beyond a corallum height of 4–5 mm; however, in some specimens the connection is never severed (Plate 41, e, g, h). A bud occasionally forms at the base of a corallum, resulting in 2 connected coralla growing in opposite directions. No coralla were observed to be attached to a substratum other than its parent corallum. Coralla begin bud formation at the relatively early stage of 8-10 mm GCD. Synapticulotheca quite porous, each septum corresponding to a flat costa about 0.5 mm wide that is bordered by intercostal furrows about 0.2 mm wide. Corallum white.

Septa hexamerally arranged in 5 cycles, the fifth incomplete, a corallum 8–10 mm in GCD with 48 septa and one of the largest of GCD 19 mm with 90 septa. S1–2 slightly exsert, thick, porous, and have straight, finely dentate lower inner edges. S3 about half width of S1–2, with finely dentate inner edges that do not reach the columella. S4 usually slightly wider than the S3 they flank, each bearing a wide paliform lobe that is paired with another in each half-system. In larger coralla, upper calicular edges of S4 bifurcate, thus becoming paired S5, and another cycle of rudimentary, dentate S4 develop between each split S4. The paliform lobes thus eventually realign with these septa. Fossa deep. Columella often absent, but if present, expressed as an elongate fusion of lower inner edges of S1–2 and P4.

TYPES: The deposition of the holotype of *E. grayi* is unknown. The holotype of *E. oahense* is deposited at the USNM (20822).

TYPE LOCALITIES: *E. grayi:* unknown. *E. oahense*: *Albatross* Stn 3810, south of Oahu, Hawaiian Islands, 386–463 m.

REMARKS: Only one recent widely distributed and morphologically variable species of *Endopachys* is considered to exist, many of the nominal species synonymised by Umbgrove (1950). The New Zealand specimens differ slightly from most Indo-Pacific populations by having a taller and narrower corallum, characterised by a smaller edge angle of 25–30° (vs 50–55° for most populations). The New Zealand specimens also often have a thicker, bulbous basal crest region, which is more characteristic of the holotype of *E. oahense.*

Eguchipsammia Cairns, 1994

Basally unattached, recumbent coralla formed through sparse, irregular, extratentacular budding from an axial corallite. Lateral attachment to substrata by epitheca not uncommon. Synapticulothecate: costate and/or epithecate. Septa arranged in a Pourtalès Plan. Paliform lobes may be present; columella spongy to swirled.

TYPE SPECIES: *Dendrophyllia cornucopia* Pourtalès, 1871, by monotypy.

REMARKS: *Eguchipsammia* is distinguished from *Dendrophyllia* by having unattached, recumbent coralla with very sparse, irregular branching. Six species are currently recognised in the genus: *E. gaditana* (Duncan, 1873); *E. cornucopia* (Pourtalès, 1871); *E. japonica* (Rehberg, 1892); *E. fistula* (Alcock, 1902a); *E. serpentina* (Vaughan, 1907); and *E. wellsi* (Eguchi, 1968), three of which occur in the New Zealand region.

Eguchipsammia gaditana (Duncan, 1873)

(Plate 42, a-c)

Balanophyllia gaditana Duncan, 1873: 333.
Dendrophyllia gaditana: Zibrowius 1980: 176-178, pl. 89, figs A–N (synonymy); Cairns 1984: 25, pl. 4, fig. I (synonymy); Cairns & Keller 1993: 279–280.
Eguchipsammia gaditana: Cairns 1994: 85–86

MATERIAL EXAMINED: New Records: NZOI Stn C530, 4; NZOI Stn C531, 11, USNM 94241; NZOI Stn E865, 2, USNM 94242; NZOI Stn I71, 2, USNM 94243; NZOI Stn K803, 7; NZOI Stn K825, 1, USNM 94244; NZOI Stn K838, 4, USNM 94245; NZOI Stn K839, 1; NZOI Stn K842, 7; NZOI Stn K857, 2, USNM 94246; NZOI Stn T217, 1, USNM 94247; NZOI Stn U582, 1; BS310, 20, MoNZ CO83; BS313, 4, MoNZ CO93; BS437, 9, MoNZ CO265; BS896 (O642), 1, MoNZ CO232. Previous Records: Specimens reported by Zibrowius (1980).

DISTRIBUTION: New Zealand region: ridges north

of North Island, including Norfolk, Three Kings, and Kermadec Ridges (Map 15); 57–988 m, but most records between 100 and 200 m. Elsewhere: worldwide, including amphi-Atlantic, southwest Indian Ocean, off Hawaiian Islands, Australia, and Japan; 73–505 m.

DESCRIPTION: Corallum consists of an elongate, cylindrical, axial corallite from which numerous smaller corallites bud at right angles to the axial. Although secondary corallites bud within the edge zone region (0.5 mm from calice), they often remain attached long after the edge zone has progressed. Synapticulotheca beneath edge zone costate, each costa slightly convex, finely granular, and separated by thin porous intercostal furrows. In some coralla the C1–2 are slightly ridged. Proximal to edge zone, which may be as close as 1 mm to calice, costae are usually covered with a very thin epitheca. Largest New Zealand specimen examined (BS310) 90 mm long, bears 20 buds or scars of bud attachment, and has an axial GCD of 5.0 mm, although GCDs of 13 mm are common, especially for budding corallites. Corallum not basally attached to substratum, but occasionally sides of axial or secondary corallites adhere to hard substrata. Corallum white.

Septa hexamerally arranged in 3 to 4 cycles, depending on calicular diameter. Small corallites (e.g., GCD = 1–3 mm) usually have only 3 cycles of septa, cycles 2 and 3 being arranged in a Pourtalès Plan. Large calices with a variable number of S4, the largest corallites with a full 48 septa. S1 only slightly exsert, with smooth, vertical inner edges that fuse with the columella. S2 about half width of S1, each S2 enclosed by a pair of S3 that fuse directly before it high in the fossa and continues toward columella as a finely dentate septum. In larger corallites, pairs of S4 merge before their common S3 and ultimately before their common S2 within its system in a typical Pourtalès Plan. Columella a small, non-discrete, concave spongy mass in center of fossa.

TYPES: The holotype of *B. gaditana* is deposited at the BM(NH) (1883.12.10.97).

TYPE LOCALITY: *Porcupine* Stn 29, 36°20′ N, 6°47′ W (Iberian-Morocco Gulf), 417 m.

REMARKS: *Eguchipsammia gaditana* and *E. wellsi* are characterised as having very slender corallites and delicate coralla, but *E. gaditana* is distinguished by its nondiscrete, spongy columella; its fusion of S3–4 high in the fossa; and epithecate lower corallum (*see* Cairns 1994).

Eguchipsammia fistula (Alcock, 1902)
(Plate 42, d-h)

Balanophyllia (Thecopsammia) fistula Alcock, 1902a: 109; 1902c: 42, pl. 5, figs 36, 36a.
Dendrophyllia oahensis Vaughan, 1907: 154–155, pl. 46, fig. 1 (new synonymy); Cairns 1984: 25.
Dendrophyllia fistula: Cairns & Keller, 1993: 281 (synonymy).
Not *Balanophyllia fistula*: Yabe & Eguchi 1942b: 141.
Eguchipsammia fistula: Cairns 1994: 86 , pl. 36, figs f-g.

MATERIAL EXAMINED: New Record: NZOI Stn K842, 31 branch fragments, NZOI, 12, USNM 94240. Previous Records: Syntypes of *B. fistula* and holotype of *D. oahensis*.

DISTRIBUTION: Known from only one site in New Zealand region off Macauley Island, Kermadecs (Map 22); 325 m. Elsewhere: western Indian Ocean; off Maldives; Sulu Archipelago; Hawaiian Islands; 210–900 m.

DESCRIPTION: Corallum consists of an elongate, cylindrical, axial corallite, from which several corallites of about equal diameter bud at right angles. Epitheca thick, usually extending to within 1 mm of the calice and masking the underlying costae and synapticulotheca. Epitheca smooth, but composed of fine (25–65 µm wide) transverse corrugations. Largest Kermadec specimen 6.4 x 5.7 mm in calicular diameter and 57 mm in length, sporting only 3 buds and one scar of bud detachment. Coralla rarely, if ever, basally attached; however, scattered epithecal attachment to small objects is not uncommon. Corallum white.

Septa hexamerally arranged in 4 complete cycles (48 septa): S1–2 independent, S3-4 arranged in a Pourtalès Plan. S1 slightly exsert, with straight, vertical inner edges that border the columella. S2 equally exsert and only slightly less wide than the S1. S3 quite small, a pair of S4 meeting before its common S3 often in a small paliform lobe (P3). Inner edges of S1–4 and paliform lobes smooth (not dentate). Fossa relatively shallow, containing a discrete, convex columella composed of closely swirled fascicular elements.

TYPES: Three syntypes of *B. fistula* are deposited at the ZMA (Coel. 563, 564). The holotype of *D. oahensis* is deposited at the USNM (20827).

TYPE LOCALITIES: *B. fistula*: *Siboga* Stn 105 and 107, Sulu Archipelago, Philippines; 270–275 m. *D. oahensis*: *Albatross* Stn 4114, 21°40'10 N, 158°08'45 W (Waimea Bay, Oahu, Hawaiian Islands), 282–357 m.

REMARKS: Comparison of the syntypes of *B. fistula* to the holotype and other Hawaiian specimens of *D. oahensis* show no differences. Among the three species of *Eguchipsammia* known from the New Zealand region, *E. fistula* is intermediate in size, and characterised by having a very well-developed epitheca and a shallow fossa.

Eguchipsammia japonica (Rehberg, 1892) n. comb.

(Plate 43, a-c)

Dendrophyllia japonica Rehberg, 1892: 28–29, pl. 4, fig. 4; Van der Horst 1926: 44–45, pl. 3, figs 4–5; Gardiner 1929: 127, pl. 1, figs 1–2; Squires & Keyes 1967: 28, pl. 6, figs 6–8; Dawson 1979: 28; Cairns 1994: 90 (synonymy).

Not *Dendrophyllia japonica* Van der Horst, 1922: 51 (junior primary homonym).

Not *Dendrophyllia japonica*: Ralph & Squires 1962: 15–16, pl. 8, figs 4–5 (= *Balnophyllia gigas*).

Balanophyllia alta: Ralph & Squires 1962: 15 (in part: pl. 8, fig. 1).

MATERIAL EXAMINED: New Records: NZOI Stn D242, 12, USNM 94212; Stn D424, 12, NZOI; Stn F933, 9, USNM 94213; Stn I375, 4, NZOI; Stn J683, 5, NZOI; Stn J711, 8, NZOI, 2, USNM 94214; Stn J716, 7, USNM 94216; Stn K795, 1, NZOI; Stn K826, 12, NZOI; Stn P13, 5, NZOI; Stn Z2098, 8, NZOI; BS314, 5, NZOI; BS313, 1, MoNZ CO126; BS630, 3, MoNZ CO123; *Eltanin* Stn 1718, >20, USNM 79500. Previous Records: Specimens reported by Squires and Keyes (1967) and Ralph and Squires (1962) as *D. japonica*.

DISTRIBUTION: Widespread in New Zealand region from the northern ridges to off Fiordland and Chatham Rise (Map 5); 142–785 m. Elsewhere: off Japan; Banda Sea; 115–245 m.

DESCRIPTION: Corallum robust, subcylindrical, and elongate, often vermiform. Largest New Zealand specimen (*Eltanin* Stn 1718) 150 mm long and 20.5 mm in GCD, although some populations (e.g., NZOI Stn J711) have consistently smaller calicular diameters that rarely exceed 8–10 mm. Irregular, asexual budding from edge zone quite common, some coralla having 10–20 buds or scars of bud detachment, the latter more common on lower theca. Third generation buds never observed. Base of all coralla either organically connected to parent corallum or broken, the latter condition a result of detachment from parent; coralla not observed attached to a substratum. Costae well defined, consisting of very finely spinose, flat to slightly convex strips 0.3–0.5 mm wide that are usually present from base to calice. Intercostal striae narrow (about 0.1 mm) and porous. Corallum white, the coenosarc (edge zone) extending only 20–40 mm from calice, below which the synapticulotheca appears worn.

Septa hexamerally arranged in 5 cycles, the fifth cycle always incomplete. Coralla 4 mm in GCD have only 3 cycles; those 5–9 mm in GCD have a complete fourth cycle; and larger coralla (up to 20 mm GCD) contain pairs of S5, but in no specimen was a complete fifth cycle present. S1 not exsert, their straight inner edges usually extending well into fossa. S2 four-fifths width of an S1, but also merge with columella low in fossa. S3 also independent and about two-thirds width of an S2. In half-systems lacking S5, the 2 S4 merge before the S3 and have dentate inner edges in this region. One or 2 pairs of S5 occur in half-systems of larger coralla, developed in a Pourtalès Plan. Fossa deep and elongate. Columella quite variable, some small coralla with fascicular columella, whereas most larger coralla have an elongate, papillose columella of variable size. Endothecal dissepiments present.

TYPES: Two syntypes of *D. japonica* are deposited at the ZMB (Van der Horst 1926).

TYPE LOCALITY: "Japan."

REMARKS: Previously (Cairns 1994), I placed Rehberg's *D. japonica* in *Dendrophyllia* because I interpreted its large-diameter basal fractures as evidence that it was an attached, sparsely branched dendrophylliid. After having examined more specimens from the New Zealand region, I now see that buds may attain a large basal diameter prior to detachment, and that the New Zealand taxon previously identified as *D. japonica* has a recumbent corallum with randomly arranged, detachable buds — characteristic of

the genus *Eguchipsammia*. In fact, it is remarkably similar to, if not conspecific with, the type species *E. cornucopia* (Pourtalès, 1871), known only from the Atlantic at 132–960 m (Cairns 1979).

Detached buds, before they have generated buds themselves, could easily be mistaken for a *Balanophyllia* with a broken pedicel.

Cladopsammia Lacaze-Duthiers, 1897

Small, phaceloid colonies formed by extratentacular budding from a common basal coenosteum and from edge zone of larger corallites. Pourtalès Plan well developed. Pali absent; columella spongy.

TYPE SPECIES: *Cladopsammia rolandi* Lacaze-Duthiers, 1897, by monotypy.

Remarks: As previously noted (Cairns 1994), *Cladopsammia* has a colony form intermediate between that of *Rhizopsammia* (reptoid) and *Dendrophyllia* (branching), characterised by budding from a common coenosteum. Four species are recognised: *C. rolandi* Lacaze-Duthiers, 1897; *C. gracilis* (Milne Edwards & Haime, 1848b); *C. eguchii* (Wells, 1982); and *C. echinata* Cairns, 1984.

Cladopsammia eguchii Wells, 1982

(Plate 43, d)

Balanophyllia eguchii Wells, 1982: 211, 213, pl. 1, figs 4–6; 1983: 239-240; Cairns 1991a: 23, pl. 9,
Cladopsammia eguchii: Cairns 1994: 88, pl. 38, figs a-b.

MATERIAL EXAMINED: New Record: L1630, 6 colonies, AIM AK76949, 1, USNM 94591; Gulf of California off La Paz, USNM 93919. Previous Records: holotype and non-type specimens of Wells (1982).

DISTRIBUTION: New Zealand region: known only from one collection from the roof of a cave on west side of N. Meyer Island, Raoul Island, Kermadec Ridge (Map 22), 7 m. Elsewhere: off Queensland; Japan; Hawaiian Islands; Gulf of Panama; Galápagos Islands; Gulf of California (reported herein); 1–85 m.

TYPES: The holotype is deposited at the USNM (46966).

TYPE LOCALITY: Marchena Island, Galápagos, 6 m.

REMARKS: *Cladopsammia eguchii* was relatively recently described (Wells 1982) and redescribed by Cairns (1991a, 1994) and need not be redescribed again. It is the only colonial dendrophylliid in the New Zealand region known to have a phaceloid growth form. The largest colony from Stn L1630 is 40 mm in width and contains about 20 corallites. The largest corallite of this corallum is 11.2 x 8.8 mm in calicular diameter and 32 mm in height, containing a full fifth cycle of septa.

Dendrophyllia de Blainville, 1830

Corallum colonial, extratentacular budding forming colonies of three shapes: 1) arborescent, with axial corallites, 2) small, bushy coralla with sparse branching, and 3) dendroid colonies with sympodial branching. All forms originate from a single basal stem. Synapticulotheca usually clearly costate. Septa arranged in a Pourtalès Plan. Pali may be present; columella spongy or papillose. Tabular endothecal dissepiments may be present.

TYPE SPECIES: *Madrepora ramea* Linnaeus, 1758, by subsequent designation (Milne Edwards & Haime 1850: liii).

REMARKS: In my emendation of the generic diagnosis of *Dendrophyllia* (Cairns 1994), I divided the 25–30 recent species in that genus into three growth forms (*see* above diagnosis), all growth forms having in common a colony supported by a single basal stem, as opposed to an encrusting, stoloniferous, phaceloid, or unattached growth mode. In the New Zealand region two species of *Dendrophyllia* are known: D. *arbuscula* Van der Horst, 1922 (a member of growth-form 2 above) and D. *alcocki* (Wells, 1954) (a member of growth-form 3 as diagnosed).

Dendrophyllia arbuscula Van der Horst, 1922

(Plate 43, e, f)

Dendrophyllia arbuscula Van der Horst, 1922: 53, pl. 8, fig. 6; Cairns 1994: 90–91, pl. 38, figs i-l (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn I72, 1, USNM 94237; NZOI Stn I76, 2I; NZOI Stn K823, 1; NZOI Stn K843, 1, USNM 94238; BS571, 1, MoNZ CO231, 1, USNM 94239.

DISTRIBUTION: New Zealand region: off Norfolk and Kermadec Islands (Raoul and Macauley Islands) (Map 15); 202–259 m. Elsewhere: off Japan; East China Sea off Korea; Banda Sea; Strait of Malacca; 40–240 m.

DESCRIPTION: Colonies small and sparsely branched at irregular intervals, the largest New Zealand specimen (BS571) 70 mm tall and having only 6 corallites. Primary corallites cylindrical (GCD up to 10 mm) and firmly attached to substratum; secondary- to quaternary-generation corallites ceratoid to cylindrical. Costae inconspicuous, being flat, highly porous, and poorly delineated by intercostal striae. The solitary coral *Caryophyllia rugosa* is often attached to dead basal sections of corallum. Corallum white.

Septa hexamerally arranged in 4 cycles (48 septa). S1 slightly exsert and thick near calicular edge, with straight, vertical inner edges that extend to the columella. S2 less exsert, about three-quarters width of an S1, reaching the columella only deep in fossa. S3 small, only one-fifth to one-quarter width of an S2, each flanked by a pair of S4, which fuse before their common S3 and continue to the columella. Paliform lobes absent. Inner edges of S4 dentate to laciniate for entire length. Fossa of moderate depth, containing a well-formed, discrete, spongy columella, which is often constricted into 3 contiguous sections by the penetration of inner edges of 4 lateral S1. Endothecal dissepiments present.

TYPES: Three syntypes of *D. arbuscula* are deposited at the ZMA (Coel. 1254, 5477).

TYPE LOCALITY: *Siboga* Stns 260 and 277, Banda Sea, 45–90 m.

REMARKS: *Dendrophyllia arbuscula* belongs to the "second growth form" as defined by Cairns (1994), i.e., those species having small, bushy coralla originating from a primary (axial) corallite and bearing relatively few additional corallites, in this case not more than four generations. Other species having this growth form include: *D. cornigera* (Lamarck, 1816); *D. cladonia* Van der Horst, 1927; and *D. horsti* (Gardiner & Waugh, 1939), the first species known from the eastern Atlantic, the latter two species from the Indian Ocean. *Dendrophyllia arbuscula* thus far appears to be limited to the western Pacific.

Dendrophyllia alcocki (Wells, 1954)
(Plates 43, g-i, 44, a, b)

Sclerhelia alcocki Wells, 1954: 465–466, pl. 177, figs 1–2.
Dendrophyllia palita Squires & Keyes, 1967: 28–29, pl. 6, figs 9–10; Dawson 1979: 28.
Dendrophyllia minuscula: Gardiner & Waugh 1939: 237 (in part: *John Murray* Stn 157).
Dendrophyllia alcocki: Zibrowius 1974c: 570–573, figs 10–14; Manning, 1991: 518.
Enallopsammia sp. Zibrowius & Grygier, 1985: 134.

MATERIAL EXAMINED: New Records: NZOI Stn C527, 10, USNM 88386; NZOI Stn C530, 2; NZOI Stn D159, 2 dead fragments, USNM 79492; NZOI Stn D424, 10 dead fragments, USNM 94259; NZOI Stn E859, 6, USNM 94260; NZOI Stn I91, 5, USNM 94261; NZOI Stn I92, 3, USNM 94262; NZOI Stn J683, 2; NZOI Stn J705, 1I; NZOI Stn K795, 1; NZOI Stn K826, 3; NZOI Stn K838, 2I; NZOI Stn K842, 4I; NZOI Stn K872, 3; NZOI Stn N897, 6; NZOI Stn P85, 1; NZOI Stn P925, 1; NZOI Stn Q70, 1; NZOI Stn S572, 7; NZOI Stn T217, 2I; NZOI Stn U594, 2. Previous Records: Type and nontypes of *D. palita* reported by Squires & Keyes (1967); holotype of *S. alcocki*.

DISTRIBUTION: New Zealand region: Norfolk, Three Kings, and Kermadec Ridges; Bay of Plenty; off Cape Egmont; off Fiordland; Solander and Hikurangi Troughs (Map 3); 118–570 m, the shallowest occurrence off Fiordland. Elsewhere: off Maldives; Bikini Atoll; Solomon Islands (Zibrowius & Grygier 1985); New Caledonia (Manning 1991); Tasman Sea west of Lord Howe Seamount Chain (NZOI Stn P925); 177–420 m.

DESCRIPTION: Uniplanar to arborescent colonies formed by extratentacular sympodial budding, a calice generated approximately every 3–5 mm on opposite sides of a branch; branch anastomosis absent. Largest New Zealand specimen (NZOI Stn B490) 110 mm in height and 8 mm in basal diameter, but most branches examined only 3–5 mm in diameter. Only several colonies were collected with their base intact, most specimens represented by broken distal branches. Calices 3–4 mm in diameter. Coenosteum dense and relatively solid, noticeably porous only near calicular edge and occasionally on surface of distal branches as irregularly spaced circular pores 0.05–0.13 mm in diameter; theca also uniformly covered with tiny (10–19 mm diameter) pits. Costae inconspicuous, the coenosteum covered with numerous small (0.13–0.15 mm tall,

2–40 mm in diameter), blunt spines, which, in most specimens, are aligned along the branch axis (Plates 43, i, 44, b). Worn specimens that lack coenosteal spines often show a weak underlying costal striation. Corallum white.

Septa invariably hexamerally arranged in 3 complete cycles: S1>S3³S2 (24 septa). S1 about 0.7 mm exsert, with straight inner edges that reach the columella. S2 about half width of S1, with sinuous inner edges, each S2 bearing a tall palus up to 0.6 mm in width. S3 equal to or wider than S2, having laciniate inner edges that solidly fuse to their common P2 within each system. Occasionally S3 will also have small (0.2 mm width) paliform lobes that fuse to their common P2. Septal and palar faces covered with tall (up to 0.11 mm), blunt to clavate spines. Fossa of moderate depth, containing a well-developed papillose columella.

TYPES: The holotype colony of *S. alcocki* is now broken into at least four pieces, three of which are deposited at the USNM (45056) and one at the BM(NH) (1974.1.10.7). The holotype of *D. palita* is deposited at NZOI (H-18).

TYPE LOCALITIES: *S. alcocki*: seaward slope of Bikini Atoll, Marshall Islands, 177–243 m. *D. palita*: NZOI Stn B490, 45°44.3′ S, 166°44.8′ E (Dusky Sound, Fiordland), 114–118 m.

REMARKS: The coenosteum of *D. alcocki* is so dense that Wells (1954) originally described it as an oculinid. In fact, worn specimens are quite similar to colonies of *Madrepora oculata*, and Squires and Keyes (1967) included several specimens of dead *M. oculata* in the nontype series (NZOI Stn B490) of their *D. palita*. *Dendrophyllia alcocki* is most easily distinguished from the oculinid by its very large S3, which sometimes fuse in pairs before their common S2. Another sympodially branching deep-water species in this region is *Oculina virgosa*, which is similar to *D. alcocki* in calicular diameter and colony form, but differs in having P1, uniformly distributed corallites, and a tendency to have 28 septa per corallite.

Zibrowius (1974c) was the first to recognise the synonymy of *S. alcocki* and *D. palita* and to transfer *S. alcocki* to the Dendrophylliidae, although he was somewhat unsure about the generic placement. According to my partial revision (Cairns 1994) of the genus *Dendrophyllia*, *D. alcocki* is one of eight species of "growth form 3", characterised by having an arborescent colony with sympodial budding.

Although P2 are usually well developed and diagnostic for *D. alcocki*, in some coralla (e.g., NZOI Stn I91, I92) P2 are poorly or irregularly developed. In some of these colonies, one, several, or no P2 may be developed in one corallite but all six developed in another corallite in the same corallum.

Enallopsammia Michelotti, 1871

Corallum colonial, arborescent to uniplanar, formed by extratentacular budding. Corallites sympodially or unifacially arranged. Synapticulo-theca dense, porous only near calice and inter-costal furrows. Septa normally arranged. Pali absent; columella small and papillose.

TYPE SPECIES: *Coenopsammia scillae* Seguenza, 1864, by monotypy.

REMARKS: *Enallopsammia* is distinguished from *Dendrophyllia* by having normally arranged septa, not a Pourtalès Plan. Four recent species are attributed to this genus: *E. profunda* (Pourtalès, 1867) (western Atlantic); *E. rostrata* (Pourtalès, 1878) (cosmopolitan); *E. pusilla* (Alcock, 1902a) (Sulu Sea); and *E. marenzelleri* Zibrowius, 1973 (Indonesia, New Zealand). The type species is *E. scillae* (Seguenza, 1864), an Italian Miocene species.

Enallopsammia rostrata (Pourtalès, 1878)

(Plate 44, c–f)

Amphihelia rostrata Pourtalès, 1878: 204, pl. 1, figs 4–5.
Enallopsammia rostrata: Zibrowius 1973: 44–45, pl. 2, figs 14–15; Cairns 1982: 57, pl. 18, figs 1–4 (synonymy); Cairns & Parker 1992: 52–53, pl. 18, figs e–i; Cairns & Keller 1993: 281–282; Cairns, 1994: 92–93, pl. 39, figs d–f.

MATERIAL EXAMINED: New Records: NZOI Stn E855; NZOI Stn F319, NZOI Stn I63, NZOI Stn I676, NZOI Stn J715, 2, NZOI Stn K795, 4, USNM 94203; NZOI Stn K800, 1, USNM 94204; NZOI Stn K842, 2; NZOI Stn K846, 2, USNM 94205; NZOI Stn K868, 1; NZOI Stn K872; NZOI Stn P8, USNM 94206; NZOI Stn P945, 1; NZOI Stn P947; NZOI Stn R437, 2, USNM 94207; NZOI Stn X182, 1; KTN 17/82, MoNZ; FV *San Manukau*, AIM AK8317; 36°22′ S, 164°49′ E, 963–967 m, 19 July 1990, AIM AK8486; *Volcanolog* Stn B30/28,

AU11622, AUM; "off Whangaroa", 110 m, H1075, AUM; *Tui*, Rumble II, 1, AU11140, AUM; *Alexander Nemeyanov* Stn N17/6, AU12251, AUM; *Alexander Nesmeyanov* Stn N17/15, AU12256, AUM; RV *Paterson*, 1 live colony, MoNZ CO361. Previous Records: syntypes of *A. rostrata*.

DISTRIBUTION: Widespread in New Zealand region from Colville to Macquarie Ridge (Map 5); 110–1276 m, but most records deeper than 500 m. Elsewhere: cosmopolitan, except for continental Antarctica and eastern Pacific; 229–2165 m. Also known from the Austral Seamounts, Cook Islands (NZOI Stn F319), reported herein.

DESCRIPTION: Large uniplanar colonies formed by frequent extratentacular budding, which sometimes leads to branch anastomosis. Largest New Zealand specimen examined (AUM H1075) 370 mm in height and 320 mm in width, with a massive basal diameter of 40 mm. Majority of specimens examined dead, and some quite worn, when collected. Calices circular to slightly elliptical and confined to one face of corallum (anterior by definition), arranged uniserially on distal branches. Calices 2–5 mm diameter, some colonies (e.g., NZOI Stn K800, K846, P947) having delicate coralla with consistently small corallites, the remaining coralla having more robust coralla with larger corallites. Adcauline (outermost) CS1 of each calice usually enlarged as a small rostrum, the associated C1 sometimes slightly ridged. Degree of rostral development variable, the rostrum often unrecognised in dead or worn coralla. Costae well developed, especially on acalicular face, where they are slightly convex, about 0.3 mm in width, and separated by thin (0.13 mm wide), deep intercostal furrows that bear circular pores about 0.1 mm in diameter. Intercostal pores covered with coenosteum in older coralla and at bases of larger coralla. Well-preserved costae covered with tall (up to 0.12 mm tall and 0.05 mm in diameter), blunt spines. Corallum white.

Septa invariably hexamerally arranged in 3 complete cycles according to the formula: S1>S2>S3. S1 slightly exsert, have straight inner edges that have dentate lower edges, and are relatively narrow, extending only about one-third distance to centre of fossa. Rostrate CS1 usually 2–3 times as exsert and thick as other CS1. S2 less exsert than normal S1 but of approximately same width, both cycles of septa reaching the columella. S3 rudimentary and dentate for entire border, having either a free inner edge or being loosely connected to its adjacent S2 through a porous fusion. All septal faces spinose. P2 (paliform lobes) sometimes present. Fossa of moderate depth, containing a small, granular, papillose columella.

TYPES: The syntypes of *A. rostrata* are deposited at the MCZ (Cairns 1979).

TYPE LOCALITY: *Blake* Stn 2, 23°14′ N, 82°25′ W (Straits of Florida), 1472 m.

REMARKS: *Enallopsammia rostrata* is one of approximately a dozen species that are virtually cosmopolitan in the world oceans, and occur at relatively great depths. Additional descriptions and discussion of its morphological variation are found in Cairns (1979, 1982) and Zibrowius (1980). It is distinguished from the other six deep-water colonial Scleractinia known from the New Zealand region by having unifacial corallites and a costoseptal rostrum. It also appears to attain the largest size of any New Zealand azooxanthellate scleractinian coral. The other New Zealand deep-water colonial species are: *Oculina virgosa* (29-388 m), *Madrepora oculata* (149–946 m), *Goniocorella dumosa* (88–1488 m), *Solenosmilia variabilis* (509–1075 m), *Dendrophyllia alcocki* (118–570 m), and *Enallopsammia marenzelleri* (333–371 m).

Enallopsammia cf. ***marenzelleri*** Zibrowius, 1973
(Plate 44, g, h)

Enallopsammia marenzelleri Zibrowius, 1973: 49–51, pl. 1, figs 1–7, pl. 2, figs 8–11 (synonymy).
Enallopsammia sp. cf. *E. marenzelleri*: Cairns 1982: 57–58, pl. 18, figs 5–6.

MATERIAL EXAMINED: New Records: None. Previous Records: *Eltanin* Stn 1411, 13 branch fragments, USNM 47535, reported by Cairns (1982).

DISTRIBUTION: New Zealand region: known only from one record on northern Macquarie Ridge; 333–371 m. Elsewhere: Meteor Seamount and the Azores, Northeast Atlantic; off Nicobar Islands; Indonesia; 595-815 m.

TYPES: The holotype and paratypes of this species are deposited at the ZMA (Coel. 6902, 588, respectively).

TYPE LOCALITY: *Siboga* Stn 266, 5°56.5′ S, 132°47.7′ E (off Kai Islands, Banda Sea), 595 m.

REMARKS: One lot of 13 branch fragments was reported as *Enallopsammia* sp. cf. *E. marenzelleri* by Cairns (1982) from Macquarie Ridge. These specimens, taken at the same station as *E. rostrata*, differ from that species in having a bushy colony shape, sympodially arranged corallites, and in lacking any trace of costoseptal rostra. No additional specimens of this species are reported in this study, and, because of the poor representation of this species in the New Zealand region, I remain tentative about its identification.

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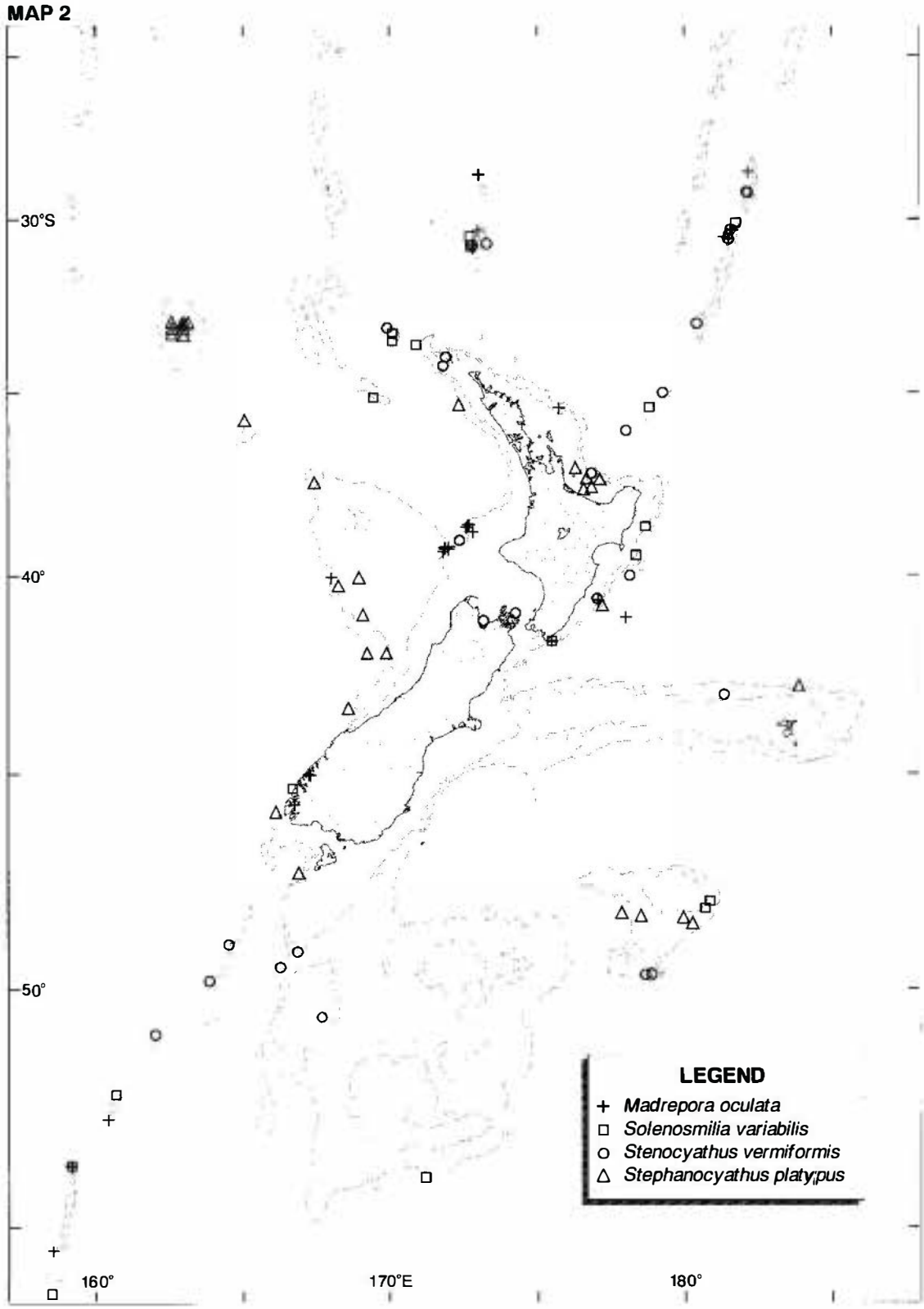

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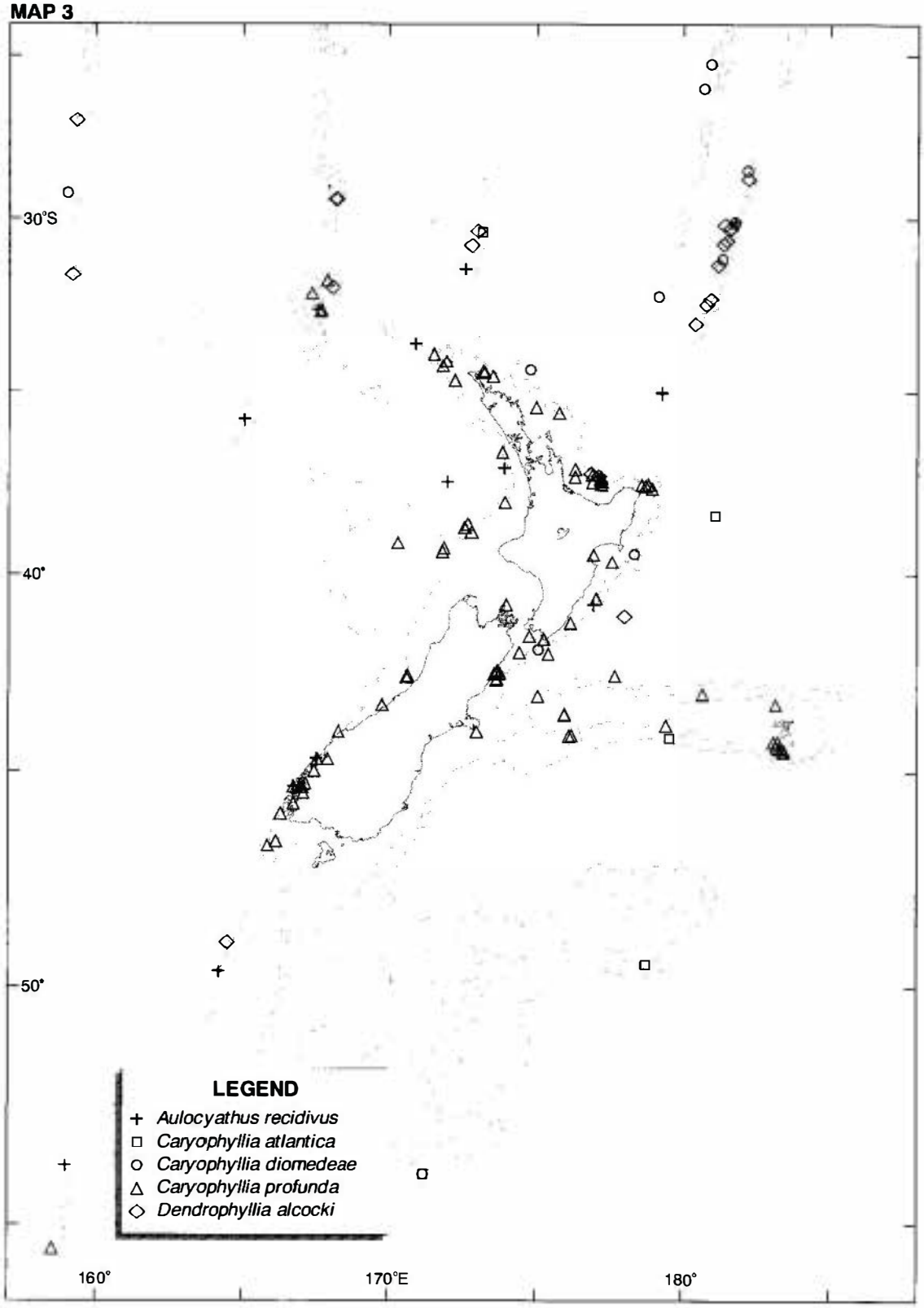

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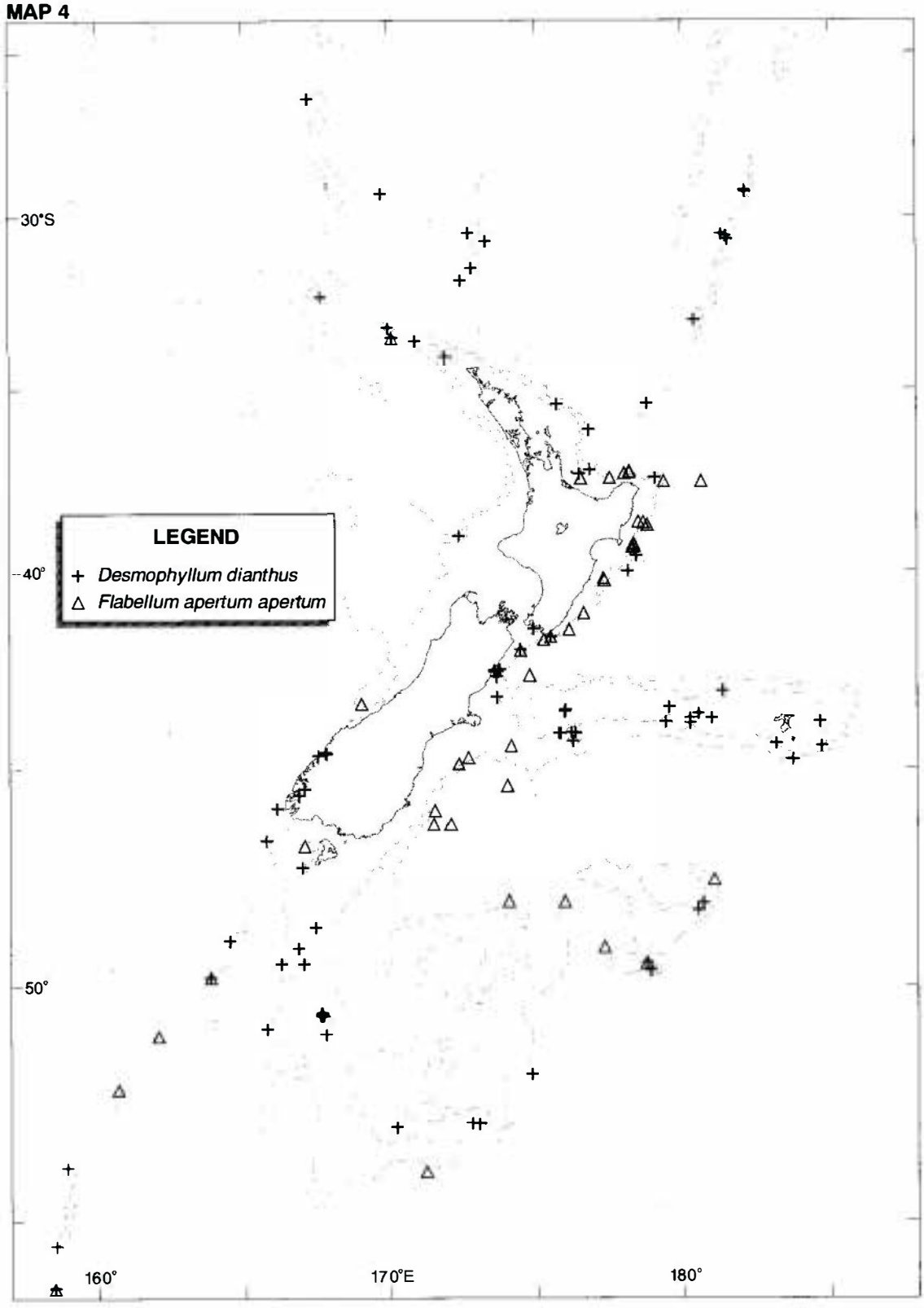

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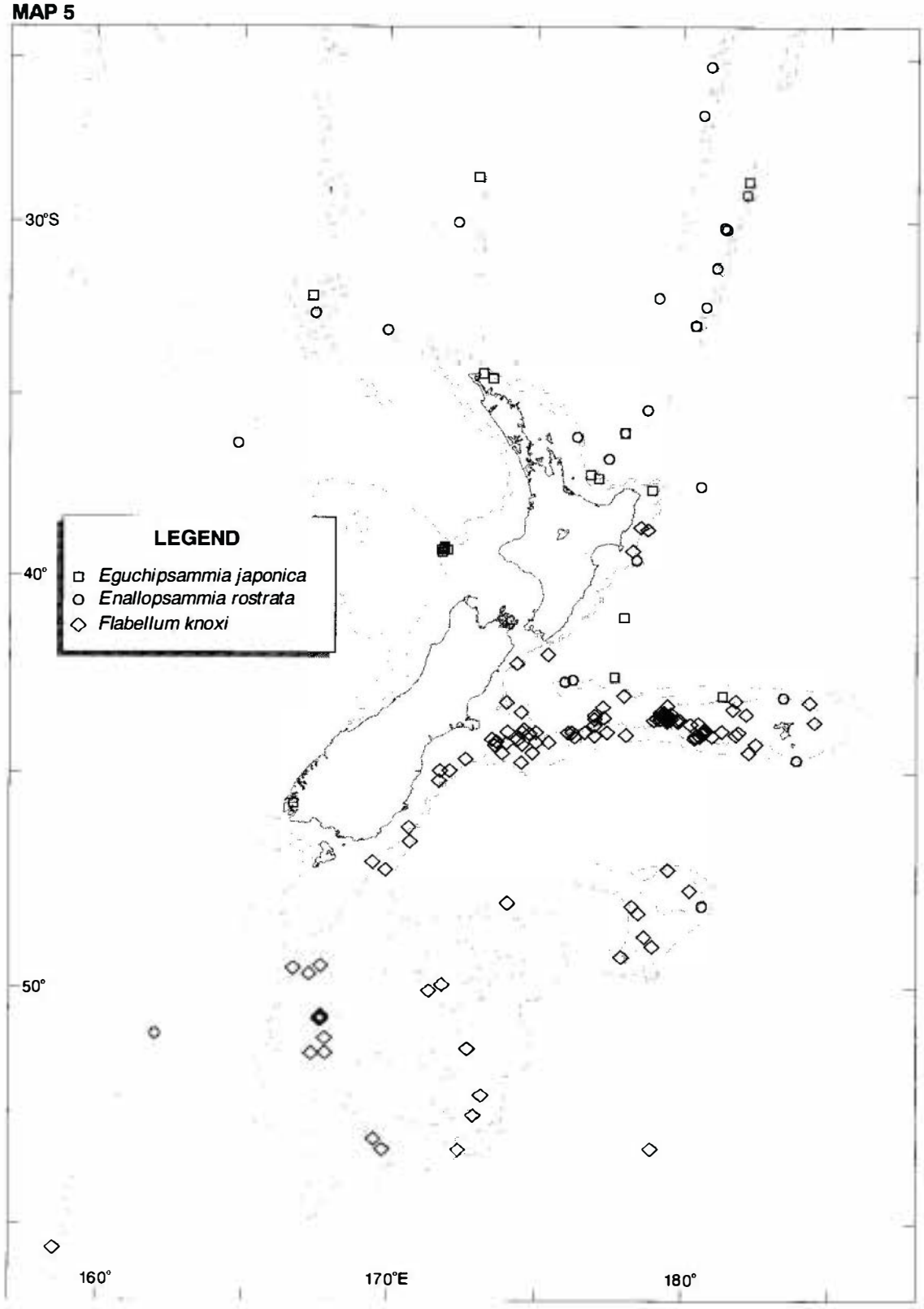

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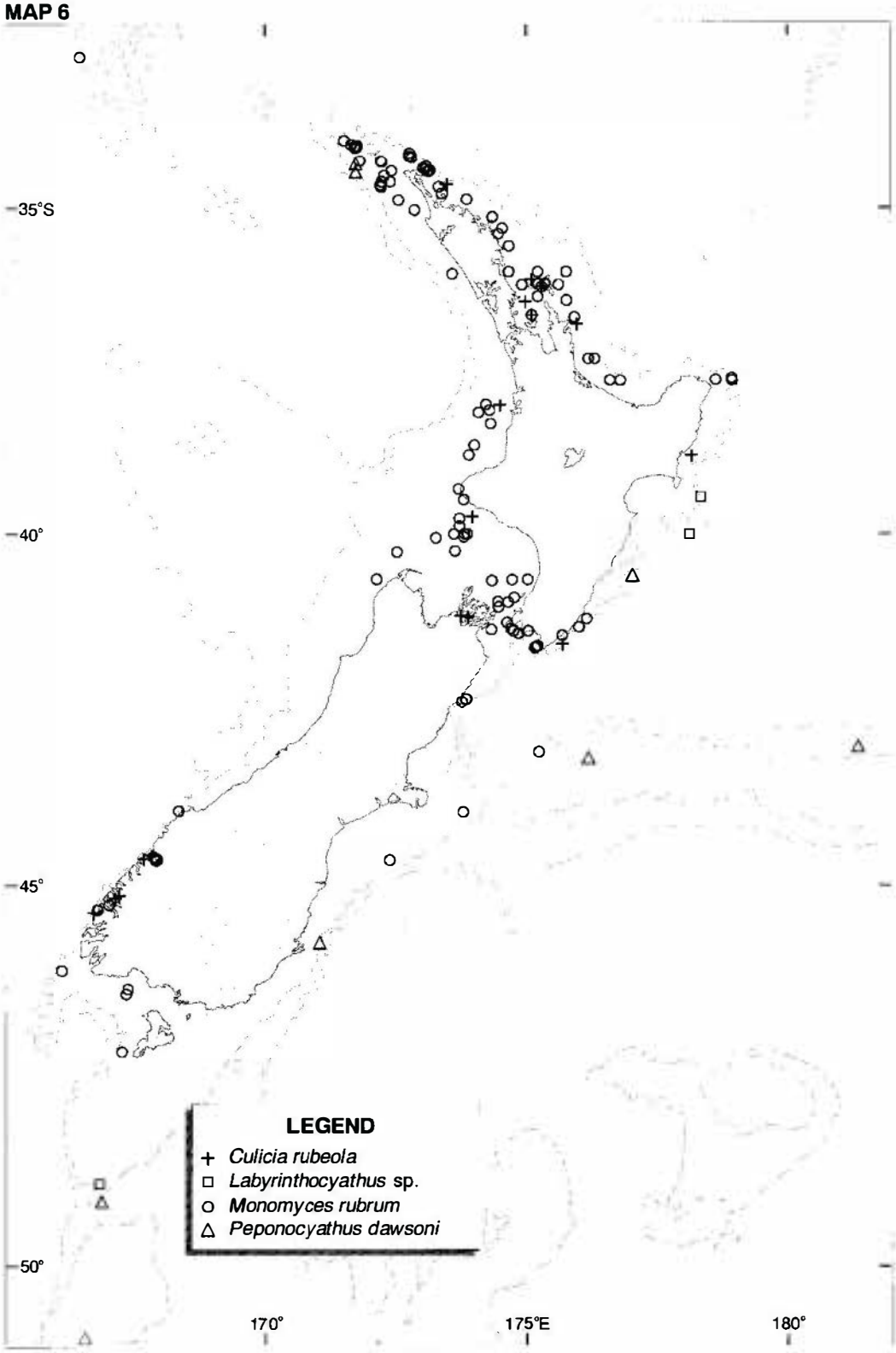

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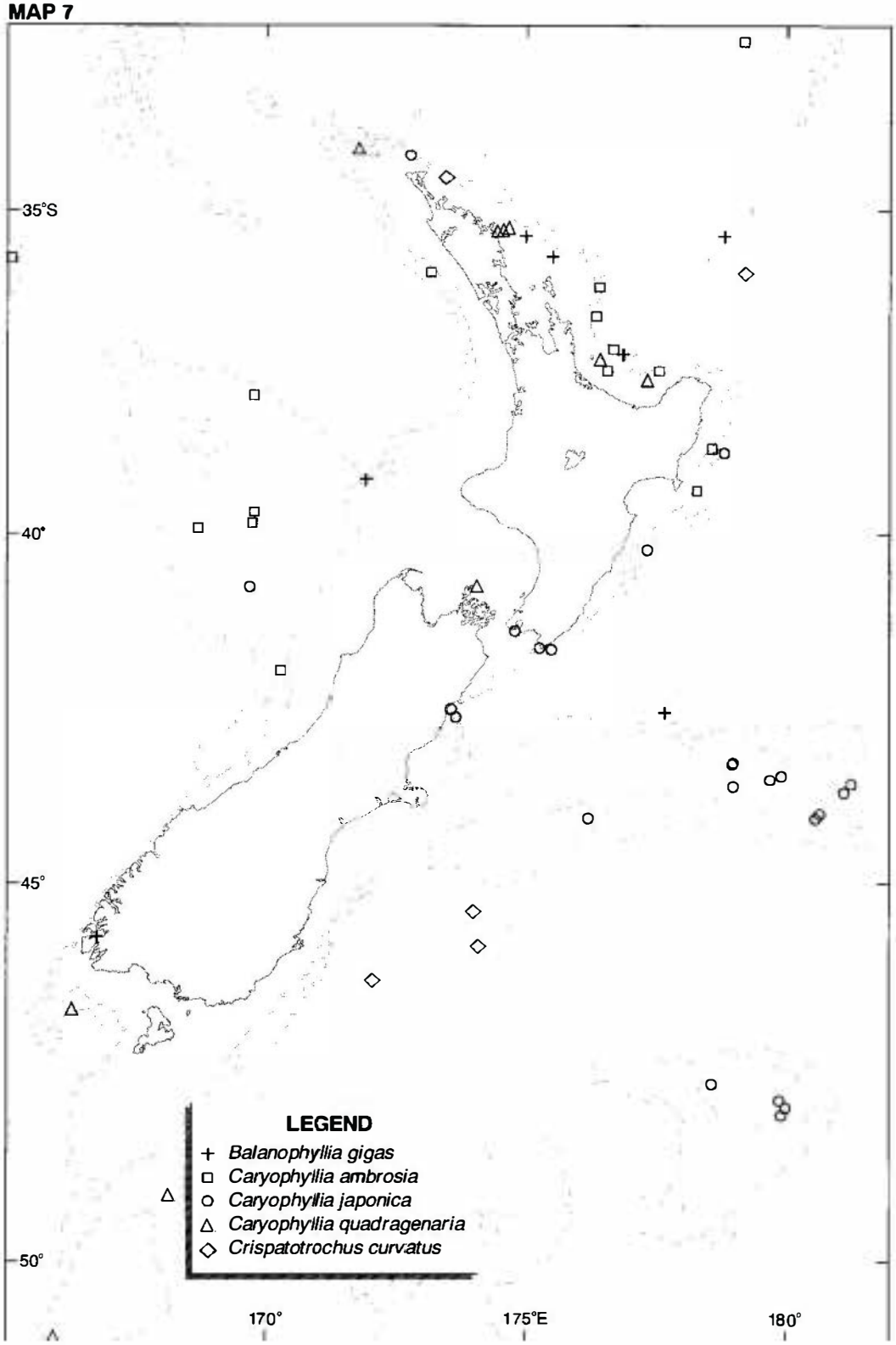

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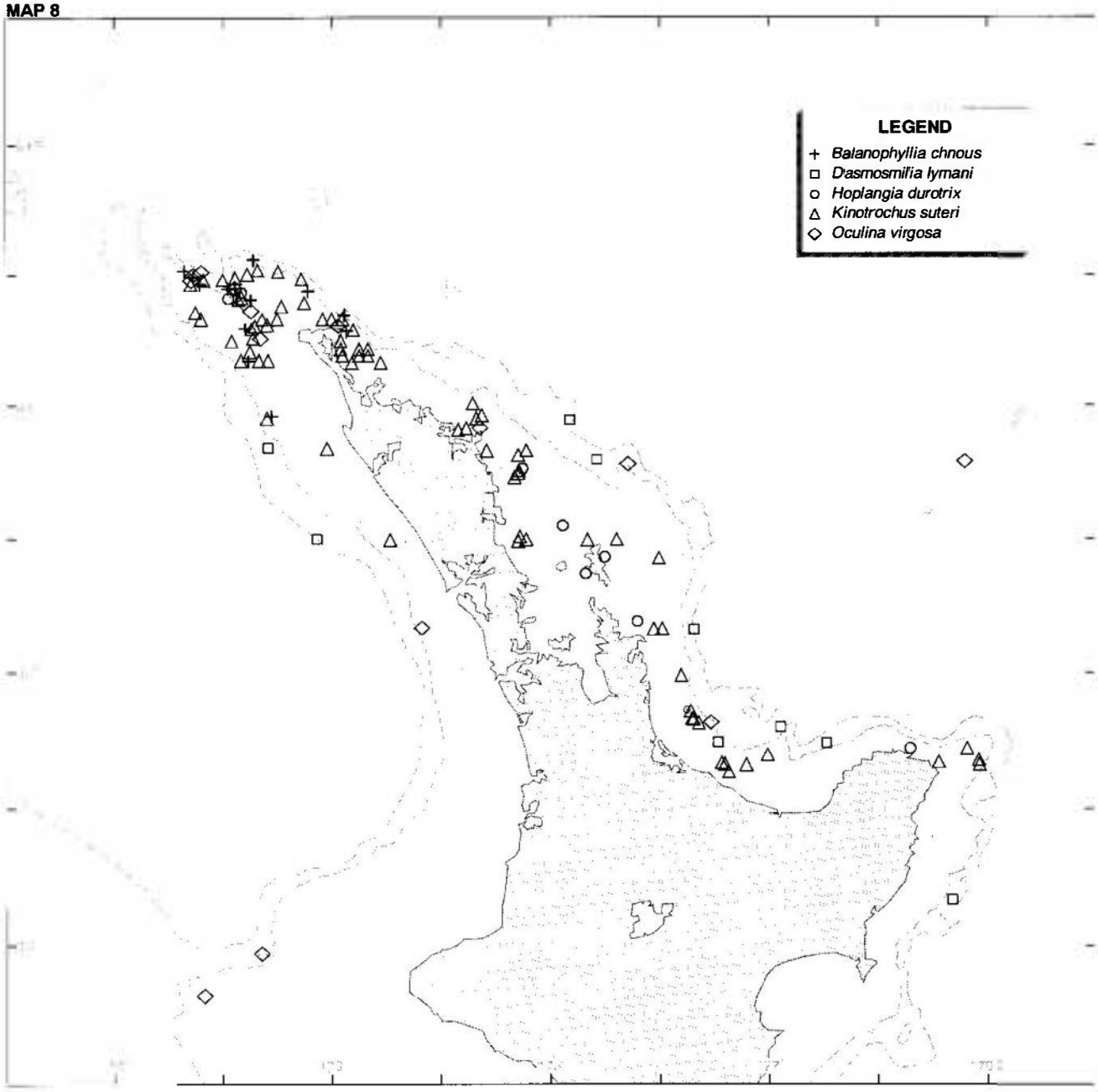

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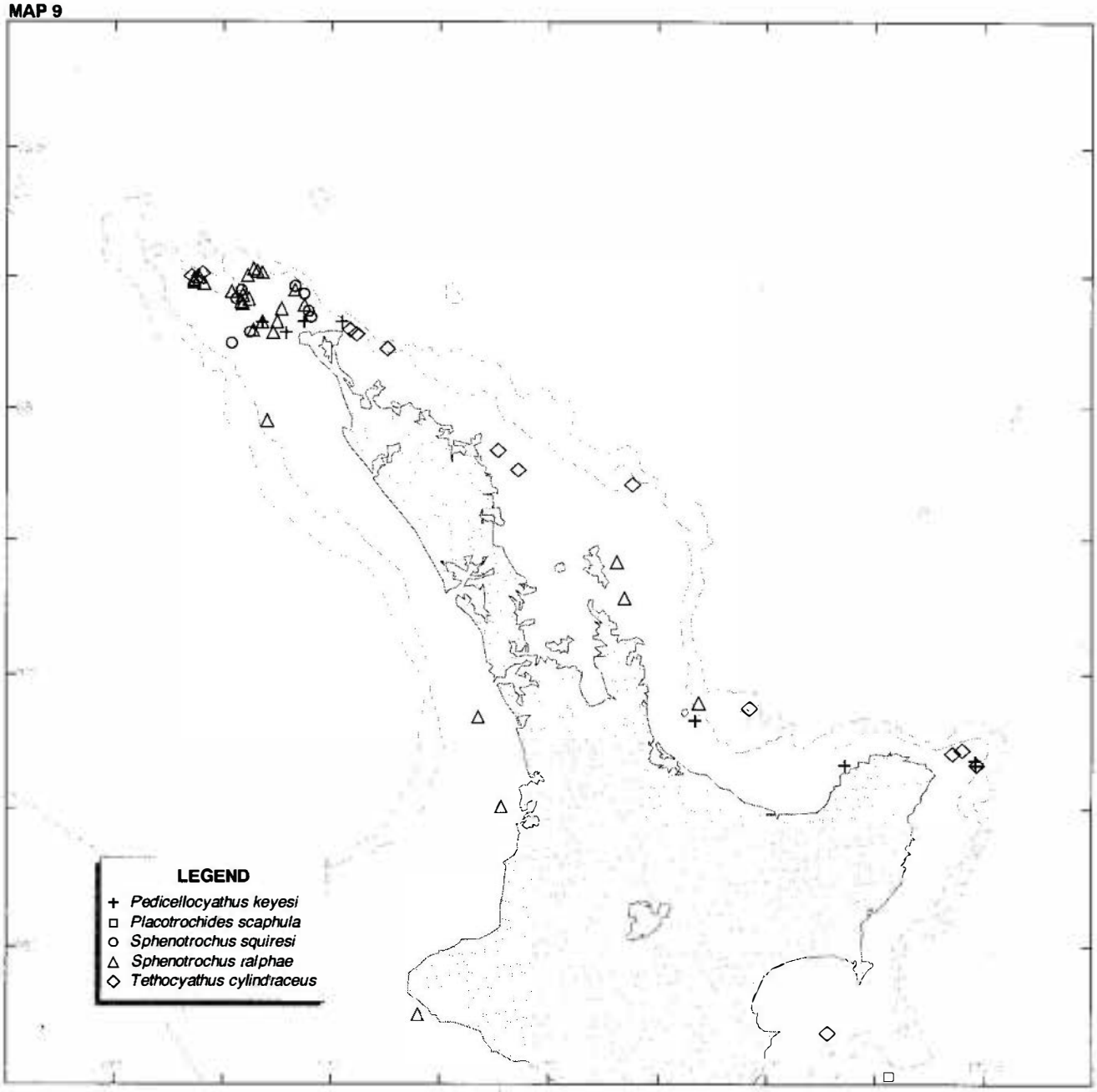

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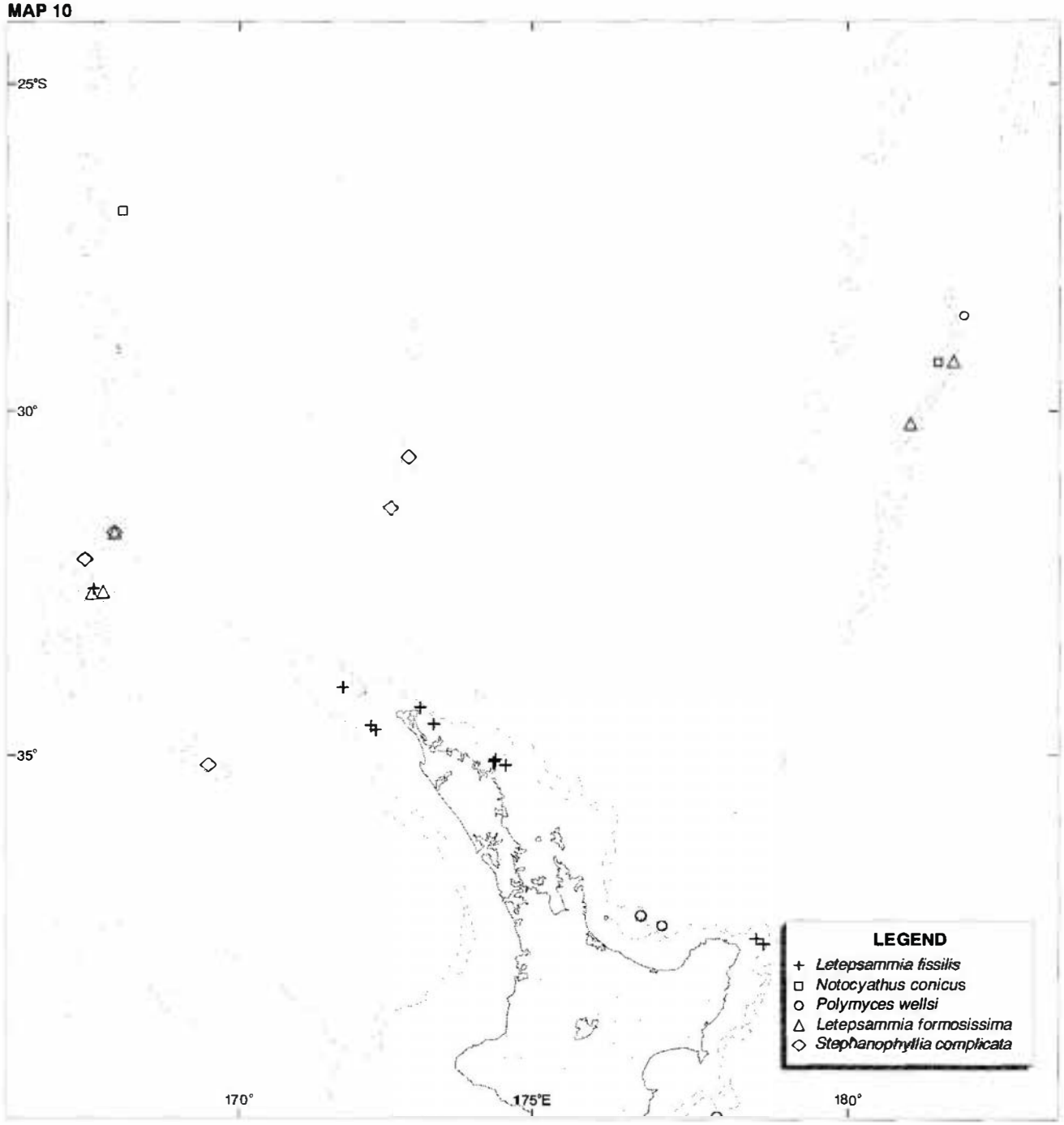

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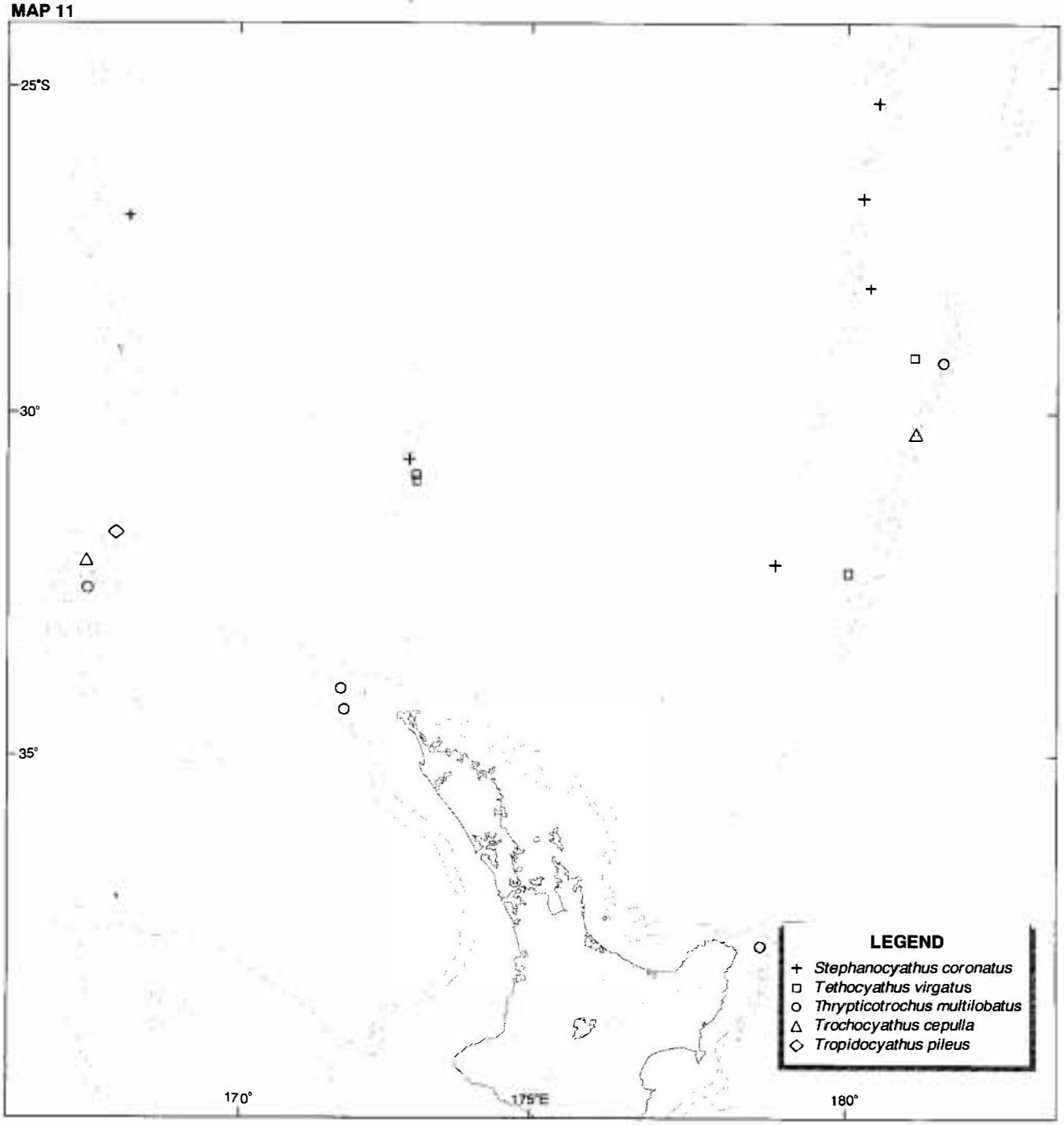

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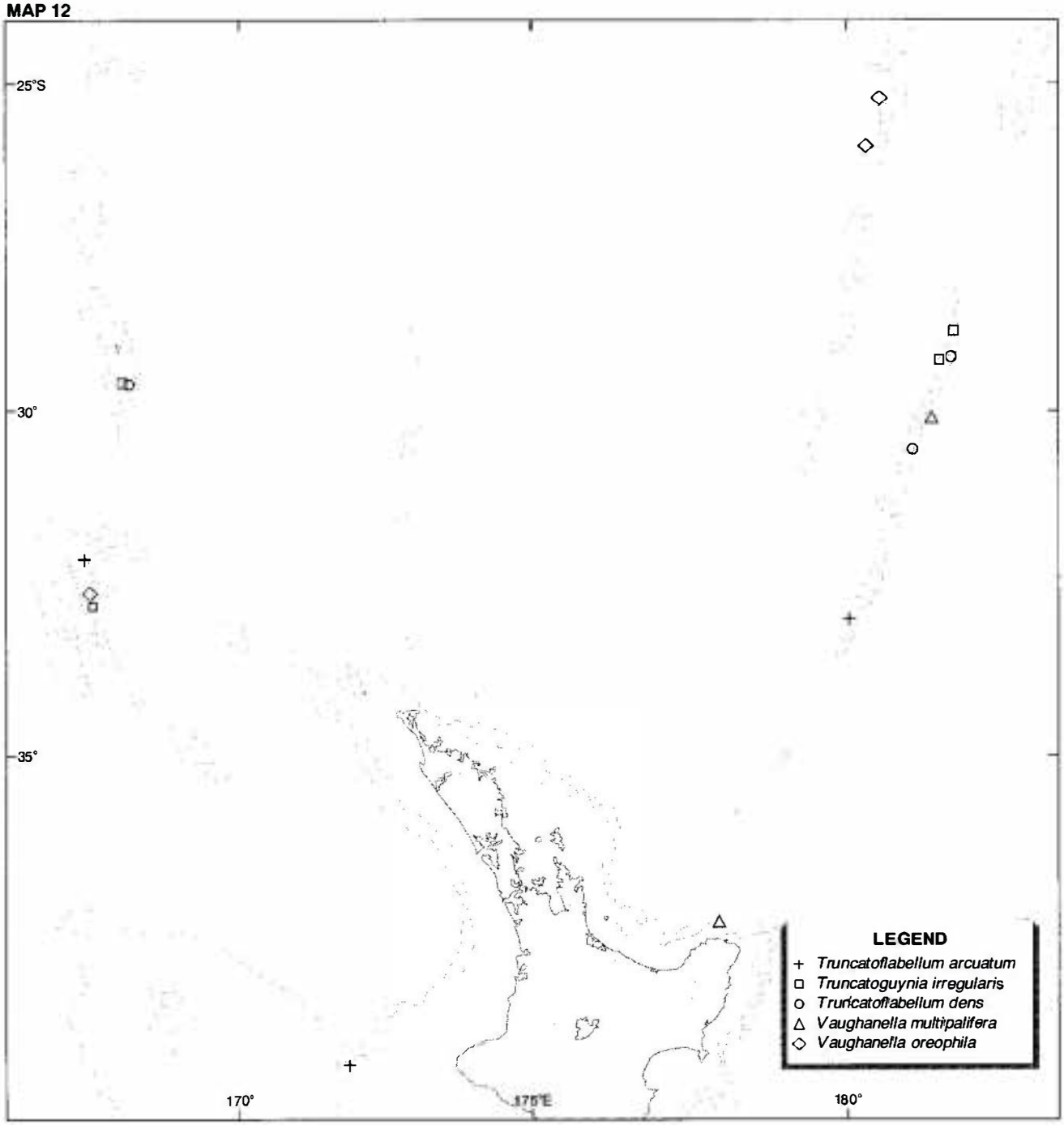

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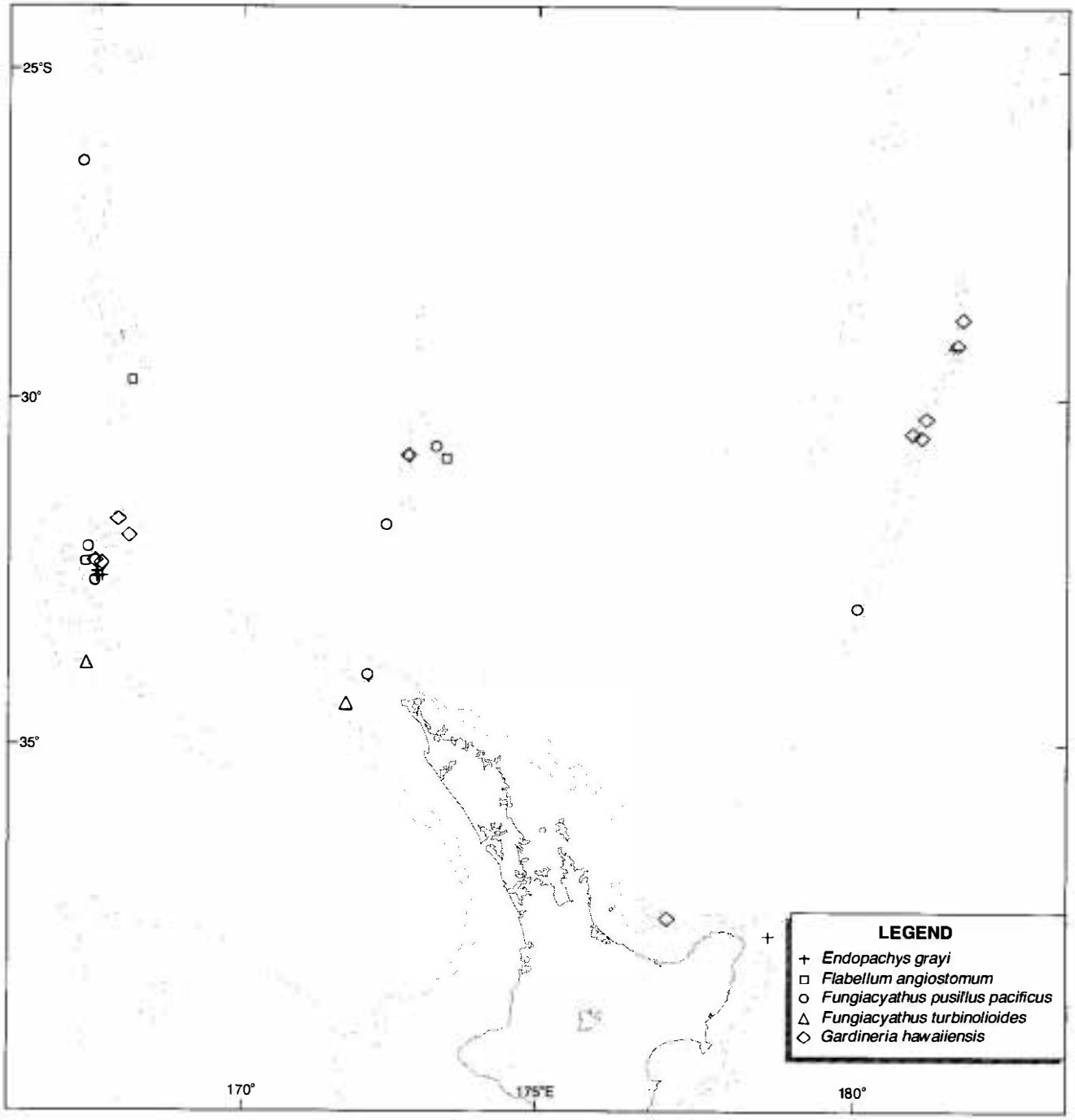

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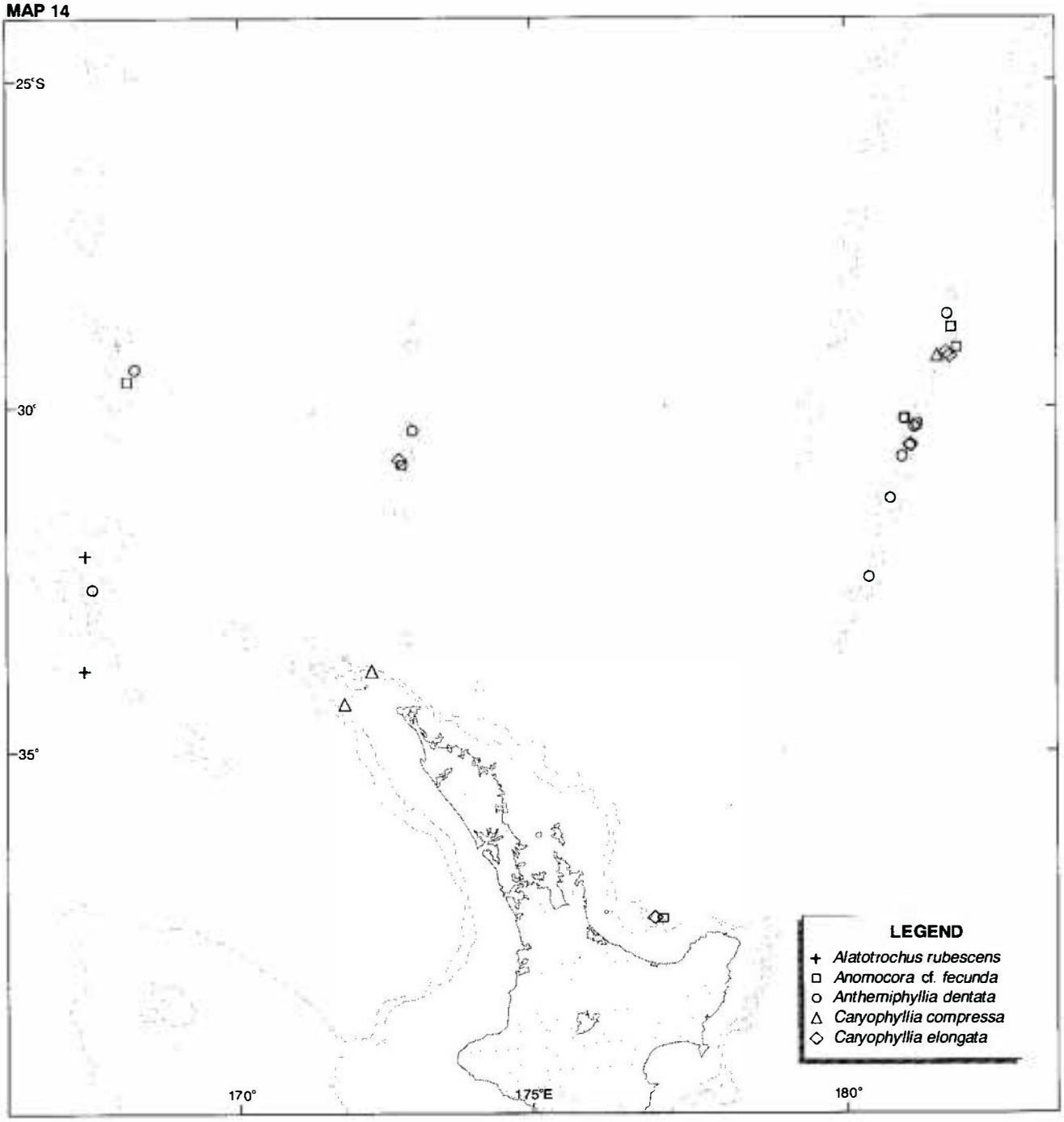

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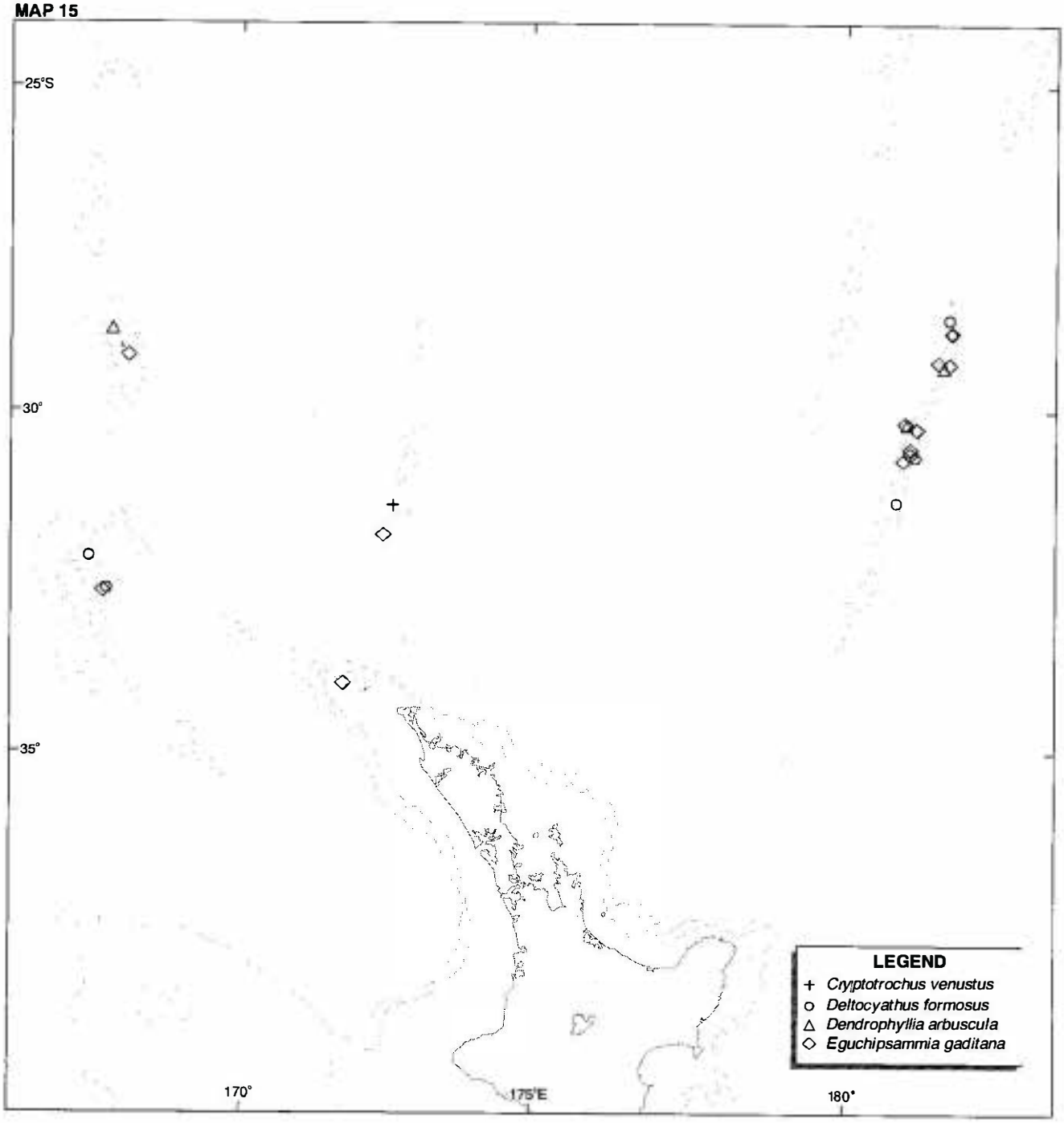

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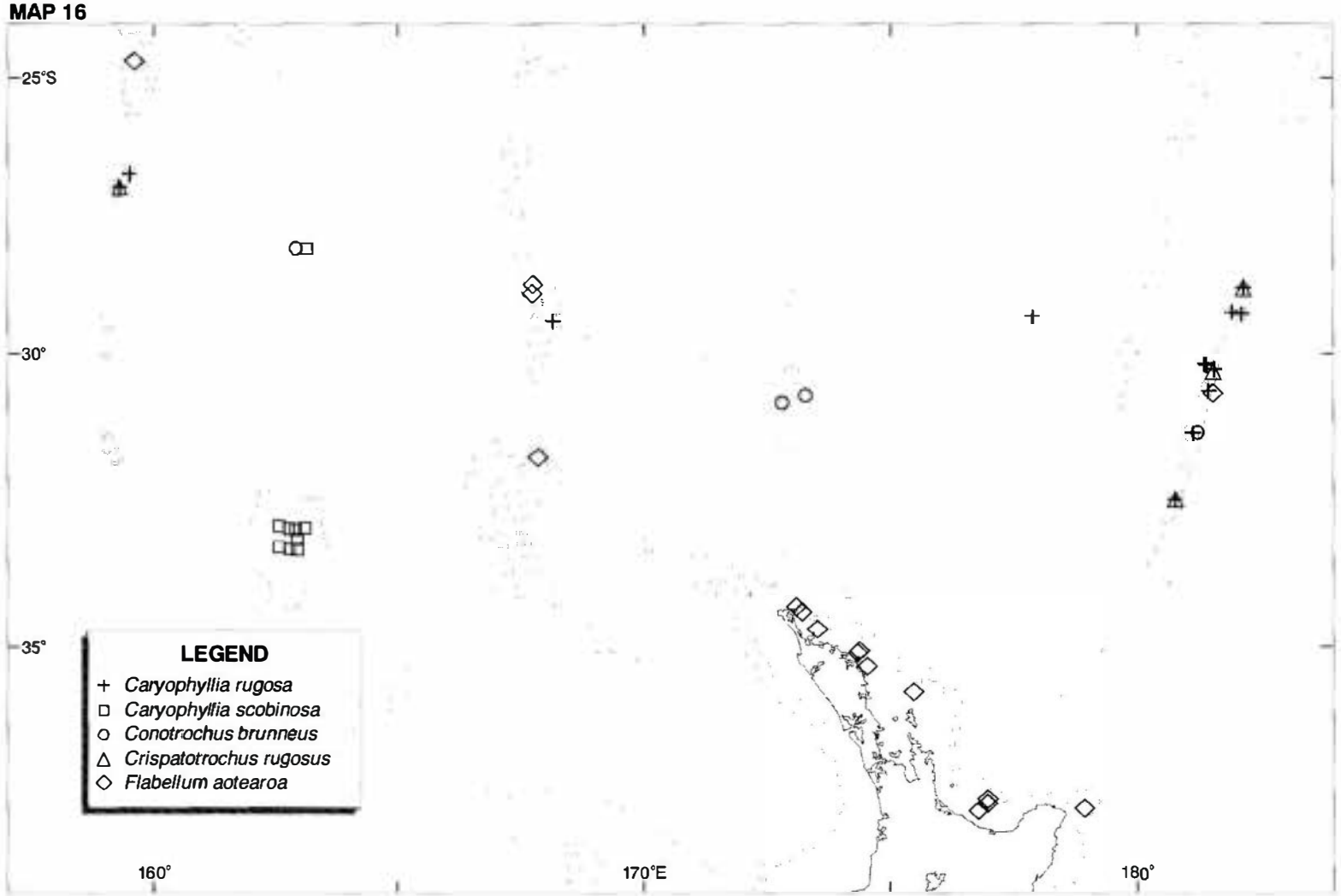
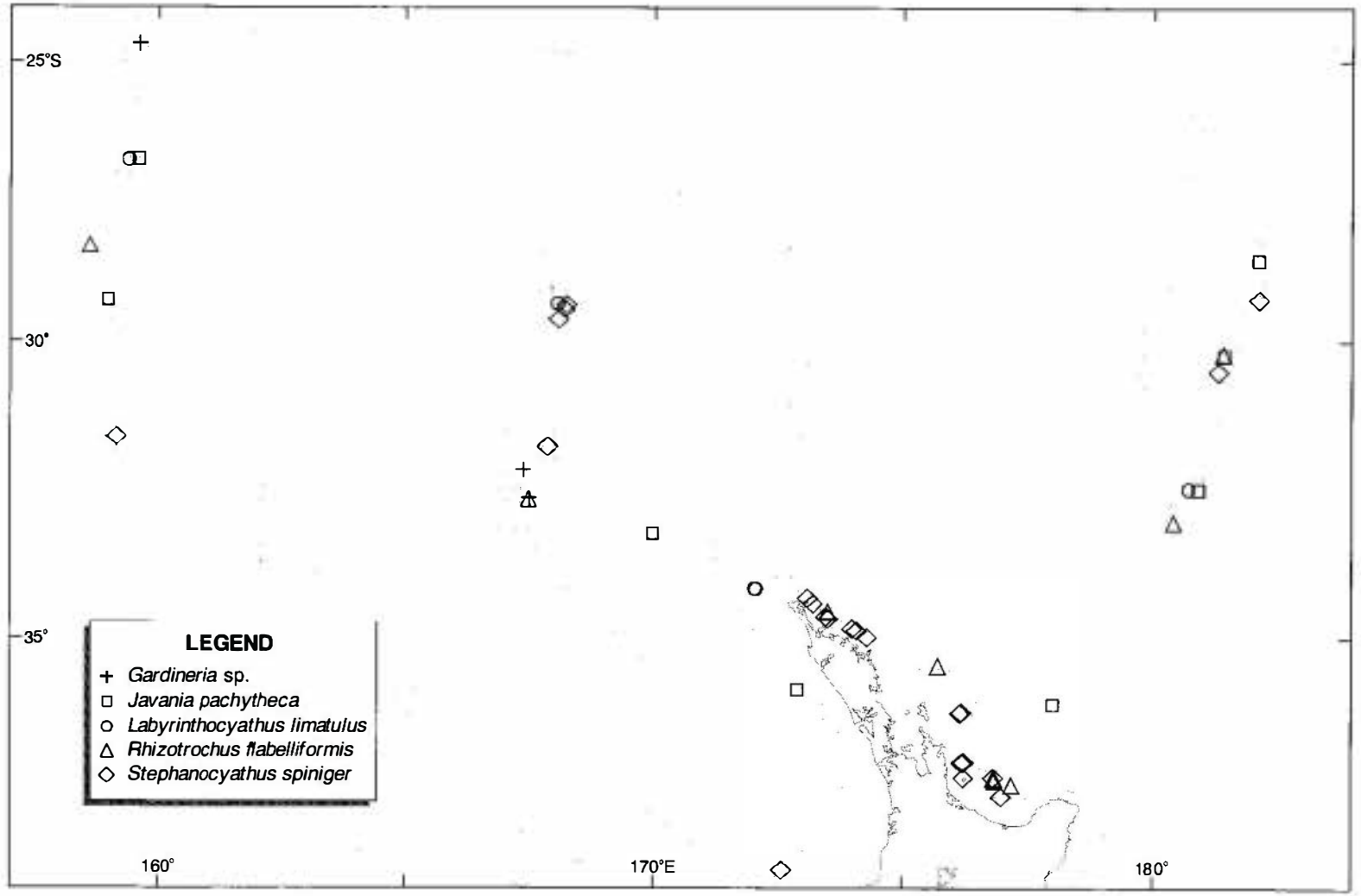
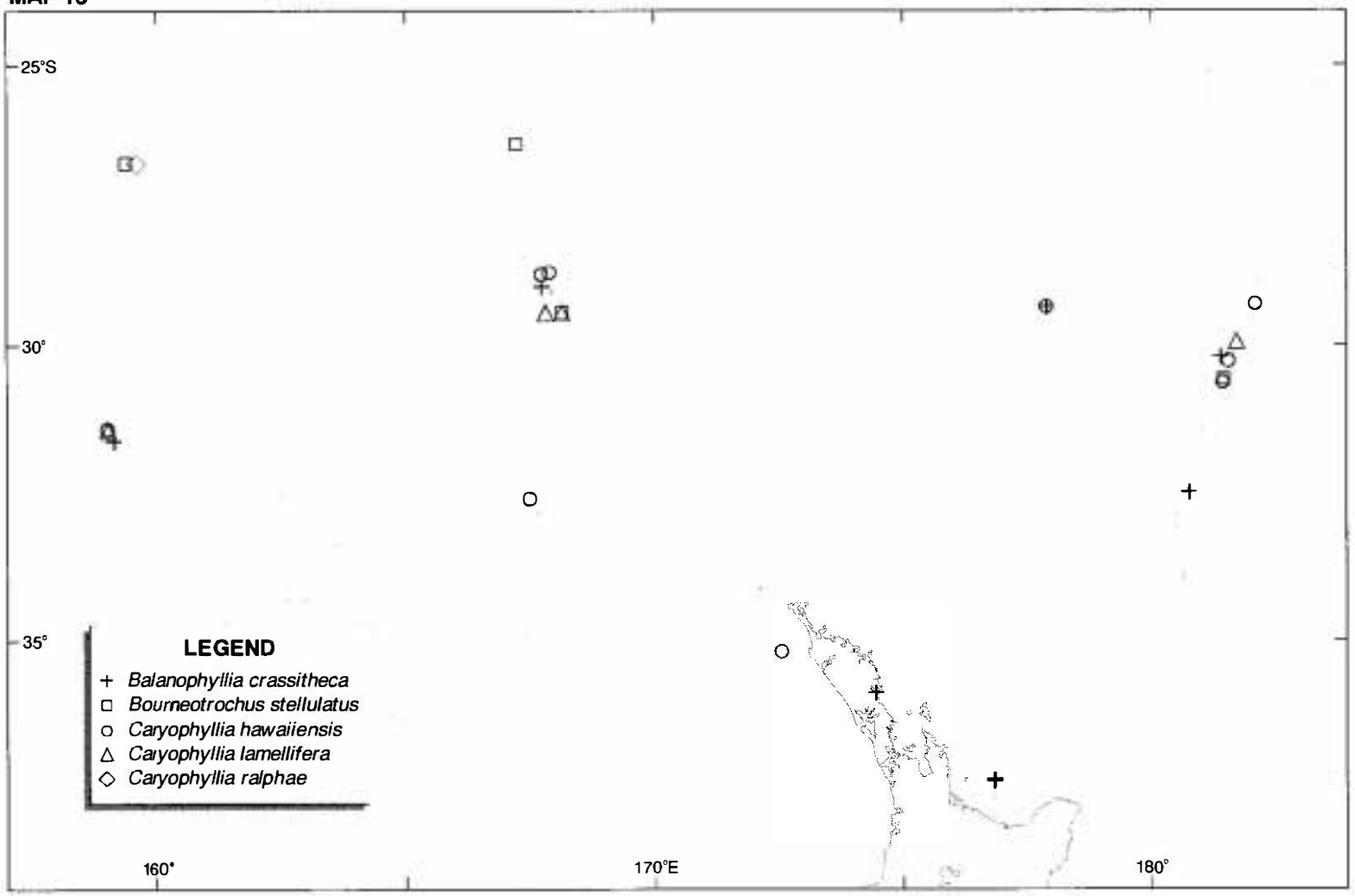


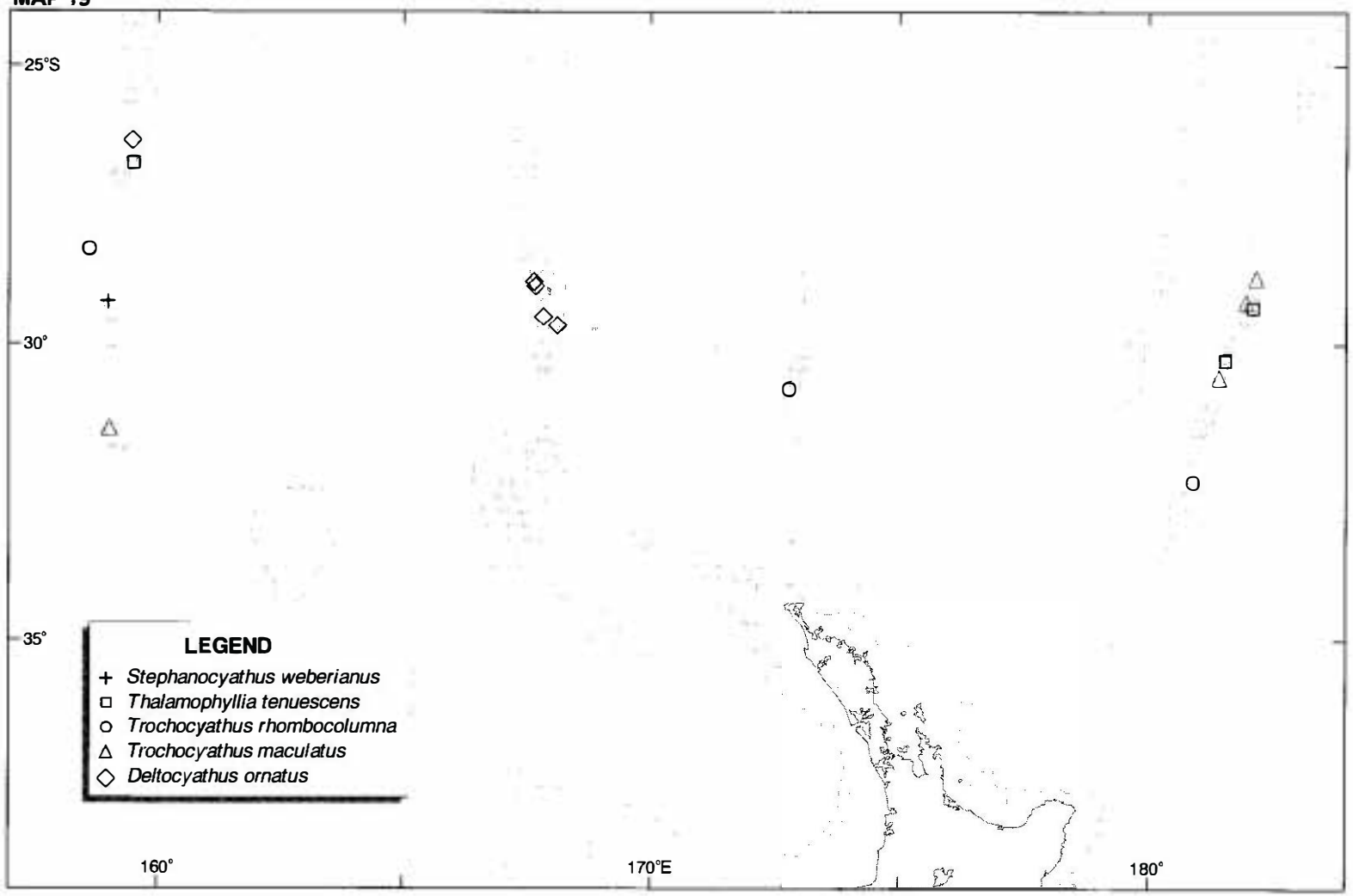
MAP 17



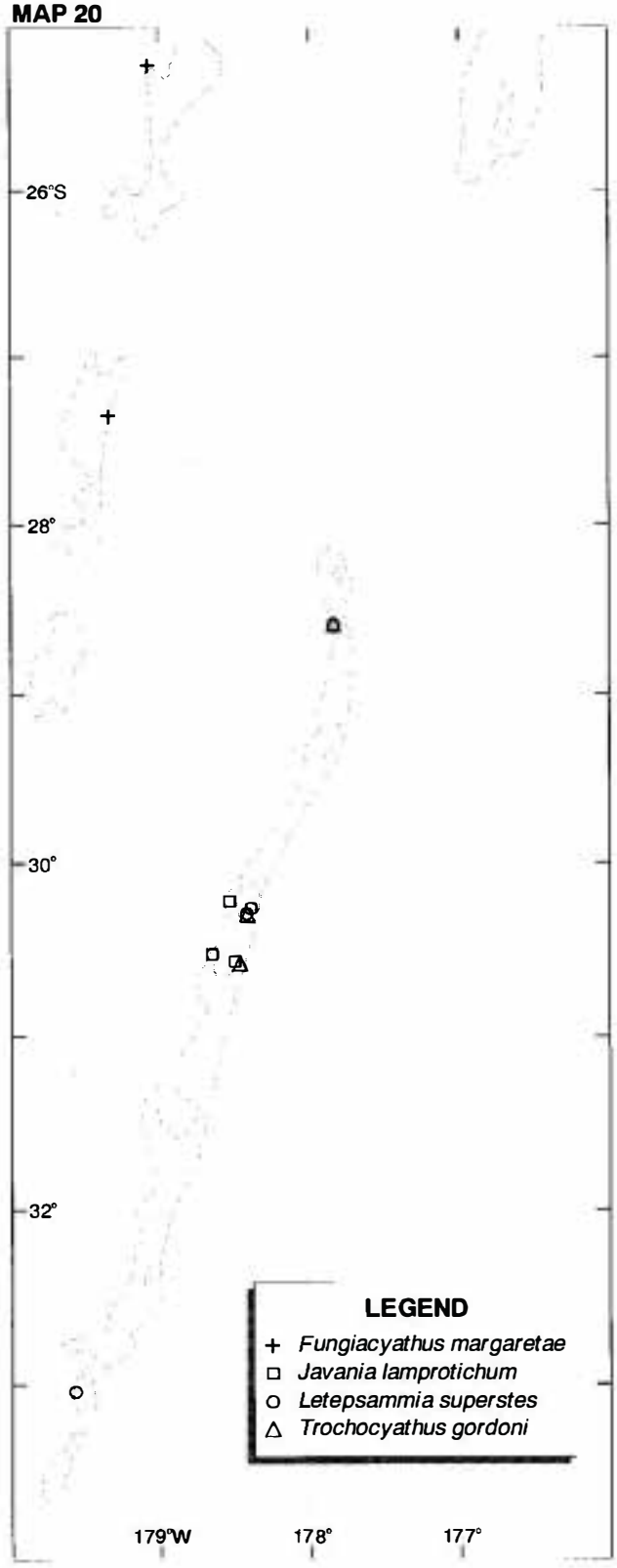
MAP 18



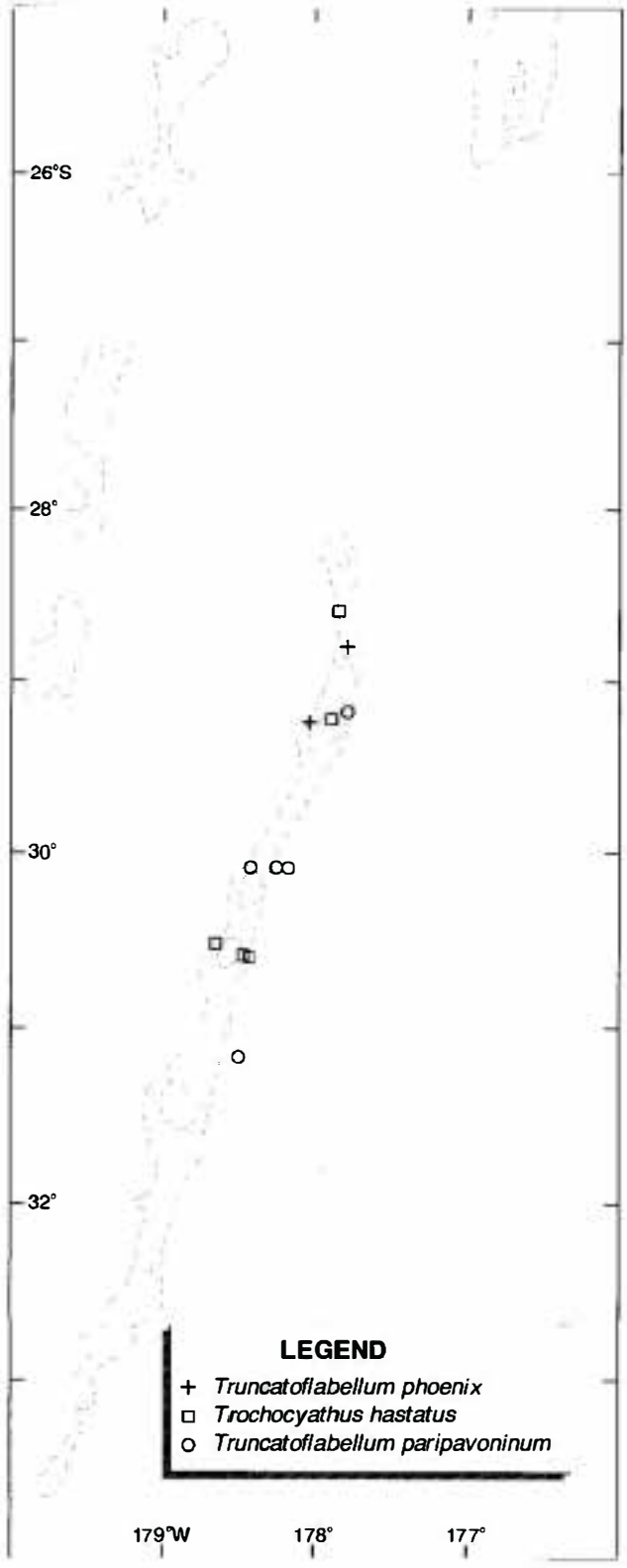
MAP 19



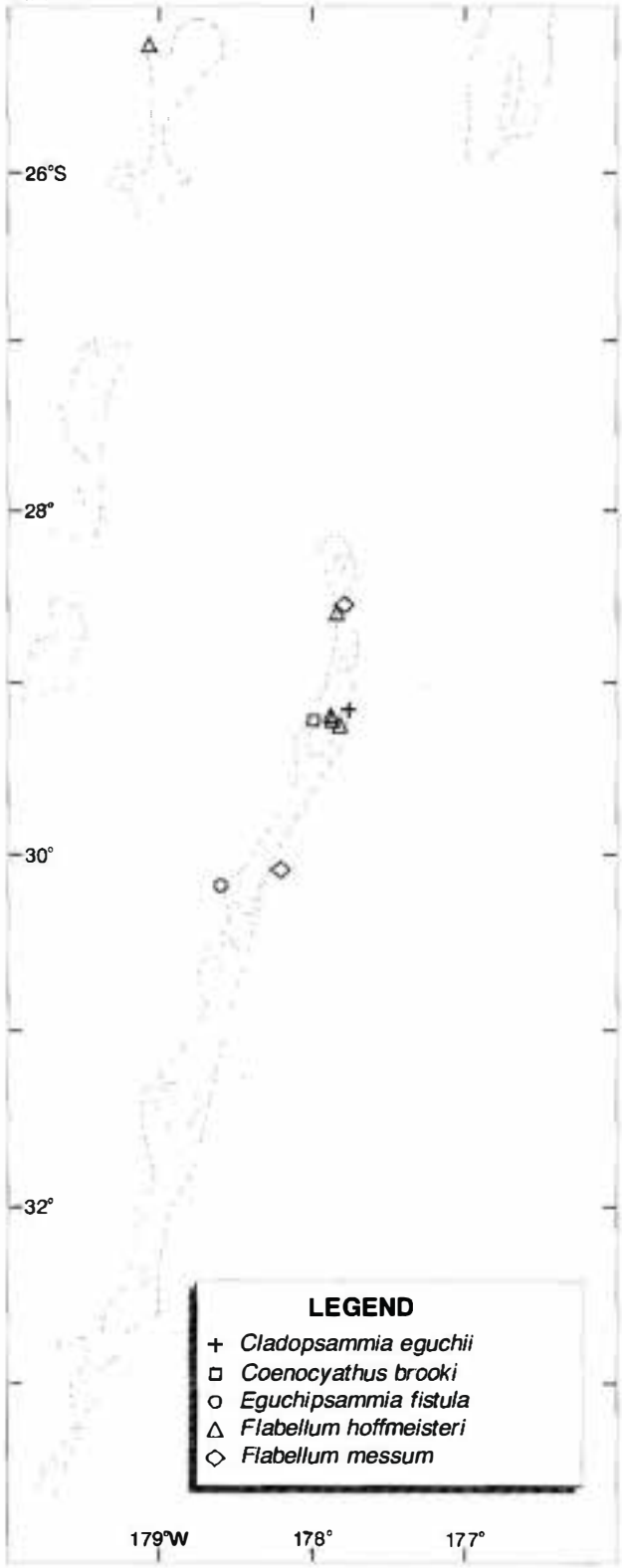
MAP 20



MAP 21



MAP 22



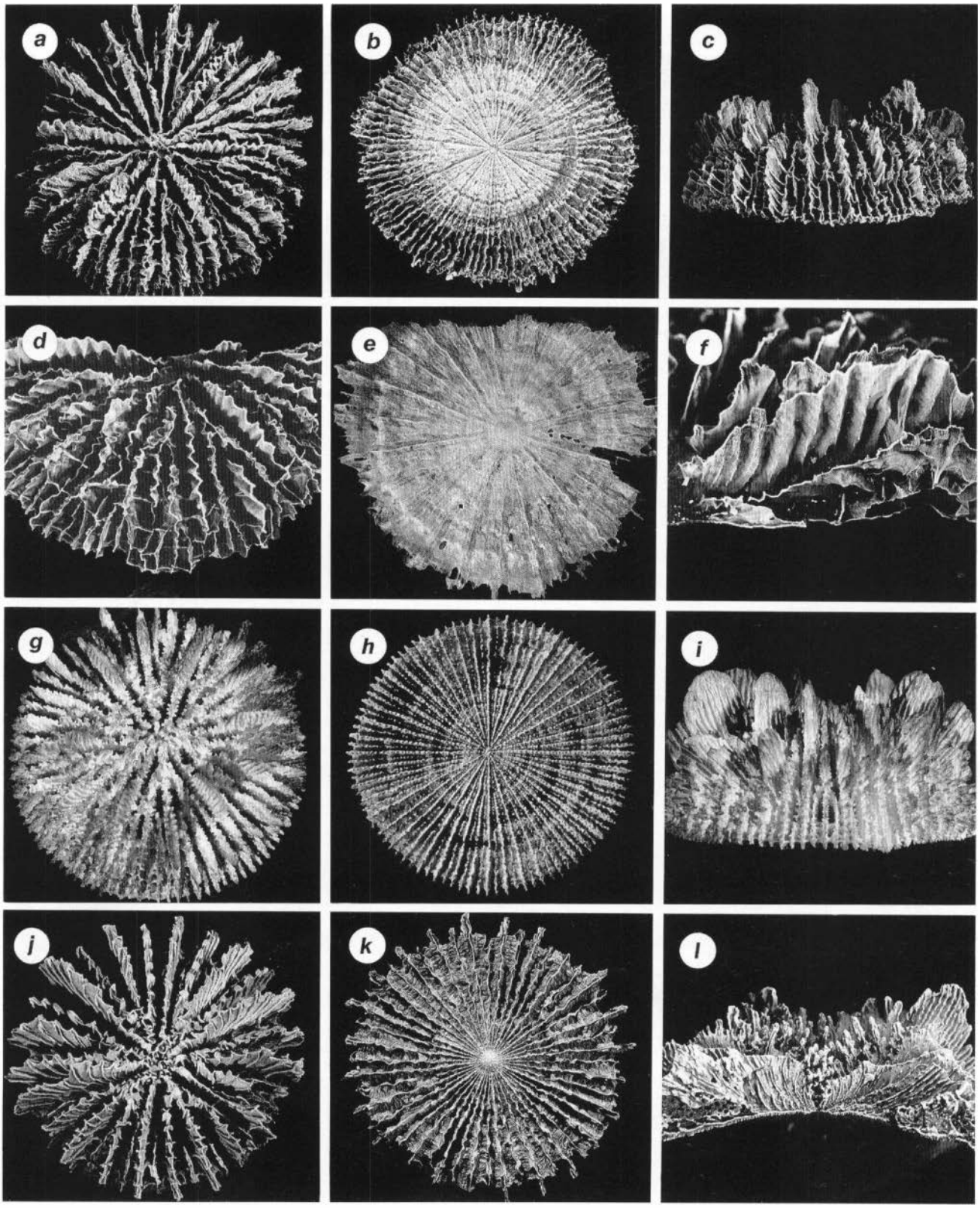


PLATE 1. *Fungiacyathus stephanus* (a-c, NZOI Stn U197, USNM 93985): a-c, oblique calicular, basal, and edge views of same corallum, all x 1.3. *Fungiacyathus fragilis* (d, f, *Eltanin* Stn 1412, USNM 47536; e, *Eltanin* Stn 1846, USNM 47537): d, f, sinuous septa, x 2.6, x 4.5, respectively; e, basal view of costae, x 2.2. *Fungiacyathus pusillus pacificus* (g-i, holotype; l, paratype, NZOI Stn I97, USNM 93974): g, i, oblique calicular, basal, and edge views, all x 3.1; l, broken corallum revealing ridges on septal face, x 3.2. *Fungiacyathus marenzelleri* (j-k, NZOI Stn J667, USNM 93976): oblique calicular and basal views of costae, both x 1.5.

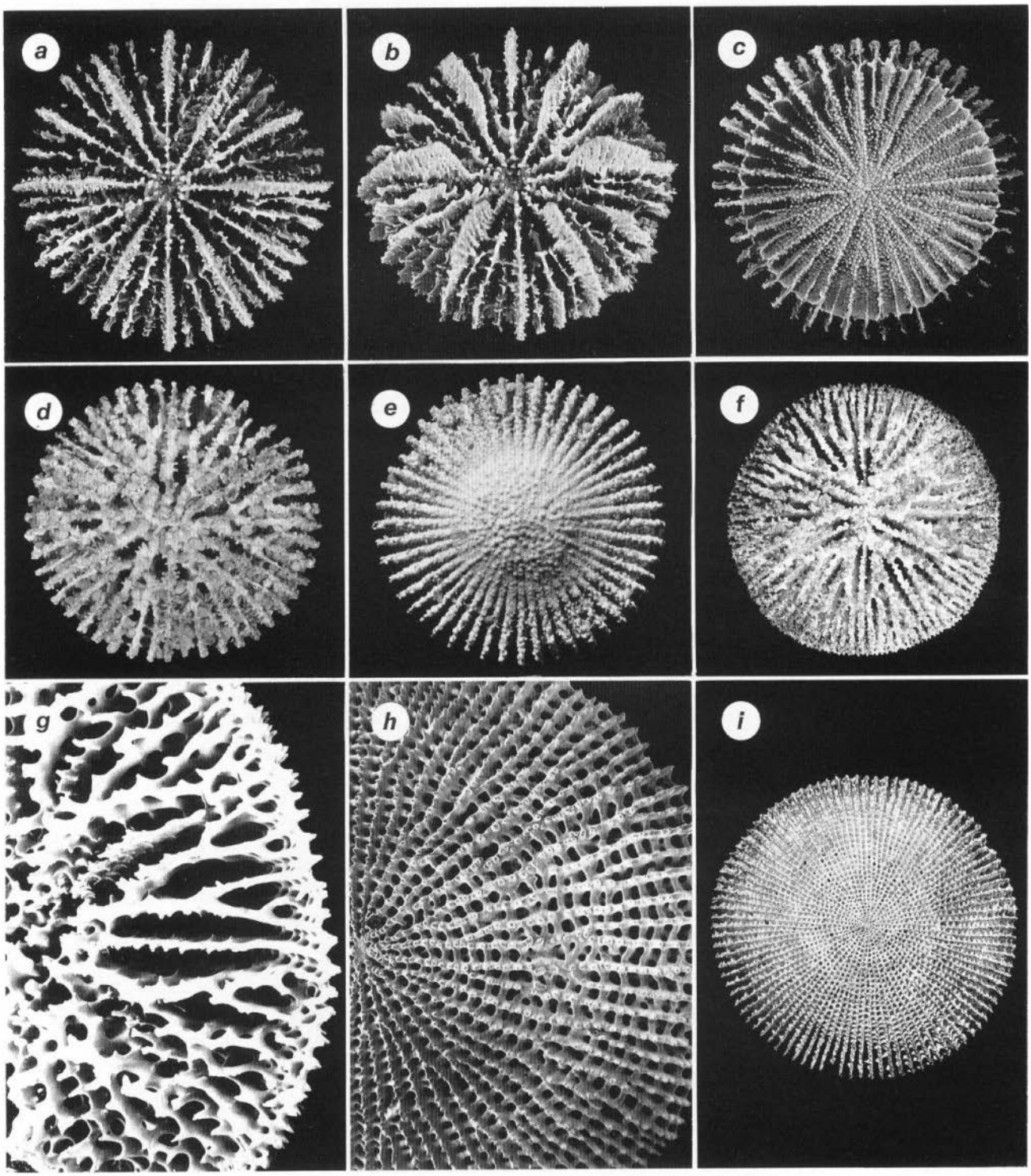


PLATE 2. *Fungiacyathus margaretae* (a-c, holotype): a-c, calicular, oblique calicular, and basal views of holotype, all x 3.2. *Fungiacyathus turbinolioides* (d-e, NZOI Stn E868, USNM 93981): d-e, calicular and basal views of a worn corallum, both x 8.7. *Letepsammia superstes* (f, NZOI Stn K795, USNM 94080; g-h, NZOI, Stn K838, USNM 94081; i, NZOI Stn K840, USNM 94082): f, i, calicular and basal views of a corallum, x 2.8, x 3.0, respectively; g-h, detail of septa and costal granulation, x 10.5, x 9.5, respectively.

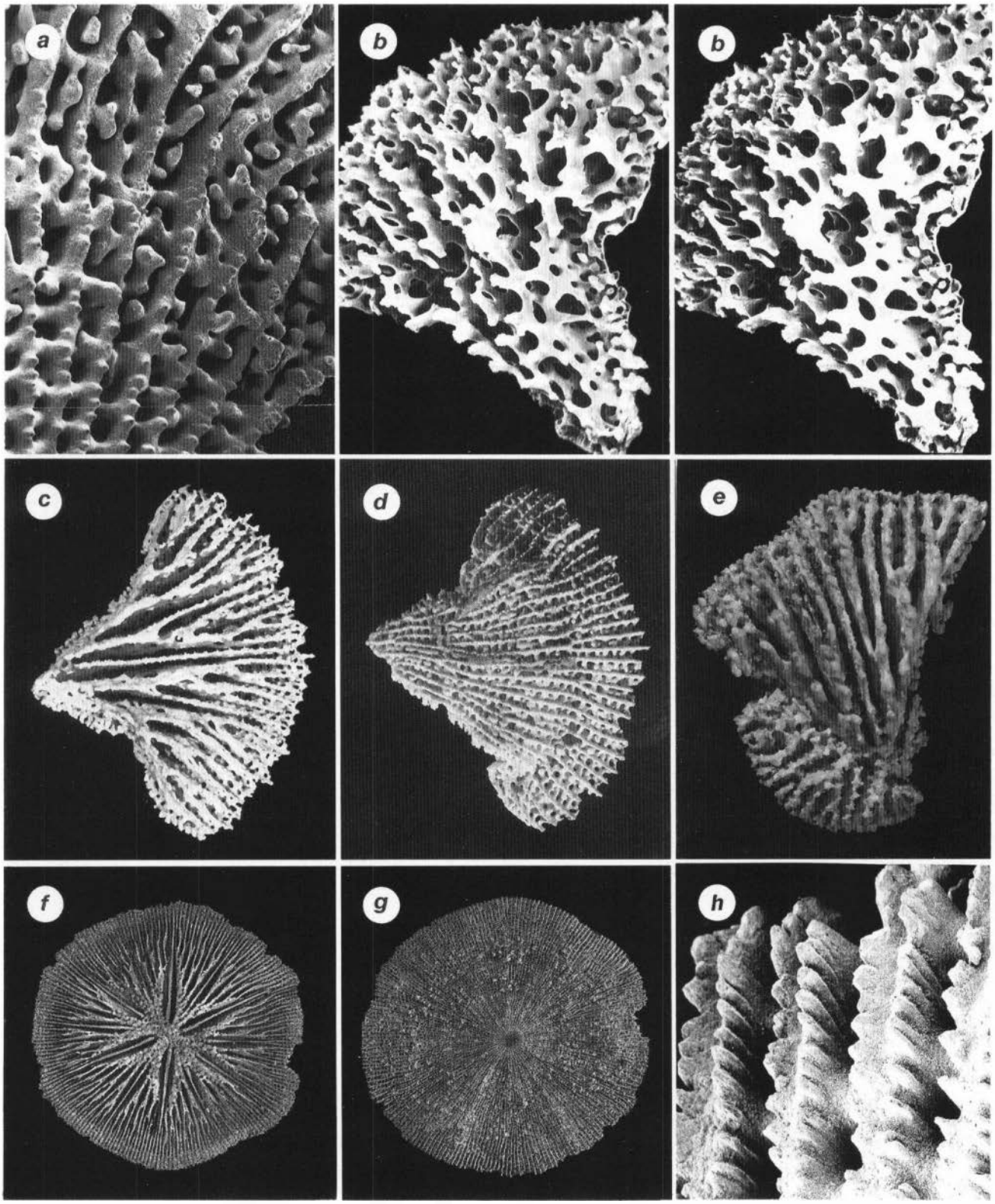


PLATE 3. *Letepsammia fissilis* (a-d, BS833, MNZ CO833; e, BS833, MoNZ CO287): a, costal granulation, x 22; b, stereo view of corallum fragment, x 10.5; c-d, calicular and basal views of holotype, x 3.5; e, regenerated corallum fragment, x 6.2. *Letepsammia formosissima* (f-g, BS888, MoNZ): f-g, calicular and basal views of same corallum, both x 1.2. *Stephanophyllia complicata* (h, NZOI Stn U584, USNM 94079): h, costae at edge of corallum, x 47.

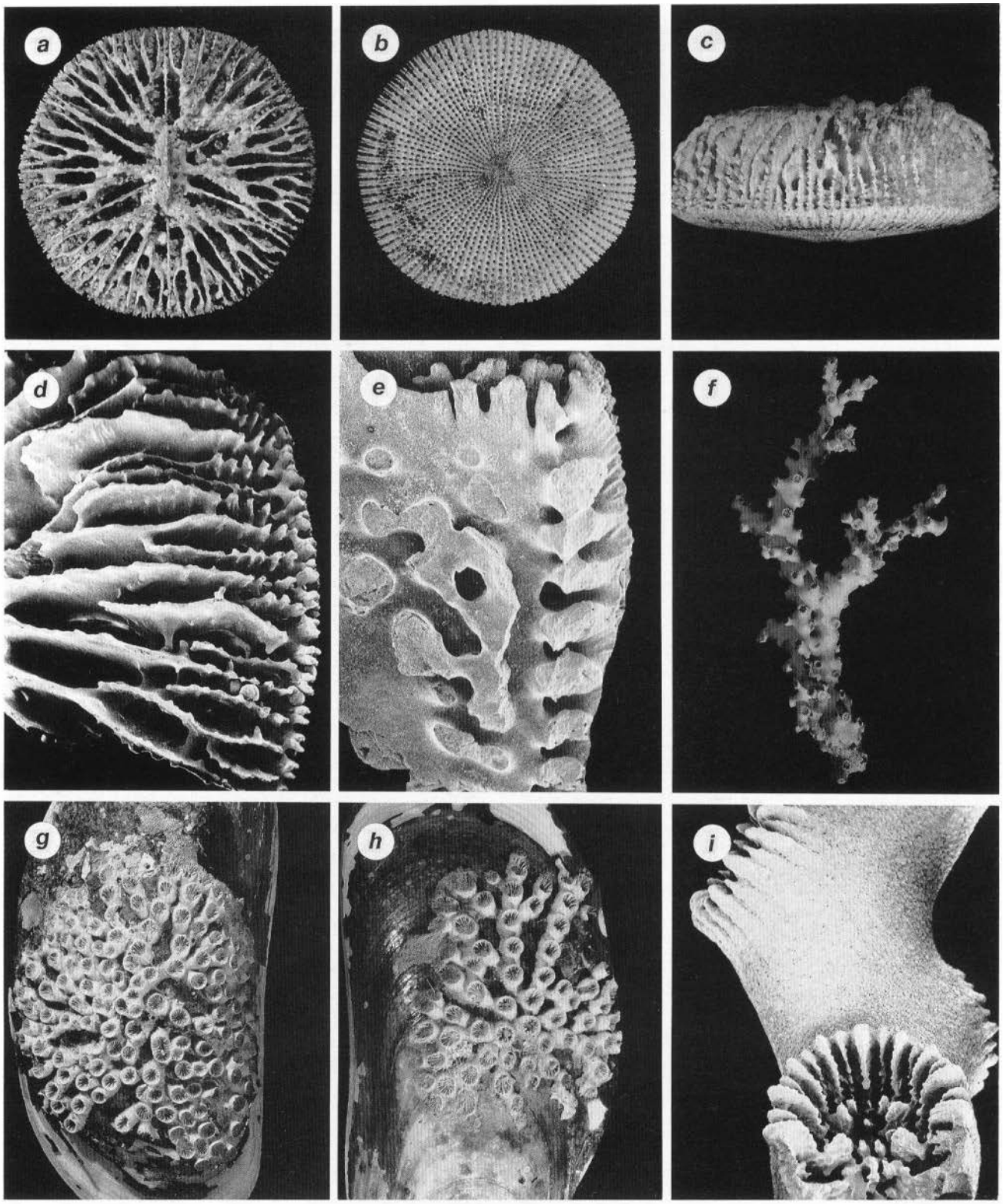


PLATE 4. *Stephanophyllia complicata* (a, d-e, NZOI Stn U584, USNM 94079; b-c, NZOI Stn P14, USNM 94078): a-c, calicular, basal, and edge views of coralla, x 2.8, x 3.5, x 4.2, respectively; d, arrangement of septa at calicular edge, x 10; e, longitudinal fracture revealing serially arranged synapticulae and fulturae on septal face, x 21. *Oculina virgosa* (f, i, AU 9129, H1200): f, colony, x 0.5; i, branch fragment, x 10.5. *Culicia rubeola* (g-h, AU 140, H1201): g-h, symmetrically radiating coralla encrusting valves of *Perna canaliculus*, both x 0.8.

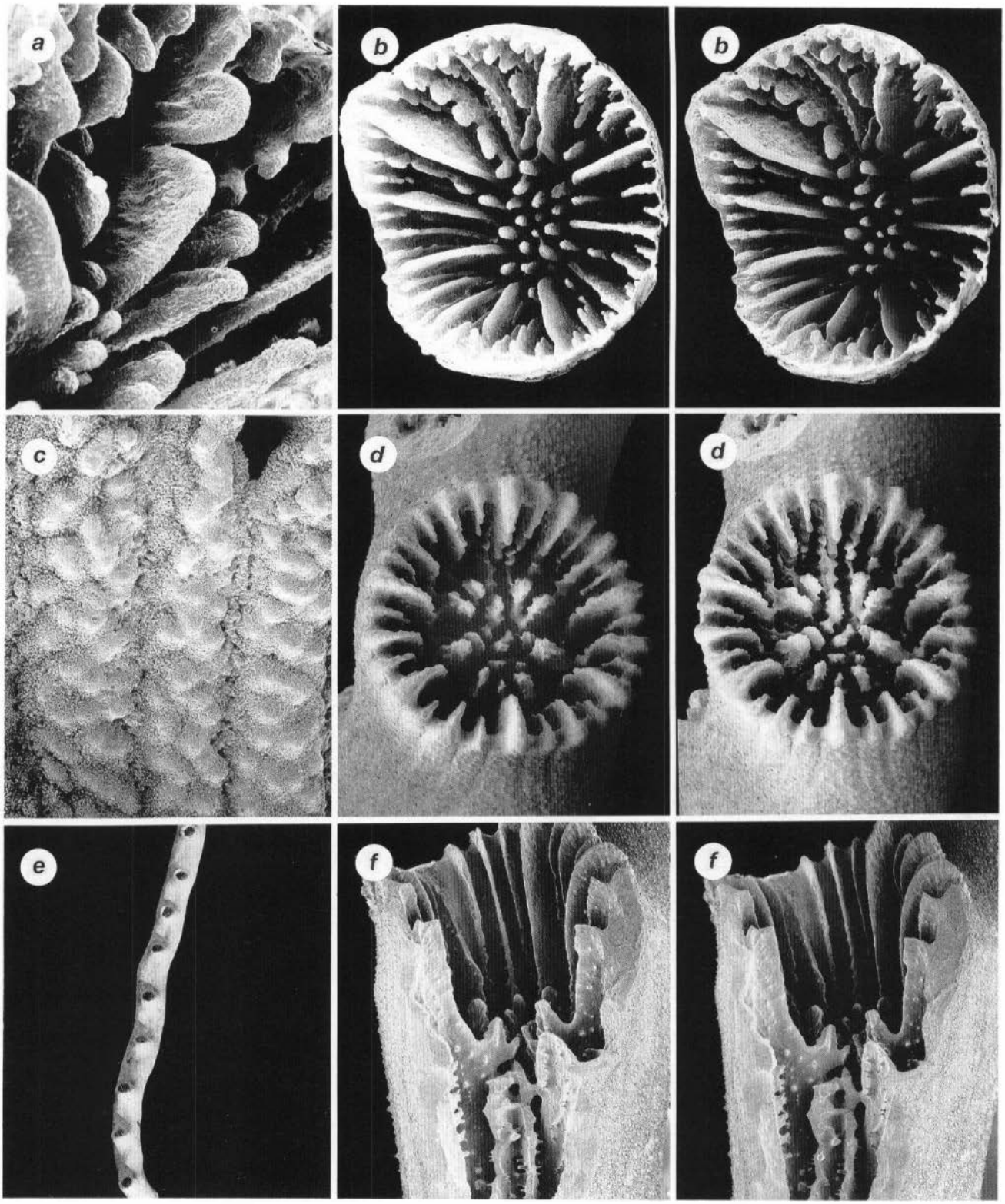


PLATE 5. *Culicia rubeola* (a-b, NZOI Stn M793, USNM 94000): a, coarse septal lobation, x 39.5; b, stereo view of a calice, x 12.2. *Oculina virgosa* (c-d, AU 9129): c, costal granulation near calice, x 54; d, stereo view of a calice having 8 pali, x 14.5. *Madrepora oculata* (e, NZOI Stn C642, USNM 47514; f, NZOI Stn B314, USNM 93986): e, branch fragment, x 1.1; f, stereo view of longitudinally fractured corallum revealing columella and pali, x 18.

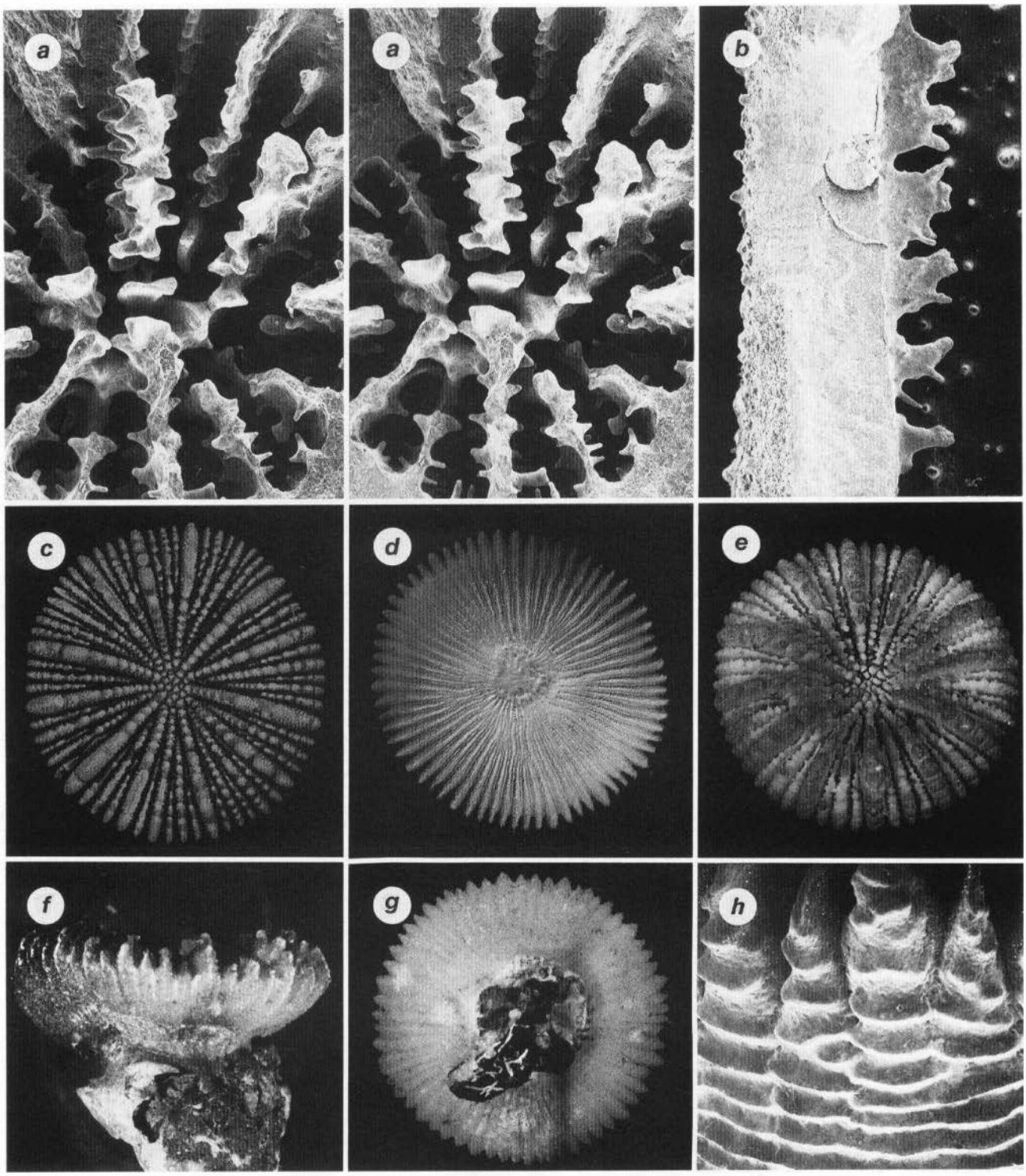


PLATE 6. *Madrepora oculata* (a, NZOI Stn U594, USNM 93988; b, NZOI Stn B314, USNM 93986): a, stereo view of a calice showing prominent septal granules, x 60; b, cross section of theca (left) and a rudimentary S3, x 78. *Anthemiphyllia dentata* (c-d, f-g, BS441, MoNZ; e, NZOI Stn T217, USNM 93994): c-d, calicular and basal view of same corallum, both x 2.7; e, calicular view, x 22; f-g, side and basal views of attached specimen, x 5.4, x 5.6, respectively. *Caryophyllia rugosa* (h, NZOI C530, USNM 94005): h, transversely ridged theca near calice, x 39.

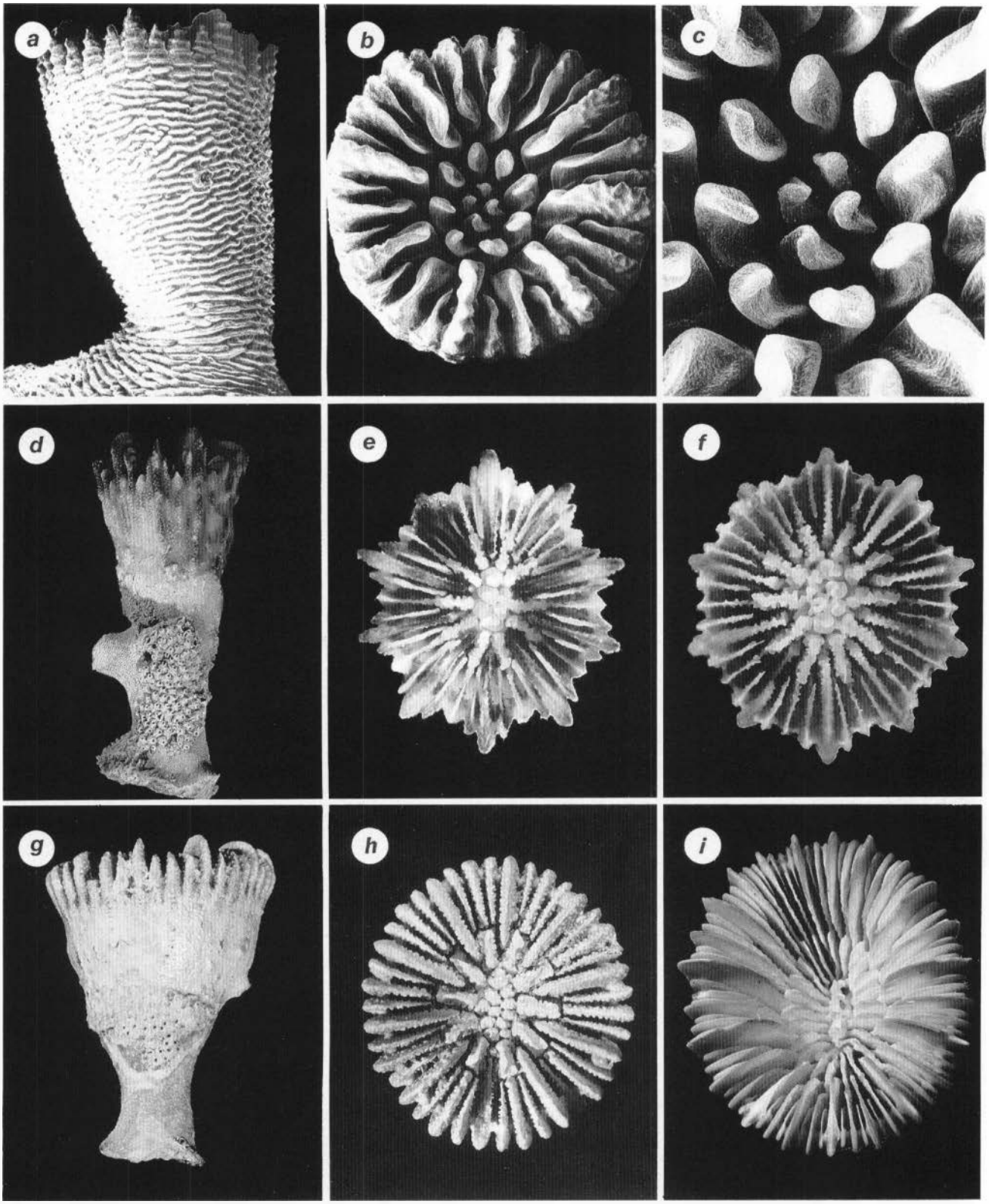


PLATE 7. *Caryophyllia rugosa* (a-c, NZOI Stn C530, USNM 95005): a, theca illustrating transverse costal ridges, x 10; b-c, calice illustrating sinuous septa, pali, and columella, x 14, x 35, respectively. *Caryophyllia hawaiiensis* (d-e, NZOI Stn P115, USNM 94013; f, syntype from *Albatross* Stn 3838, USNM 20750): d-e, side and calicular views of same specimen, x 2.4, x 5.0, respectively; f, calicular view, x 8.6. *Caryophyllia quadragenaria* (g-h, NZOI Stn C776, USNM 94007): g-h, side and calicular views of same specimen, x 4.6, x 5.4, respectively. *Caryophyllia profunda* (i, syntype from *Challenger* Stn 135, BM(NH) 1880.11.25.36): i, oblique calicular view, x 2.3.

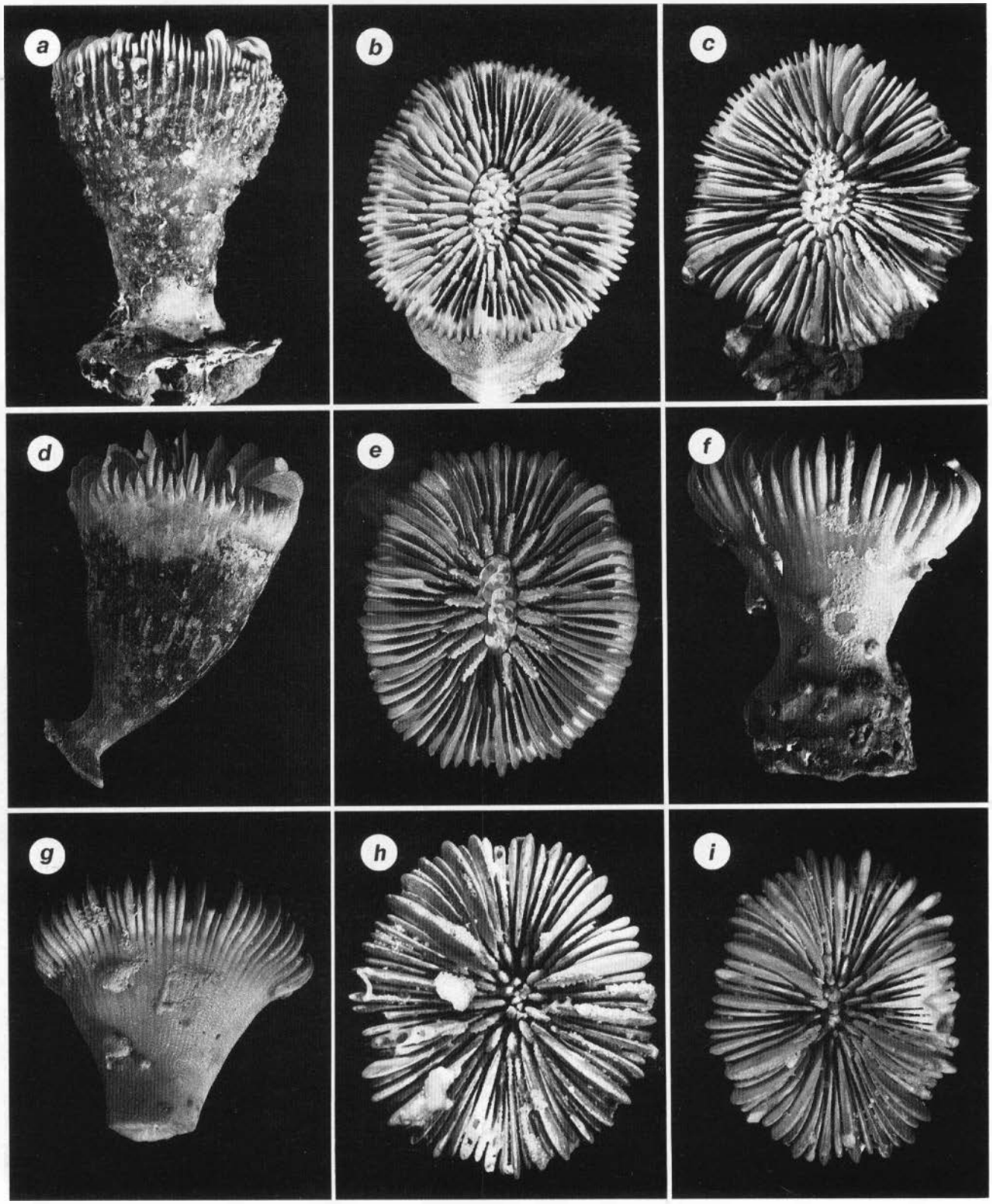


PLATE 8. *Caryophyllia profunda* (a, NZOI Stn E751, USNM 94020; b, NZOI Stn D876, USNM 94019; c, NZOI Stn M782, USNM 94039): a, side view, x 1.2; b-c, calicular views of different specimens, x 1.4, x 1.5, respectively. ***Caryophyllia atlantica*** (d-e, *Eltanin* Stn 1712, USNM 94022): d-e, side and calicular views of same specimen, x 1.5, x 2.0, respectively. ***Caryophyllia ralphae*** (f, i, holotype; g-h, paratype, *Franklin* Stn 5/89/40, AMS, G15500): f-g, side views, x 1.7, x 1.8, respectively; h-i, calicular views, x 1.8, x 1.5, respectively.

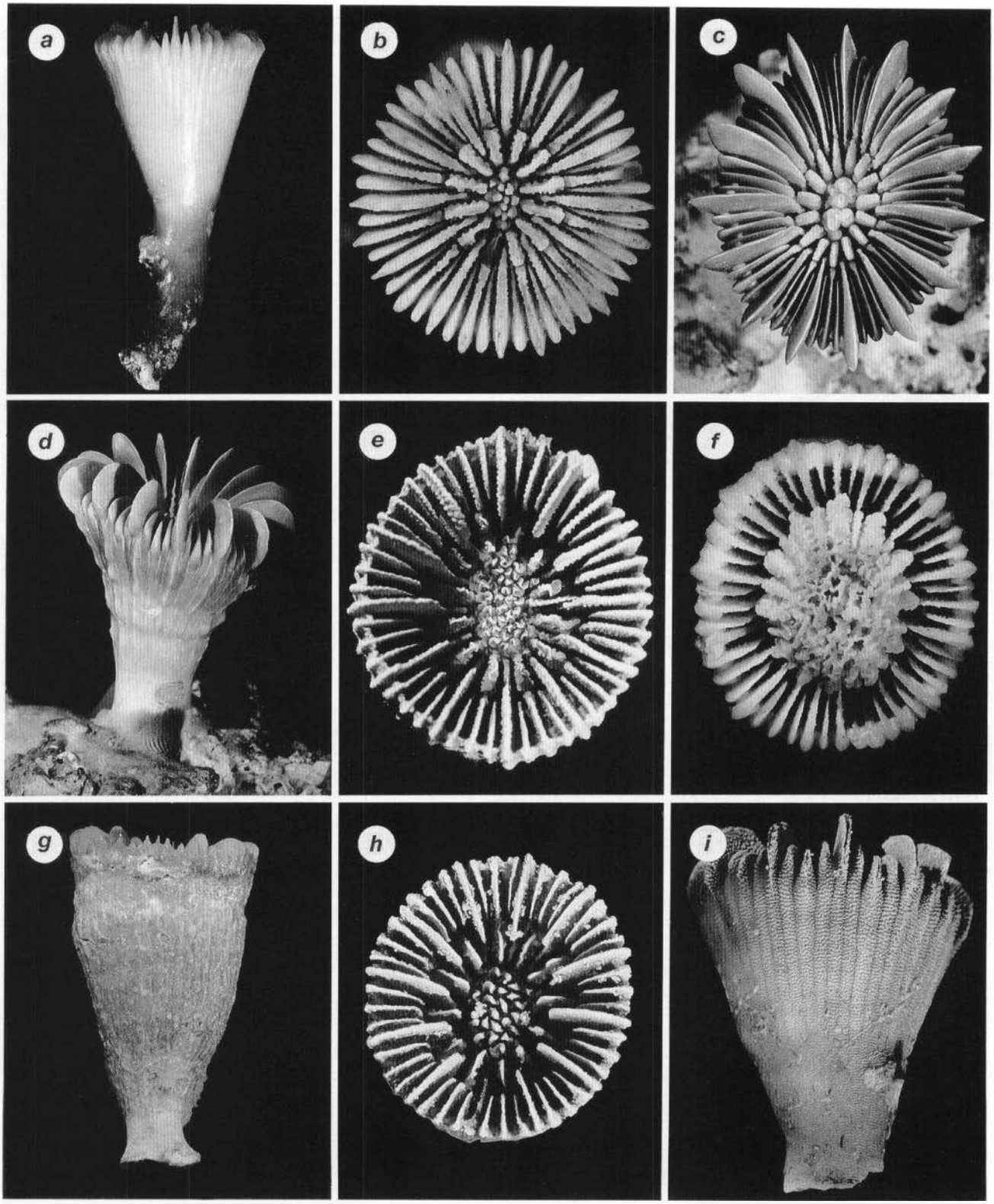


PLATE 9. ***Caryophyllia diomedeae*** (a-b, NZOI P946, USNM 94057; c-d, *Eltanin* Stn 1403, USNM 47518): a-b, side and calicular views of specimen with porcellanous theca, x 1.7, x 3.3, respectively; c-d, calicular and side views of a specimen with 14 pali, x 2.0, x 1.4, respectively. ***Caryophyllia japonica*** (e, NZOI Stn V372, USNM 94036; f, NZOI Stn C690, USNM 94030; g-h, NZOI G230, USNM 94033): e, h, calicular views, x 4.1, x 4.4, respectively; f, aberrant calice with hypertrophied columella and pali, x 3.4; g, side view, x 2.6. ***Caryophyllia lamellifera*** (i, NZOI Stn I91, USNM 94358): i, side view showing transversely ridged theca, x 3.0.

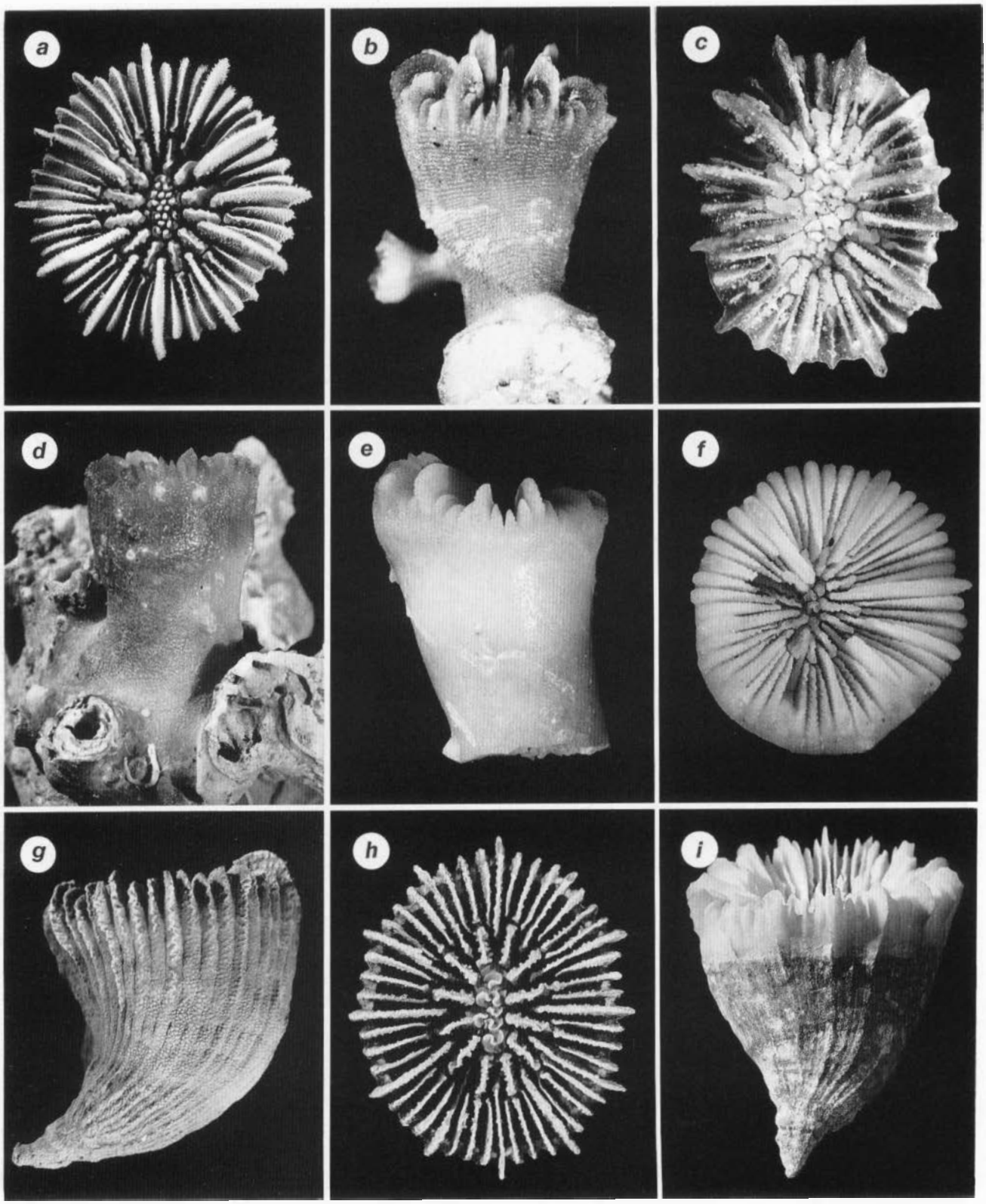


PLATE 10. *Caryophyllia lamellifera* (a, NZOI Stn 191, USNM 94358; b-c, holotype, *Challenger* Stn 170, BM(NH): a, calicular view of specimen coated with ammonium chloride, x 3.1; b-c, side and calicular views of holotype, x 4.8, x 8.2, respectively. *Caryophyllia elongata* (d-f, BS310, MoNZ CO85 and USNM 94054): d-e, side views, x 3.7, x 4.0, respectively; f, calicular view, x 4.7. *Caryophyllia scobinosa* (g-h, NZOI Stn G818, USNM 94045; i, *Franklin* Stn 5/89/25, AMS G15497): g-h, side and calicular views of same specimen, x 3.4, x 3.6, respectively; i, side view, x 2.3.

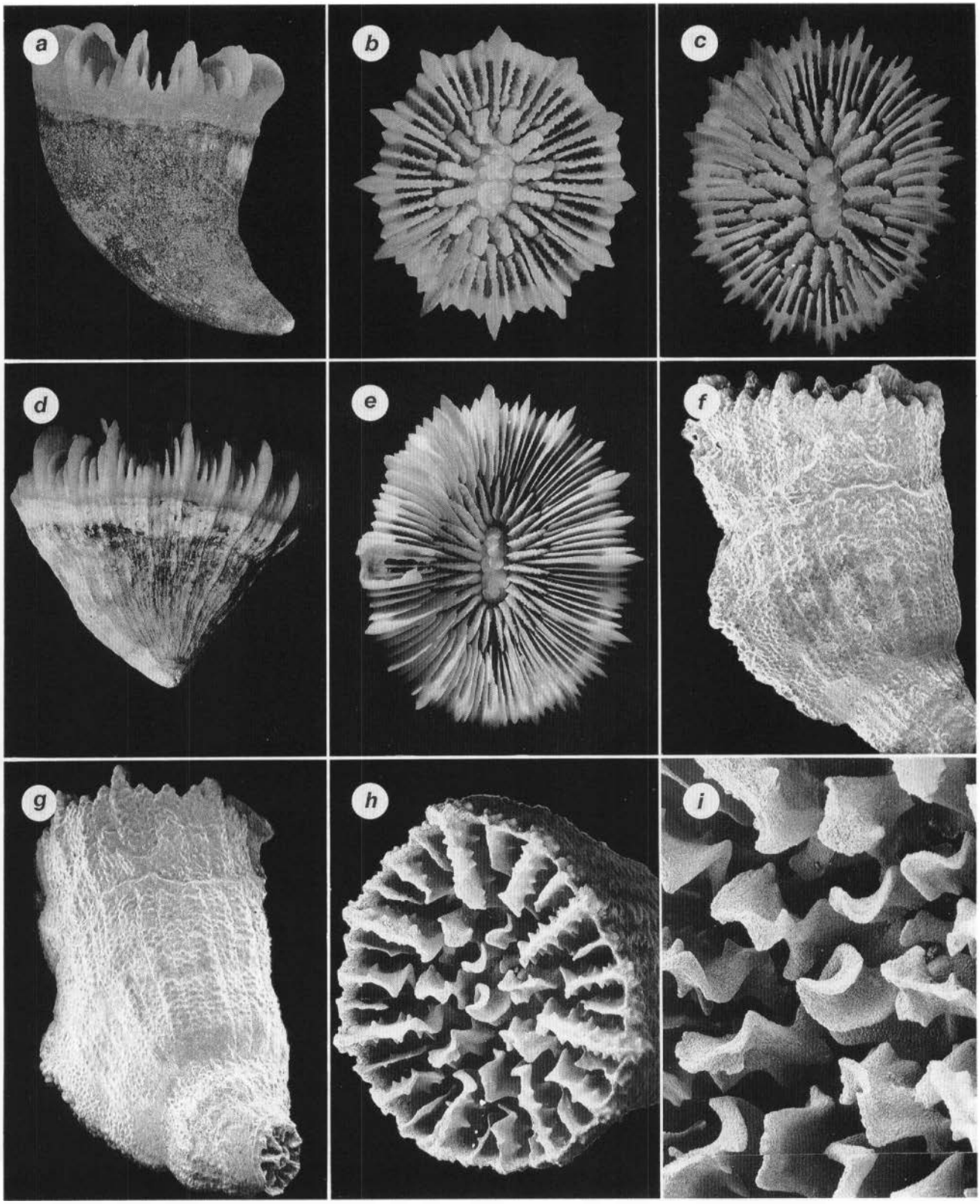


PLATE 11. *Caryophyllia scobinosa* (a-b, syntype, *Siboga* Stn 45, ZMA 574; c, *Franklin* Stn 5/89/25, AMS G15497): a-b, side and calicular views of same specimen, x 2.5, x 3.1, respectively; c, calicular view, x 2.8. *Caryophyllia ambrosia* (d-e, BS844, USNM 94041): d-e, side and calicular views of same specimen, x 1.0, x 1.1, respectively. *Caryophyllia compressa* (f-i, BS441, MoNZ): f-g, side views showing thecal crest on convex edge, x 10; h-i, calice of specimen with 7 pali, x 20, x 44, respectively.

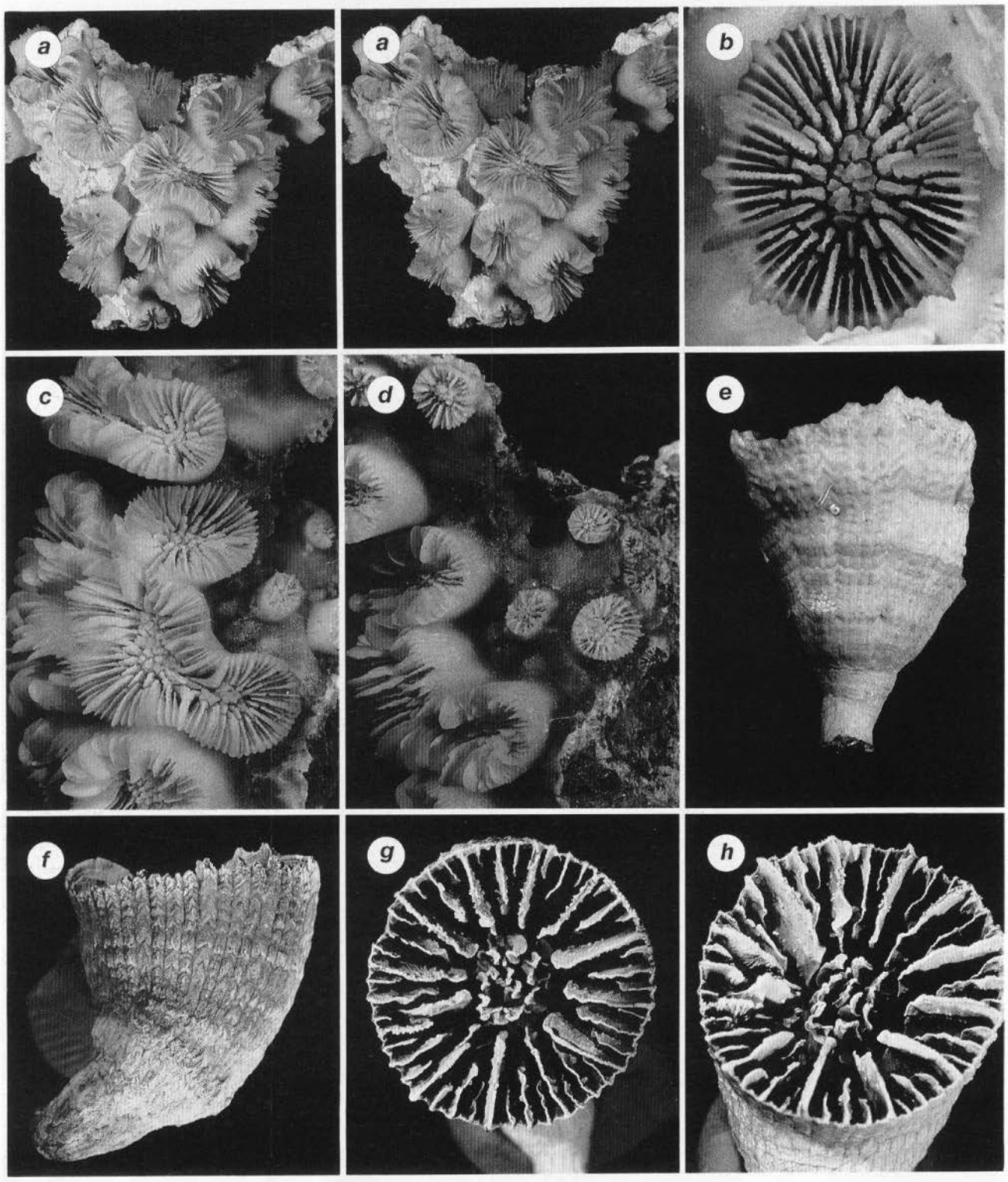


PLATE 12. *Coenocyathus brooki* (a, c-d, holotype; b, L1413, AIM AK76441, paratype): a, stereo view of holotype colony, x 1.2; b, calice, x 5.6; c, intratentacular budding, x 2.3; d, extratentacular budding from edge zone, x 2.5. *Crispatotrochus curvatus* (e, *Terra Nova* Stn 96, BM(NH) 1929.10.22.15; f-h, holotype): e, side view, x 2.7; f-h, side, calicular, and oblique calicular views of holotype, x 2.9, x 3.4, x 3.5, respectively.

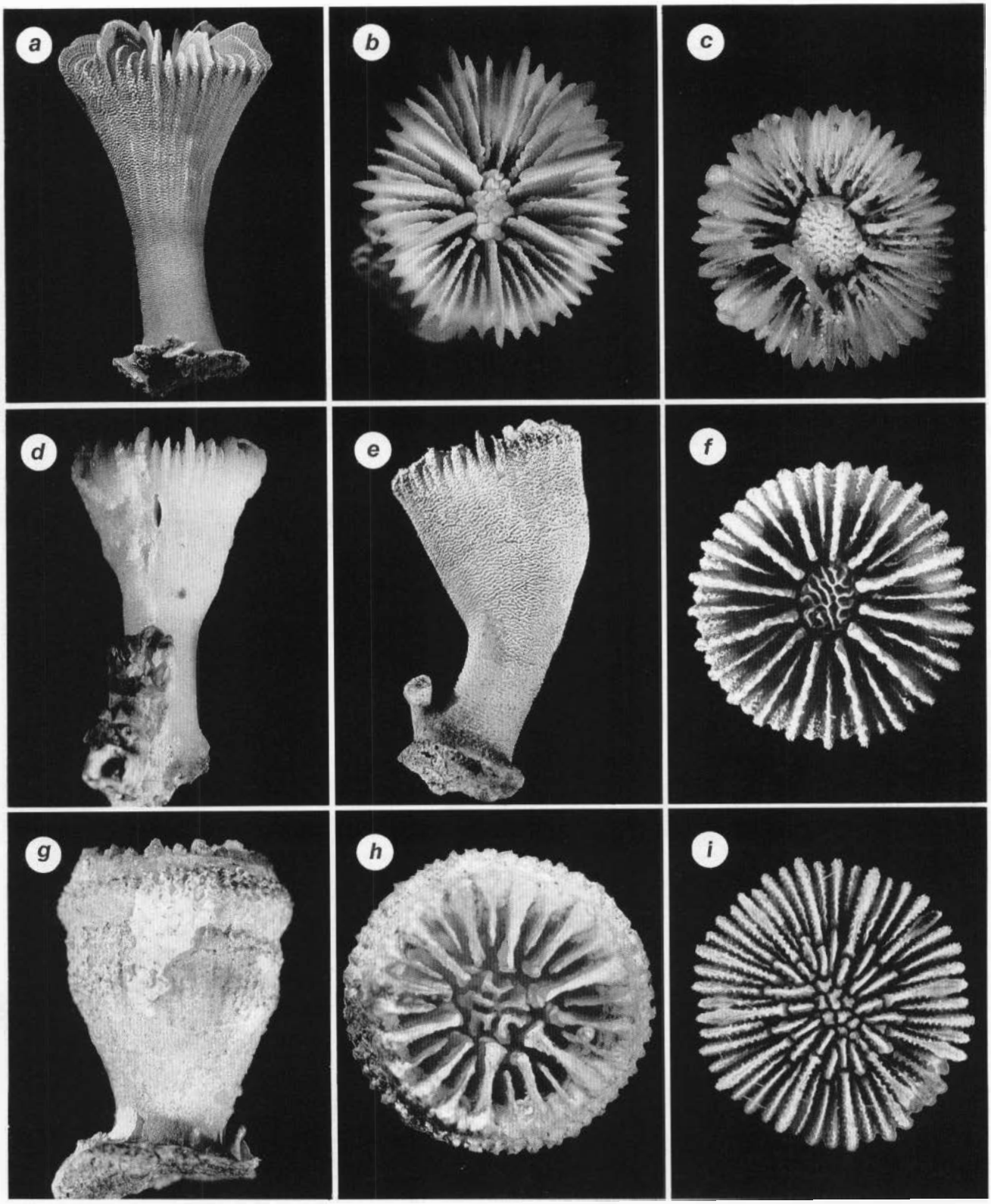


PLATE 13. *Crispatotrochus rugosus* (a-b, holotype): a-b, side and calicular views, x 2.4, x 3.4, respectively. ***Labyrinthocyathus limatulus*** (c-d, *Franklin* Stn 5/89/40, USNM 94128; e-f, NZOI Stn I94, USNM 94127): c-d, calicular and side views of specimen with an acrothoracid gall, x 4.1, x 2.8, respectively; e-f, side and calicular views of another specimen, x 3.7, x 5.6, respectively. ***Labyrinthocyathus*** sp. (g-h, NZOI Stn G941, USNM 94129): g-h, side and calicular views of same specimen, x 6.0, x 9.2, respectively. ***Trochocyathus rhombocolumna*** (i, holotype of *Paracyathus tenuicalyx*, USNM 20755): i, calice, x 6.2.

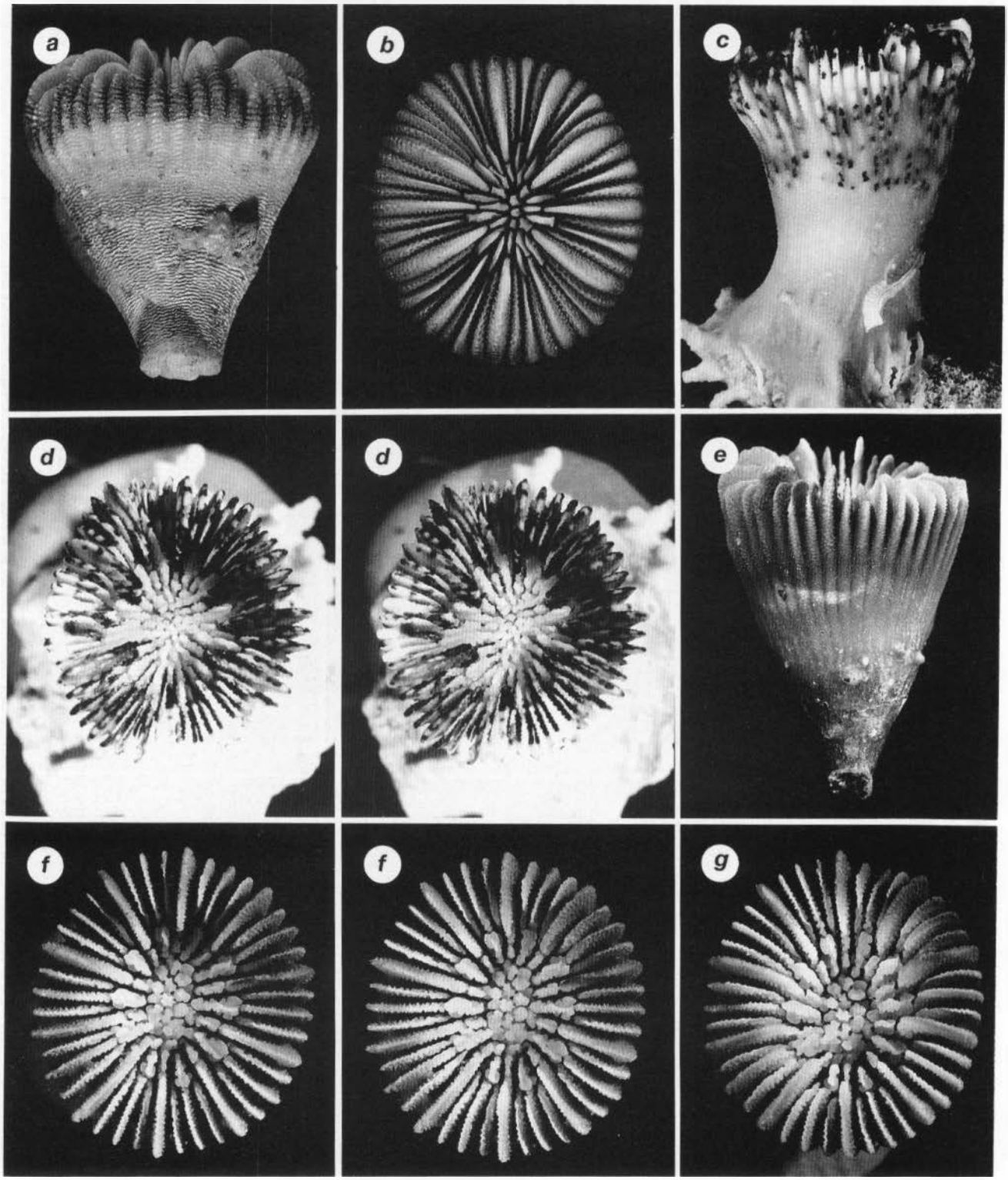


PLATE 14. *Trochocyathus rhombocolumna* (a-b, NZOI Stn S572, USNM 94100): a-b, side and calicular views of same specimen, both x 2.7. *Trochocyathus maculatus* (c-d, holotype): c-d, side and stereo calicular views of holotype, x 3.6, x 4.2, respectively. *Trochocyathus gordoni* (e-g, holotype): e, side view, x 3.8; f-g, stereo calicular and oblique calicular views, both x 4.2.

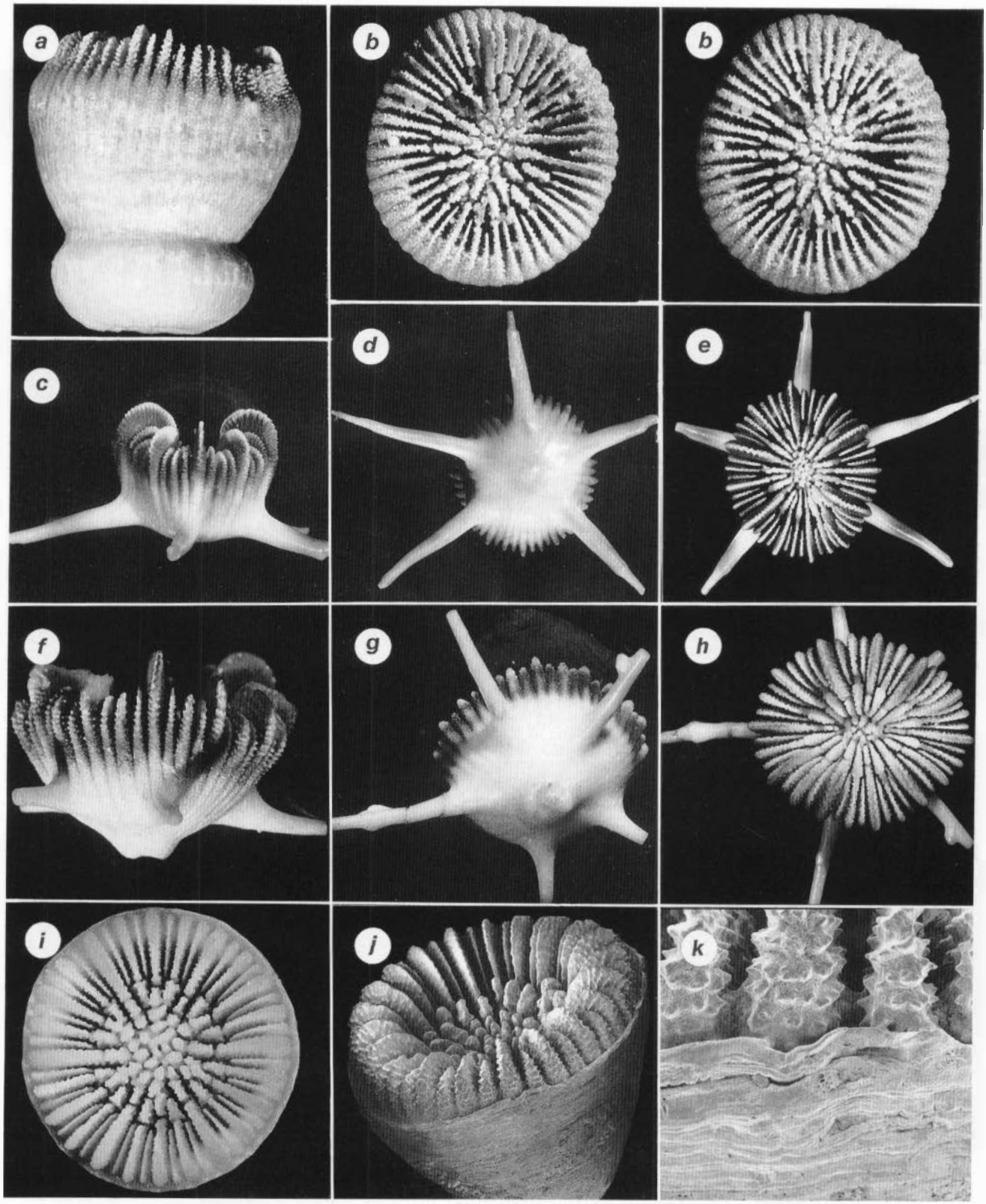


PLATE 15. *Trochocyathus cepulla* (a-b, holotype): a-b, side and stereo calicular views of holotype, x 4.1, x 4.6, respectively. *Trochocyathus hastatus* (c-e, NZOI Stn T225, USNM 94113; f-h, syntypes, AMS G14462-3): c-e, edge, basal, and calicular views of same specimen, all x 2.0; f-h, edge, basal, and calicular views of a syntype, x 3.2, x 2.5, x 2.5, respectively. *Tethocyathus cylindraceus* (i, Poor Knights Islands, NZGS; j-k, L3071, AIM AK78395): i, calicular view, x 6.6; j, oblique calicular view, x 8.3; k, epitheca near calicular edge, x 31.

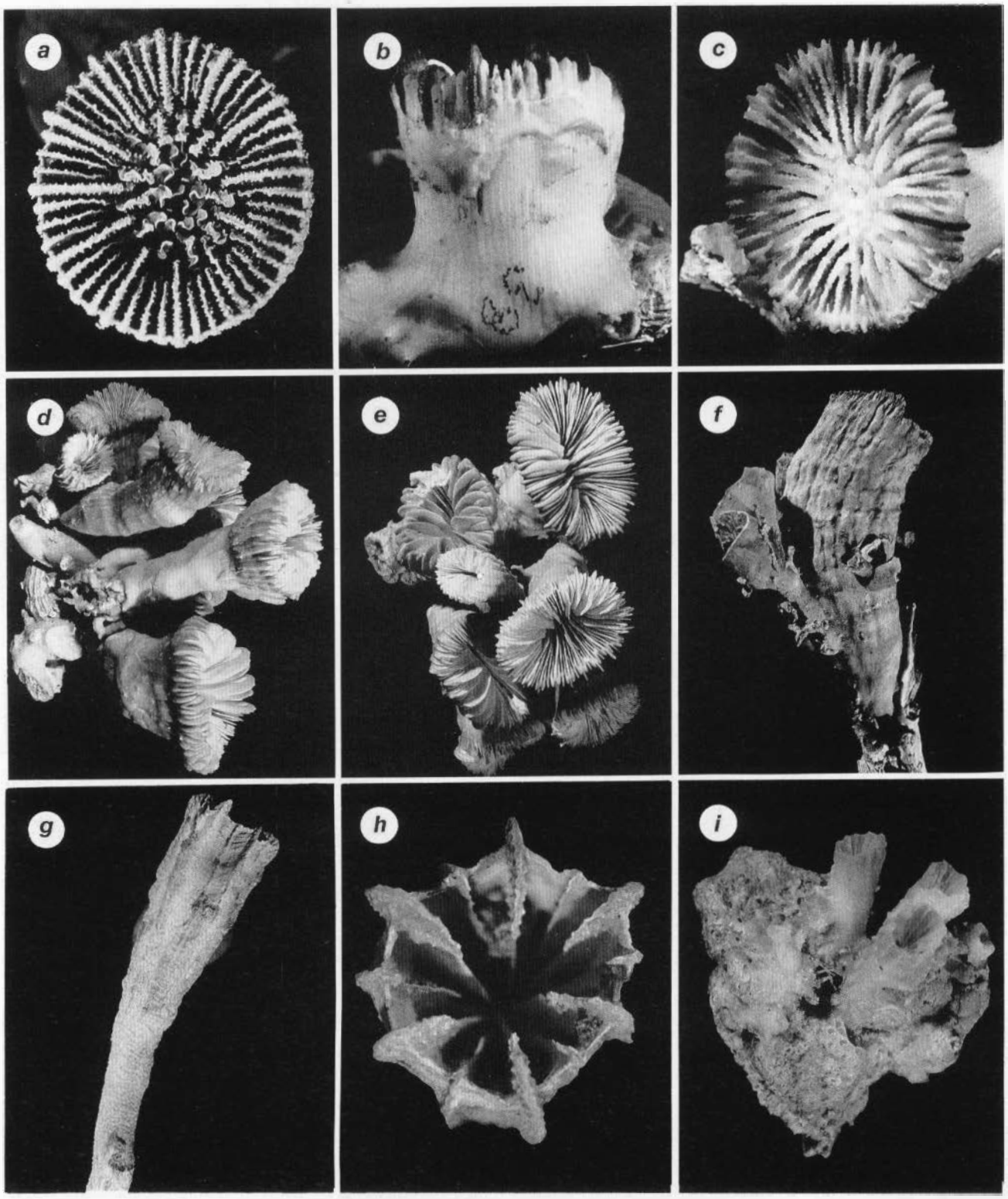


PLATE 21. ***Dasmosmilia lymani*** (a, NZOI Stn F896, USNM 94139): a, calicular view, x 3.2. ***"Caryophyllia" (=Rhizosmilia) maculata*** *sensu* Moseley (1881) (b-c, *Challenger* Stn 170, BM(NH) (unregistered)): b-c, side and calicular views of same specimen, x 3.1, x 3.9, respectively. ***Desmophyllum dianthus*** (d-e, NZOI D175, USNM 47413; f, NZOI Stn G200, USNM 94064): d-e, a pseudocolonial cluster of coralla, x 0.51; f, very large corallum bearing numerous, widely spaced endothecal dissepiments internally, x 0.35. ***Thalamophyllia tenuescens*** (g-h, BS571, MoNZ CO230; i, NZOI K838, USNM 94141): g-h, side and calicular views of a corallite, x 4, x 13, respectively; i, a small cluster of corallites, x 3.1.

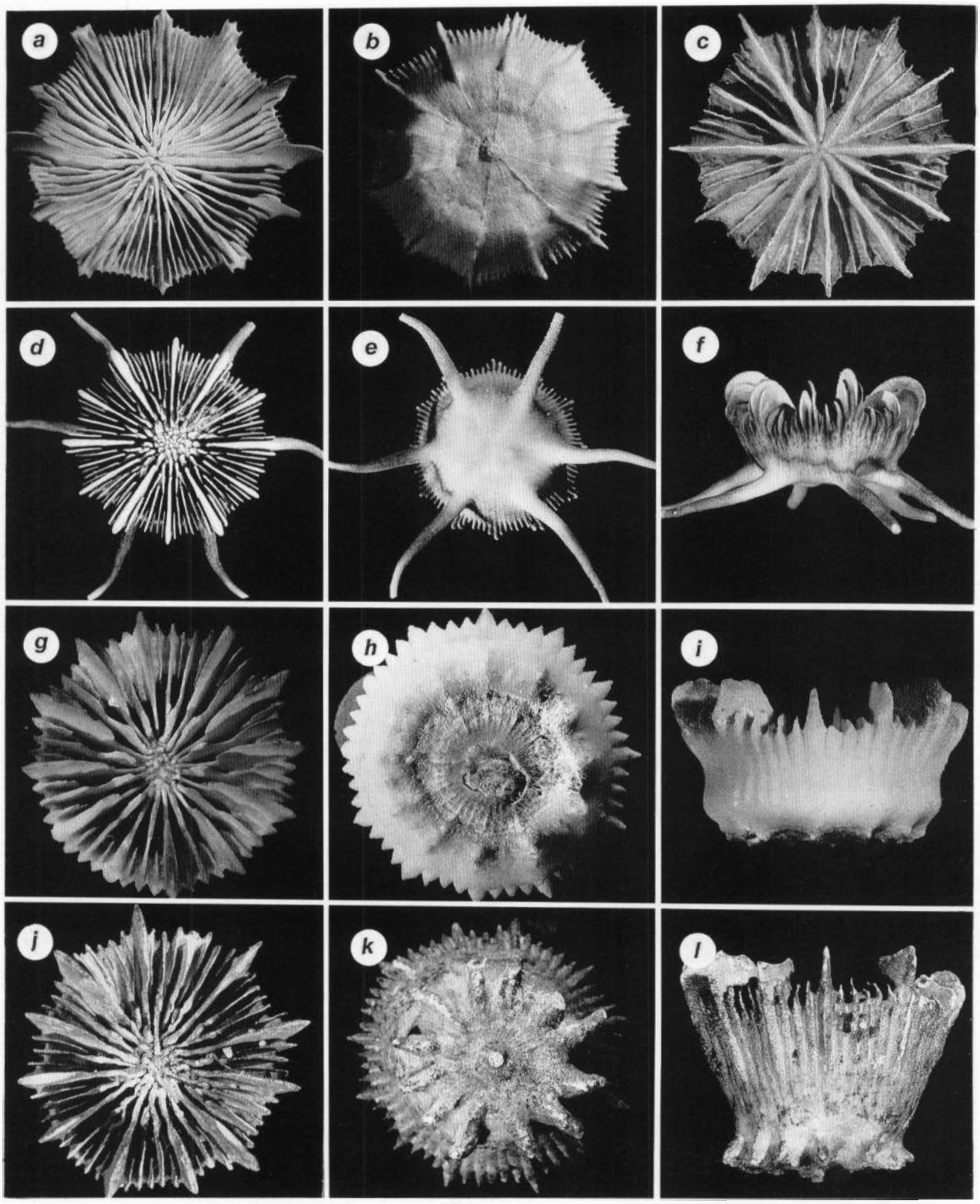


PLATE 17. ***Stephanocyathus platypus*** (a-b, *Eltanin* Stn 1718, USNM 47522; c, NZOI Stn P120, USNM 94165): a-b, calicular and basal views of same specimen, both x 0.8; c, juvenile corallum still attached to substratum, x 2.1. ***Stephanocyathus spiniger*** (d-f, NZOI Stn P14, USNM 49231): d-f, calicular, basal, and edge views of same corallum, x 1.3, x 1.0, x 1.2, respectively. ***Stephanocyathus weberianus*** (g-i, NZOI Q68, USNM 94149): g-i, calicular, basal, and edge views of same corallum, all x 2.3. ***Stephanocyathus coronatus*** (j-l, NZOI Stn P945, USNM 94147): j-l, calicular, basal, and edge views of same corallum, all x 1.2.

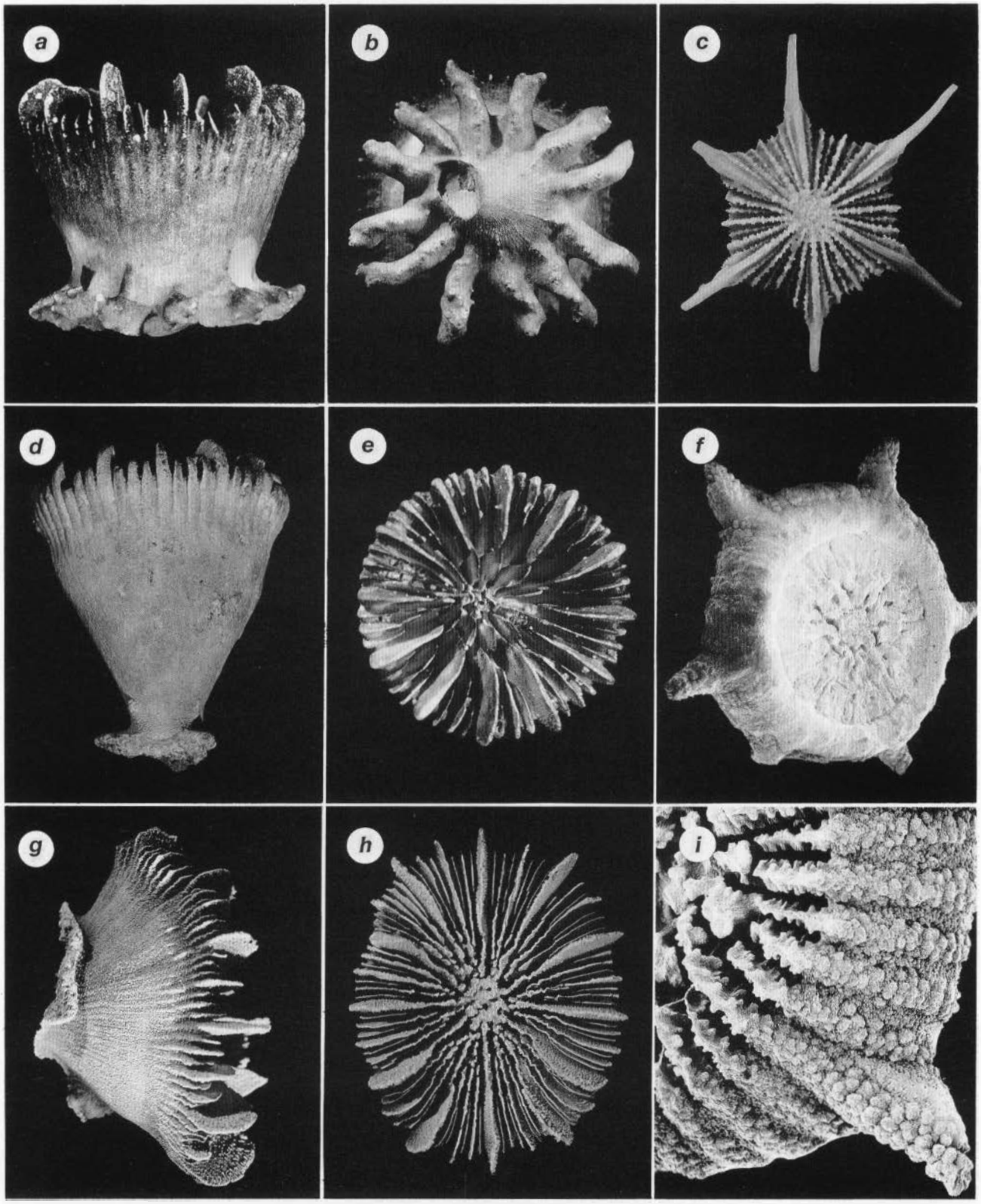


PLATE 18. ***Stephanocyathus coronatus*** (a-b, NZOI Stn P943, USNM 94146): a-b, side and basal views of specimen with prominent costal tubercles, both x 1.5. ***Stephanocyathus spiniger*** (c, NZOI Stn 194, USNM 94156): c, juvenile specimen, x 3.4. ***Vaughanella oreophila*** (d, NZOI Stn P8, USNM 94166; e, NZOI Stn P947, USNM 94168): d-e, calicular views of different specimens, x 2.0, x 2.9, respectively. ***Bourneotrochus stellulatus*** (f, i, *Franklin* Stn 5/89/40, AMS G15557): f, basal view of anthocyathus showing detachment scar, x 14; i, enlargement of a costal spine, x 33. ***Vaughanella multipalifera*** (g-h, NZOI Stn F874, paratype, USNM 94152): g-h, side and calicular views of a paratype, both x 2.0.

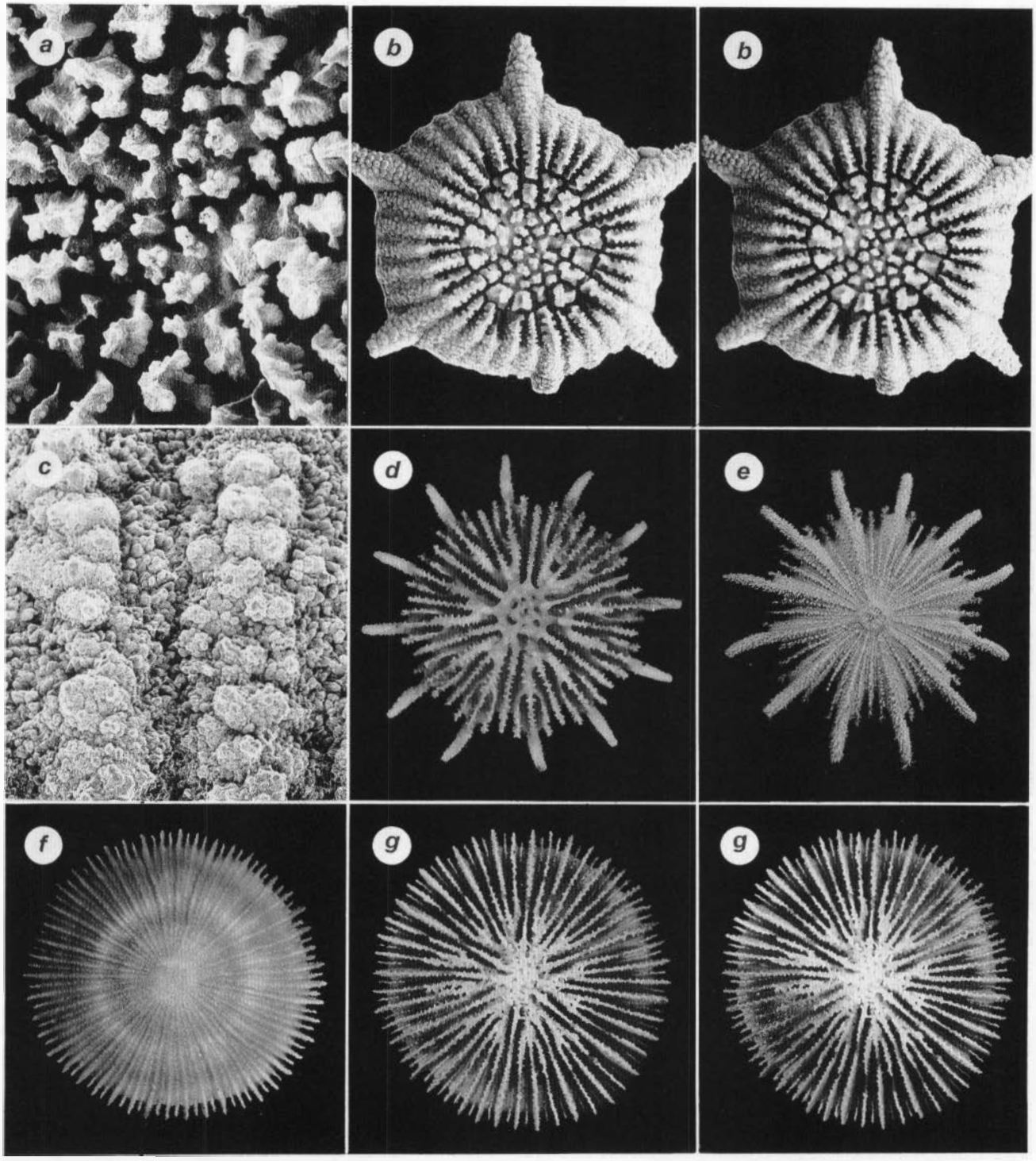


PLATE 19. ***Bourneotrochus stellulatus*** (a-c, *Franklin* Stn 5/89/40), AMS G15557: a, columella and pali, x 39; b, stereo view of calice, x 13.2; c, enlargement of two costae and an intercostal furrow, x 101. ***Deltocyathus ornatus*** (d-e, NZOI Stn P27, USNM 94169): d-e, calicular and basal views of same specimen, both x 4.1. ***Deltocyathus formosus*** (f-g, holotype): f-g, basal and stereo calicular views of holotype, both x 2.9.

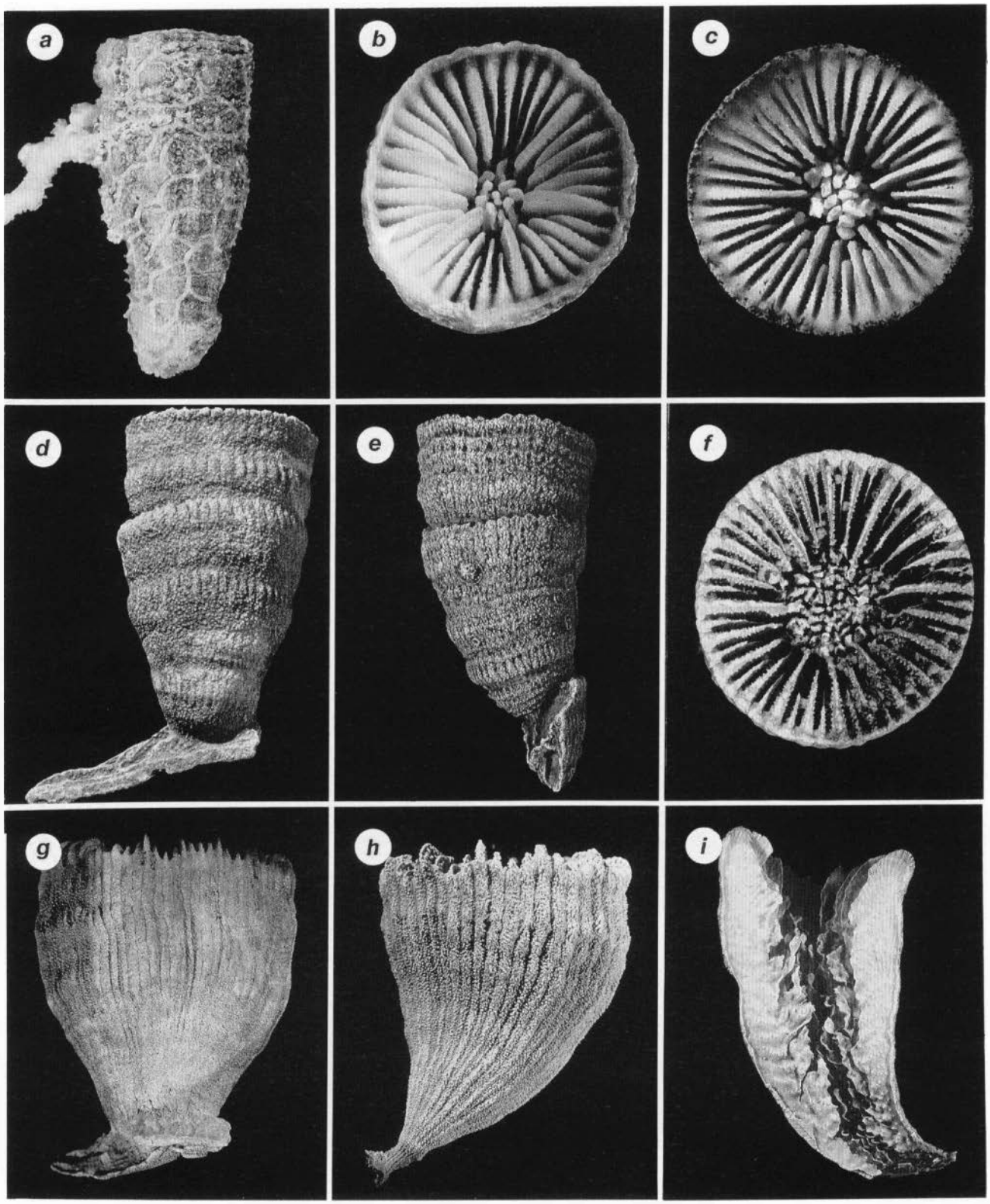


PLATE 20. *Conotrochus brunneus* (a-b, NZOI Stn U591, USNM 94116): a-b, side and calicular views of same specimen, x 3.5, x 6.4, respectively. *Aulocyathus recidivus* (c, e, NZOI Stn C734, USNM 47524; d, f, NZOI Stn U584, USNM 94121): c, f, calicular views, x 4.5, x 3.8, respectively; d-e, side views, x 2.9, x 2.8. respectively. *Dasmosmilia lymani* (g, NZOI Stn F909, USNM 94137; h, NZOI Stn F896, USNM 94139; i, BS831, MoNZ): g, side view of a typical specimen regenerated from a fragment, x 2.5; h, side view of specimen growing from planular settlement, x 1.7; i, longitudinal fracture showing multiple paliform lobes, x 2.4.

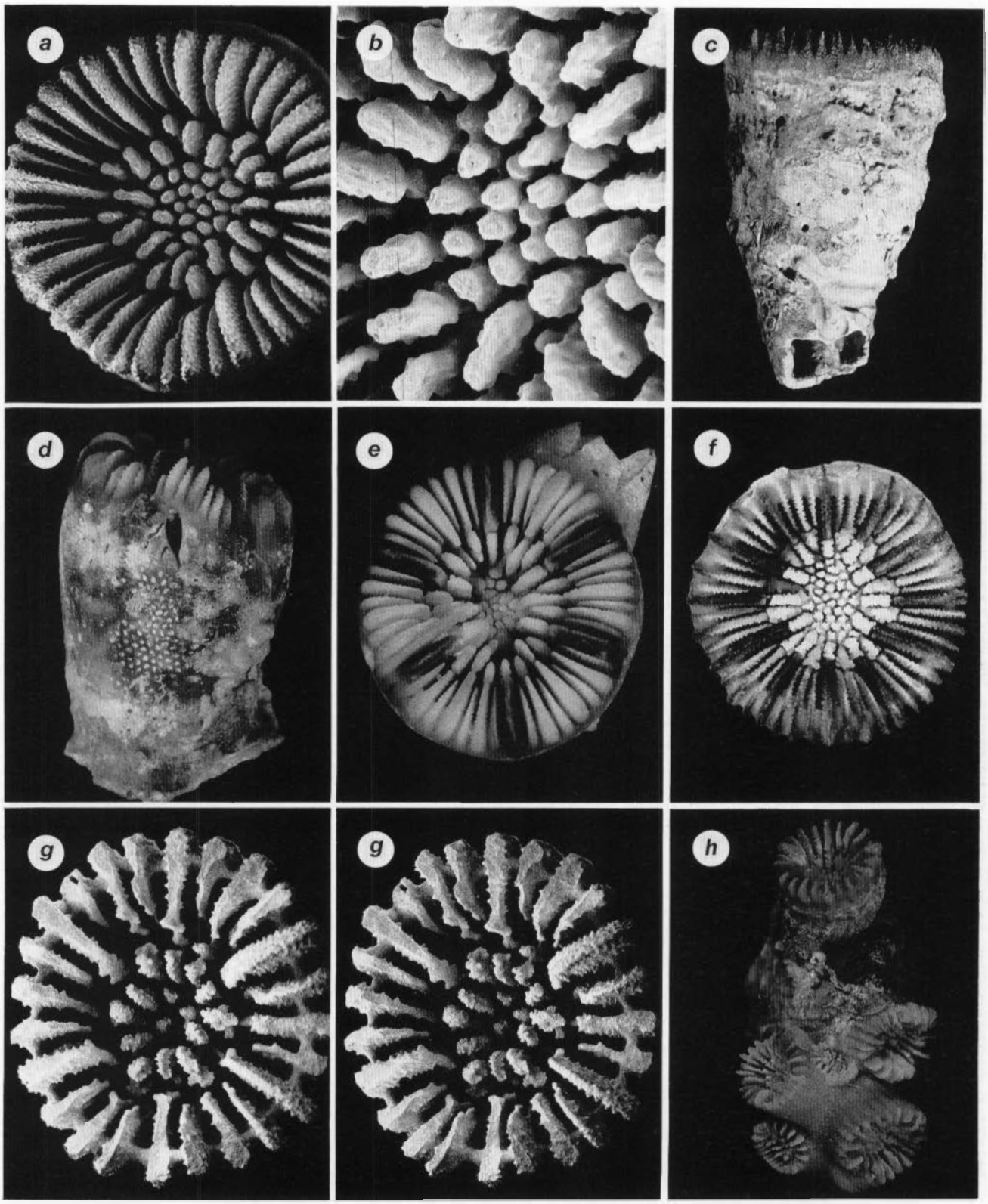


PLATE 16. *Tethocyathus cylindraceus* (a-b, L3071, AIM AK78395): a-b, calicular elements, x 8, x 18, respectively. *Tethocyathus virgatus* (c, f, holotype; d-e, NZOI Stn S572, USNM 94093): c, f, side and calicular views of holotype, x 3.4, x 4.3, respectively; d-e, side and calicular views of corallum with acrothoracid gall, x 2.7, x 3.9, respectively. *Polycyathus norfolkensis* (g-h, L4622, AIM AK72401, types): g, stereo view of a paratype calice, x 15; h, holotype colony, x 4.5.

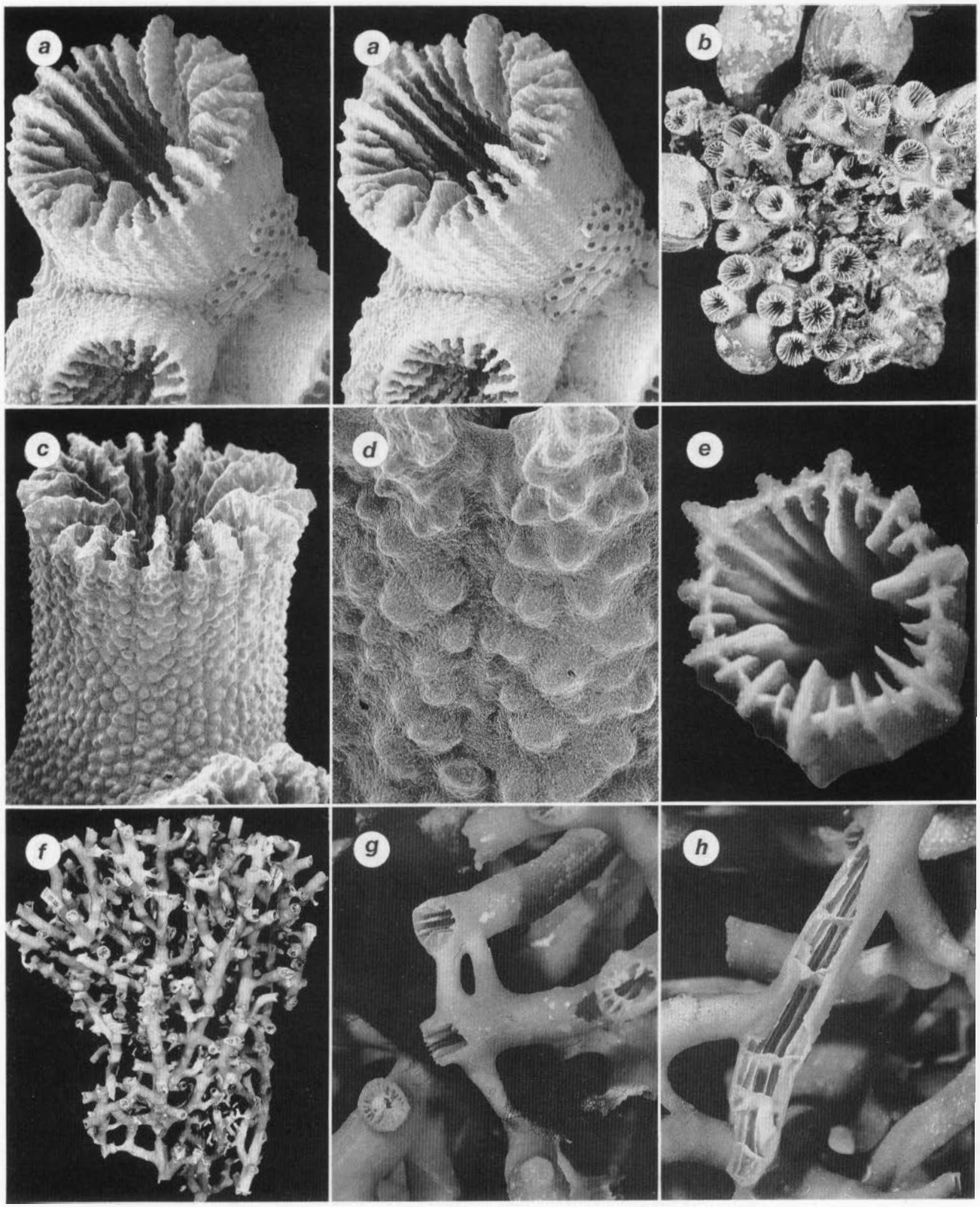


PLATE 22. ***Hoplangia durotrix*** (a, c-d, off Mokohinau, AU 6097; b, L2925, AIM AK78232): a, stereo view ot a corallite, x 12.6; b, a small colony, x 1.4; c, side view of a corallite, x 22; d, enlargement of costal granulation, x 92. ***Goniocorella dumosa*** (e-h, NZOI Stn D175, USNM 47505): e, calice of a corallite, x 12.1; f, densely branched colony, x 0.6; g, corallites linked by coenosteal bridges, x 2.3; h, fractured branch revealing tabular endothecal dissepiments, x 3.1.

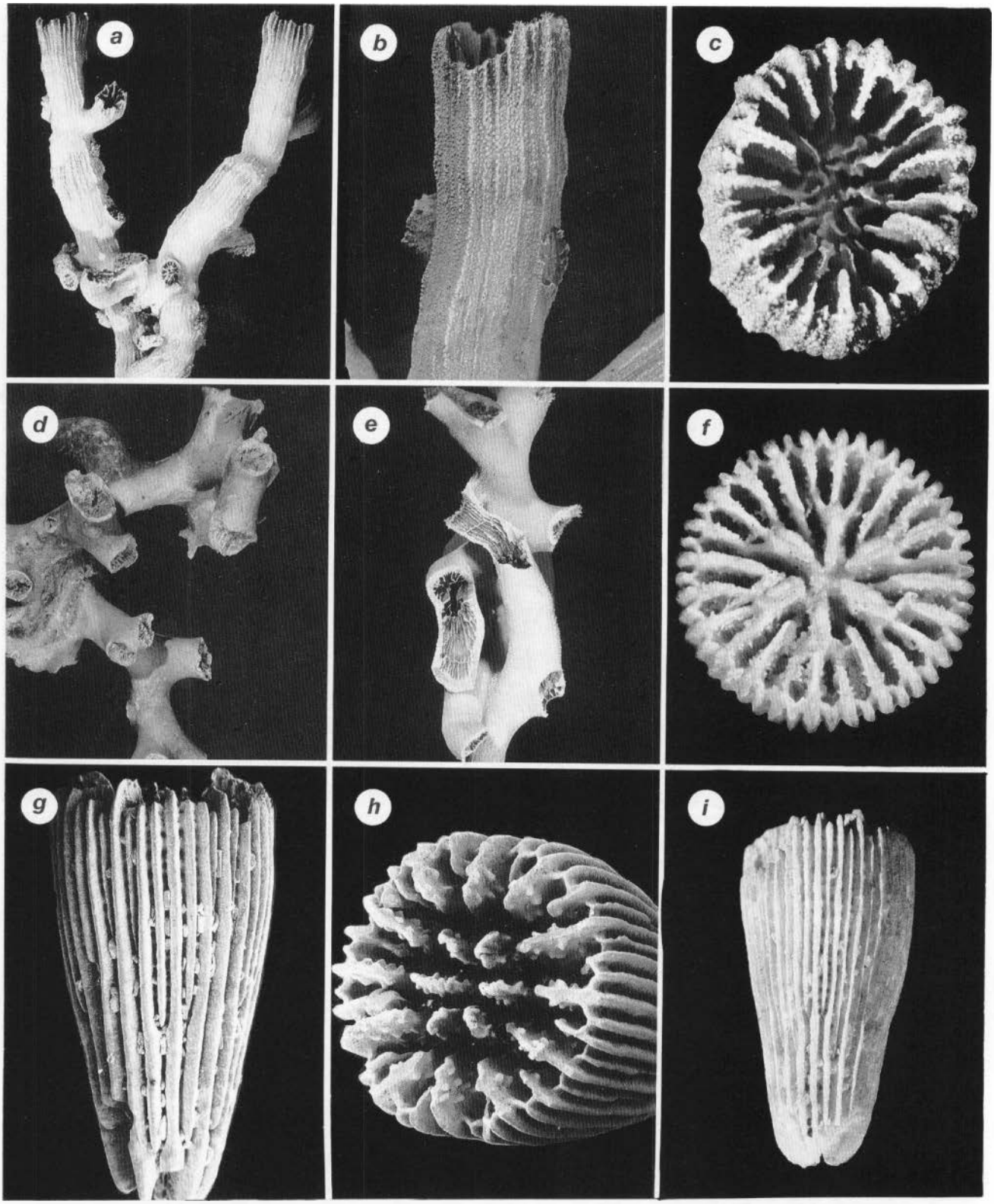


PLATE 23. *Anomocora* cf. *fecunda* (a-c, NZOI Stn K838, USNM 94140): a, colony, x 2.0; b, costal granulation, x 4.8; c, calice, x 11.2. ***Solenosmilia variabilis*** (d, NZOI Stn S46, USNM 94145; e, *Eltanin* Stn 1414, USNM 47420): d, a small colony showing intratentacular budding, x 1.1; e, fractured corallites revealing endothecal dissepiments, x 2.2. *Coenocyathus zelandiae* (f, i, syntype, BM(NH) 1890.2.27.2; g-h, King George Sound, western Australia, USNM 85713): f, h, calicular views, x 12.8, x 26, respectively; g, i, side views, x 17, x 8.7, respectively.

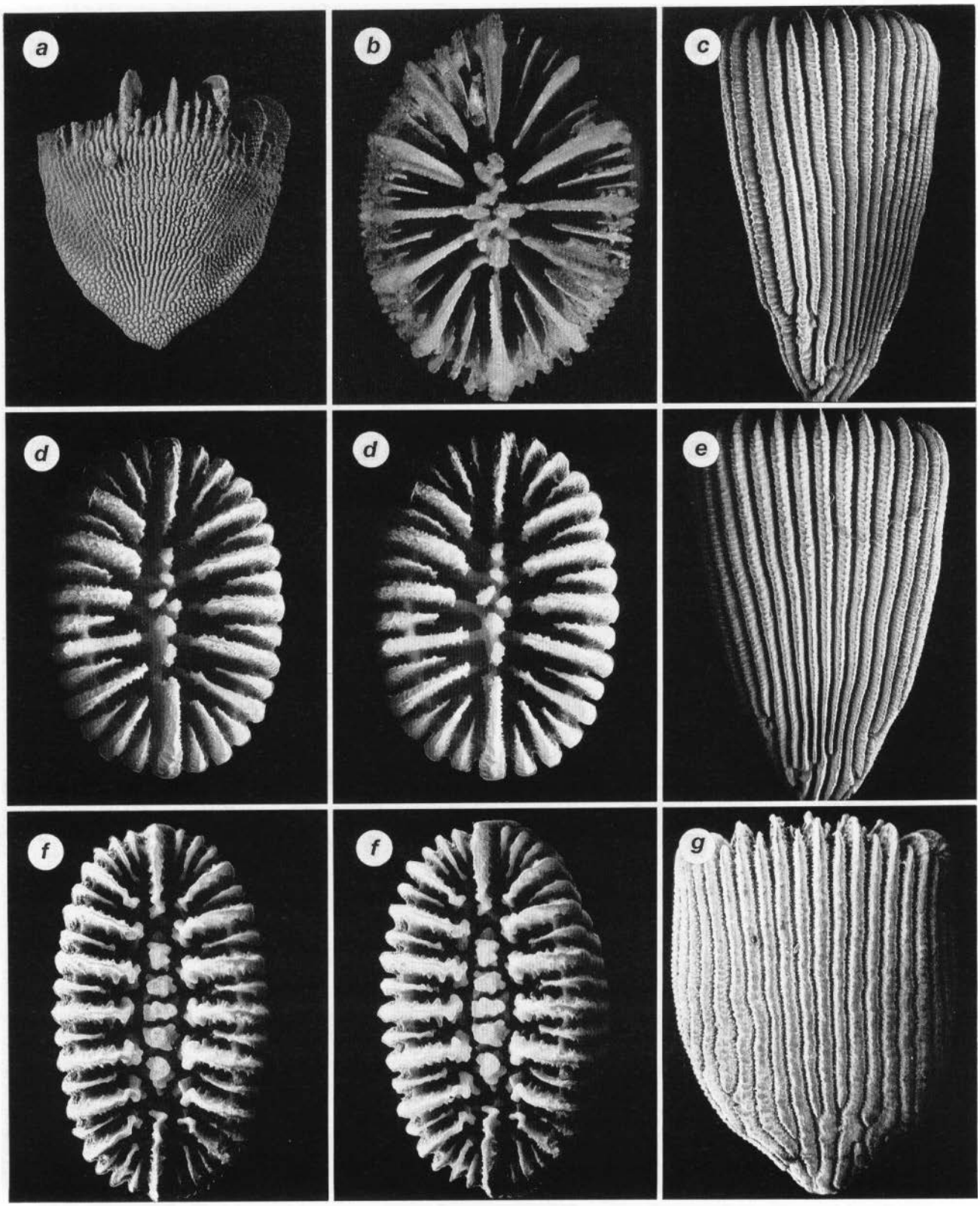


PLATE 24. *Alatotrochus rubescens* (a-b, NZOI Stn P13, USNM 94175): a-b, side and calicular views of same specimen, x 3.5, x 5.2, respectively. *Sphenotrochus ralphae* (c-e, AIM AK76312): c-e, oblique edge, stereo calicular, and side views of same specimen, x 9.5, x 13.0, x 10.0, respectively. *Sphenotrochus squiresi* (f-g, BS642, MNZ CO274, paratype): f-g, stereo calicular and side views of same specimen, x 17.5, x 12.9, respectively.

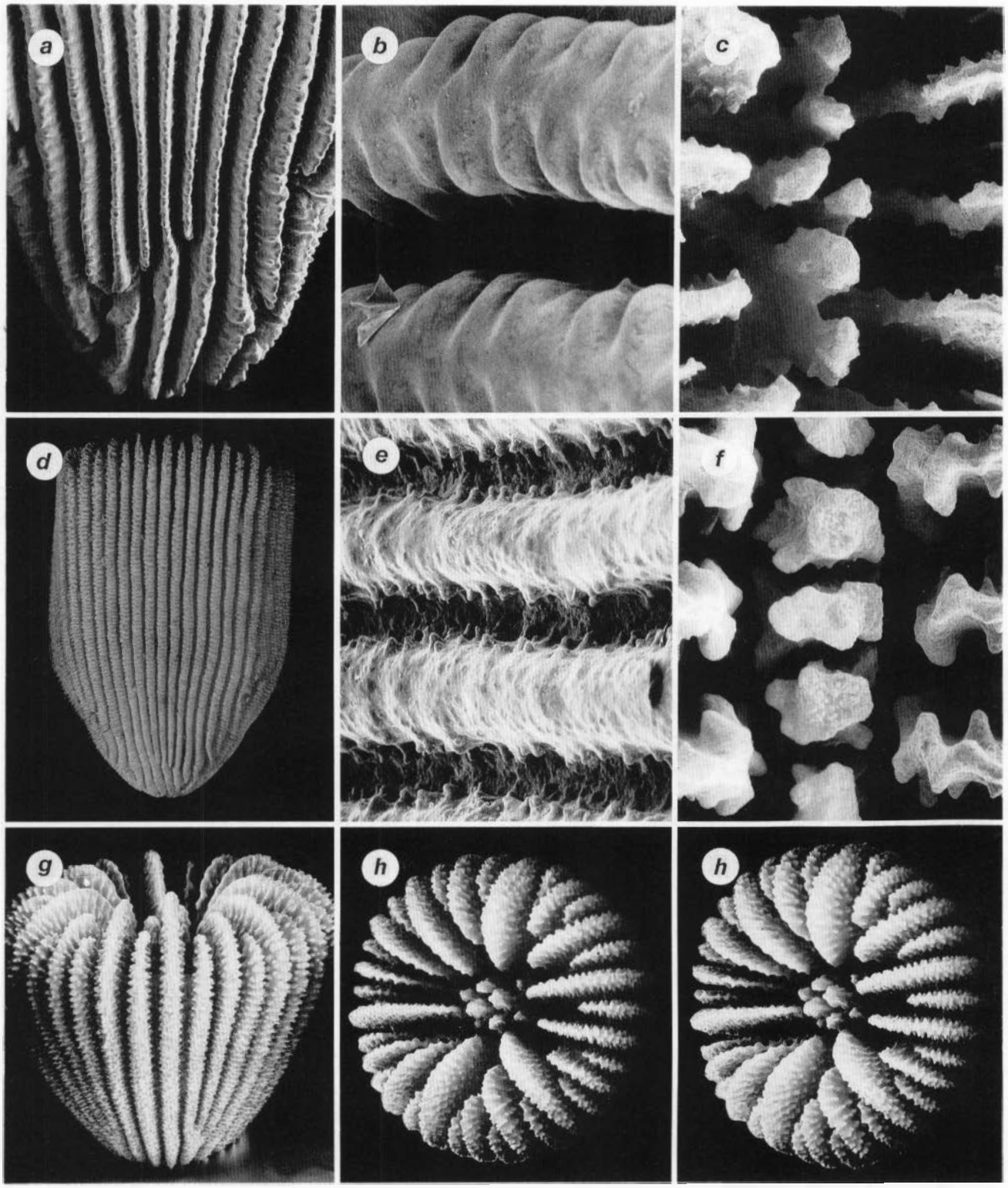


PLATE 25. *Sphenotrochus ralphae* (a-c, AIM AK76312): a, costae at base of corallum, x 26; b, enlargement of two costae near calicular edge, x 113; c, enlargement of columella, x 39. *Sphenotrochus squiresi* (d, holotype; e-f, BS642, MoNZ CO274, paratype): d, side view of holotype, x 6.8; e, enlargement of two costae, x 105; f, columella, x 60. *Kionotrochus suteri* (g-h, NZOI Stn F915, USNM 94200): g-h, side and oblique calicular stereo views, x 11.8, x 10.0, respectively.

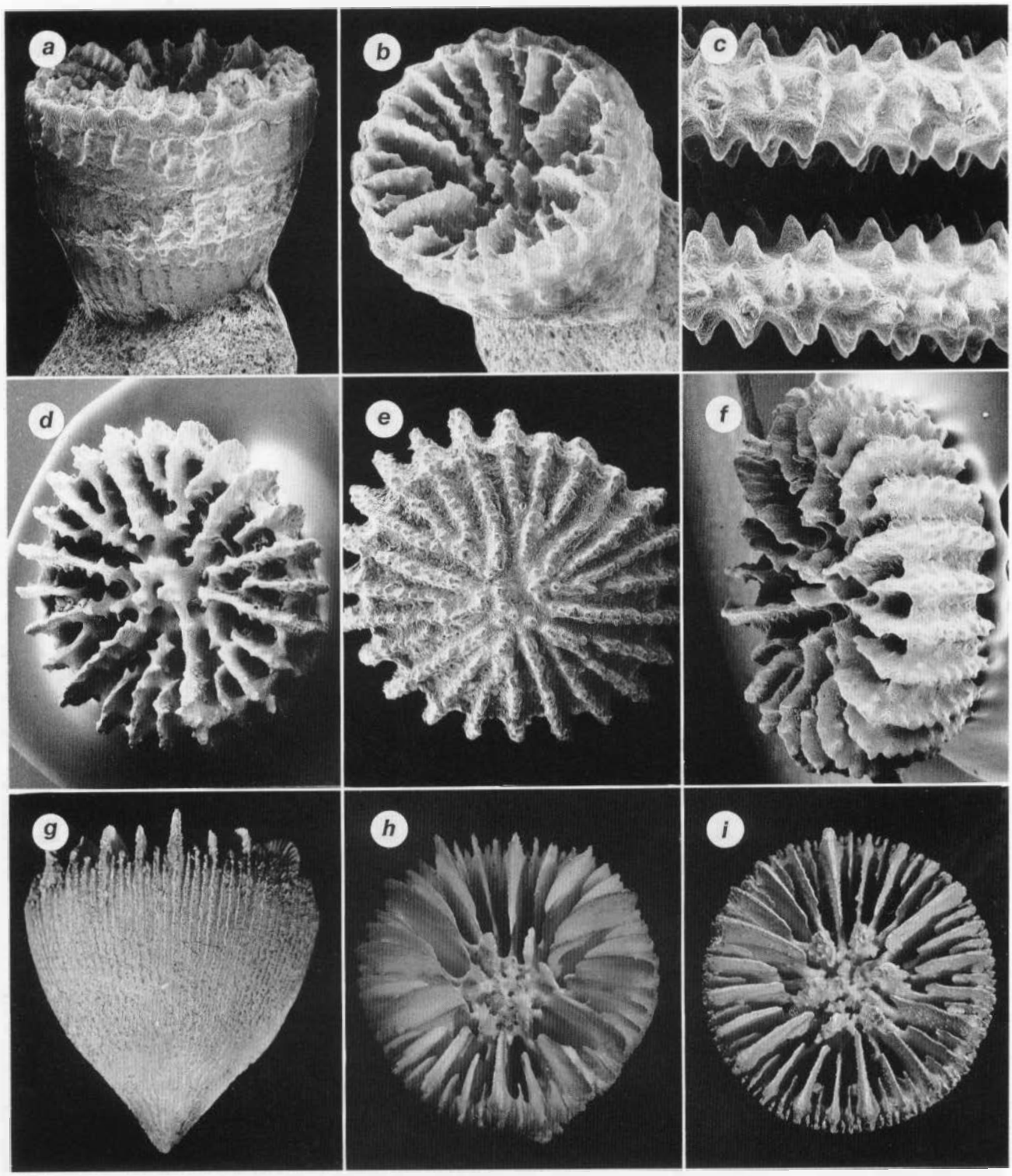


PLATE 26. *Kionotrochus suteri* (a-b, d, f, NZOI Stn C793, USNM 94195; c, NZOI Stn F915, USNM 94200; e, off Cuvier Island, USNM 78586): a-b, side and oblique calicular views of an anthocaulus, both x 23; c, costal granulation of an anthocyathus, x 67.5; d-f, calicular, basal, and side views of a recently budded anthocyathus, x 24, x 20, x 30, respectively. *Cryptotrochus venustus* (g-i, NZOI Stn U584, USNM 94178): g, side view, x 3.5; h-i, calicular views of two specimens, x 4.2, x 3.9, respectively.

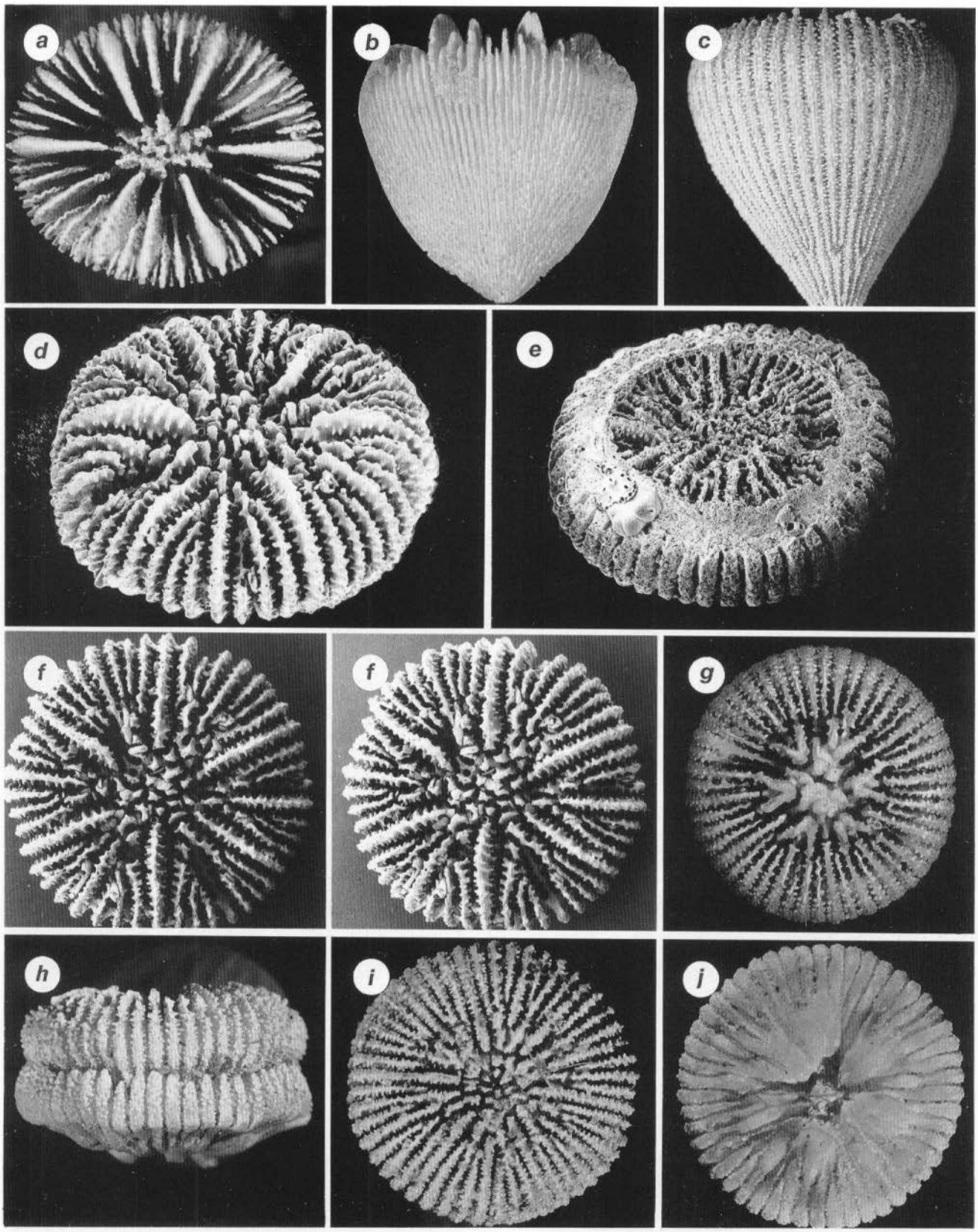


PLATE 27. *Cryptotrochus venustus* (a-b, holotype, *Siboga* Stn 256, ZMA 1184): a-b, calicular and side views of holotype, x 5.8, x 4.9, respectively. ***Notocyathus conicus*** (c, g, BS441, USNM 94177): c, g, side and calicular views of same specimen, x 7.0. ***Peponocyathus dawsoni*** (d, f, M●NZ, BS634; e, NZOI Stn D173, USNM ; h-j, holotype): d, f, oblique calicular and stereo calicular views of an anthocyathus, x 20.5, x 16.0, respectively; e, an anthocaulus showing transverse division scar, x 12.7; h-j, side, calicular, and basal views of two anthocyathi that have not yet separated, the lower anthocyathus also showing its detachment scar, all x 7.2.

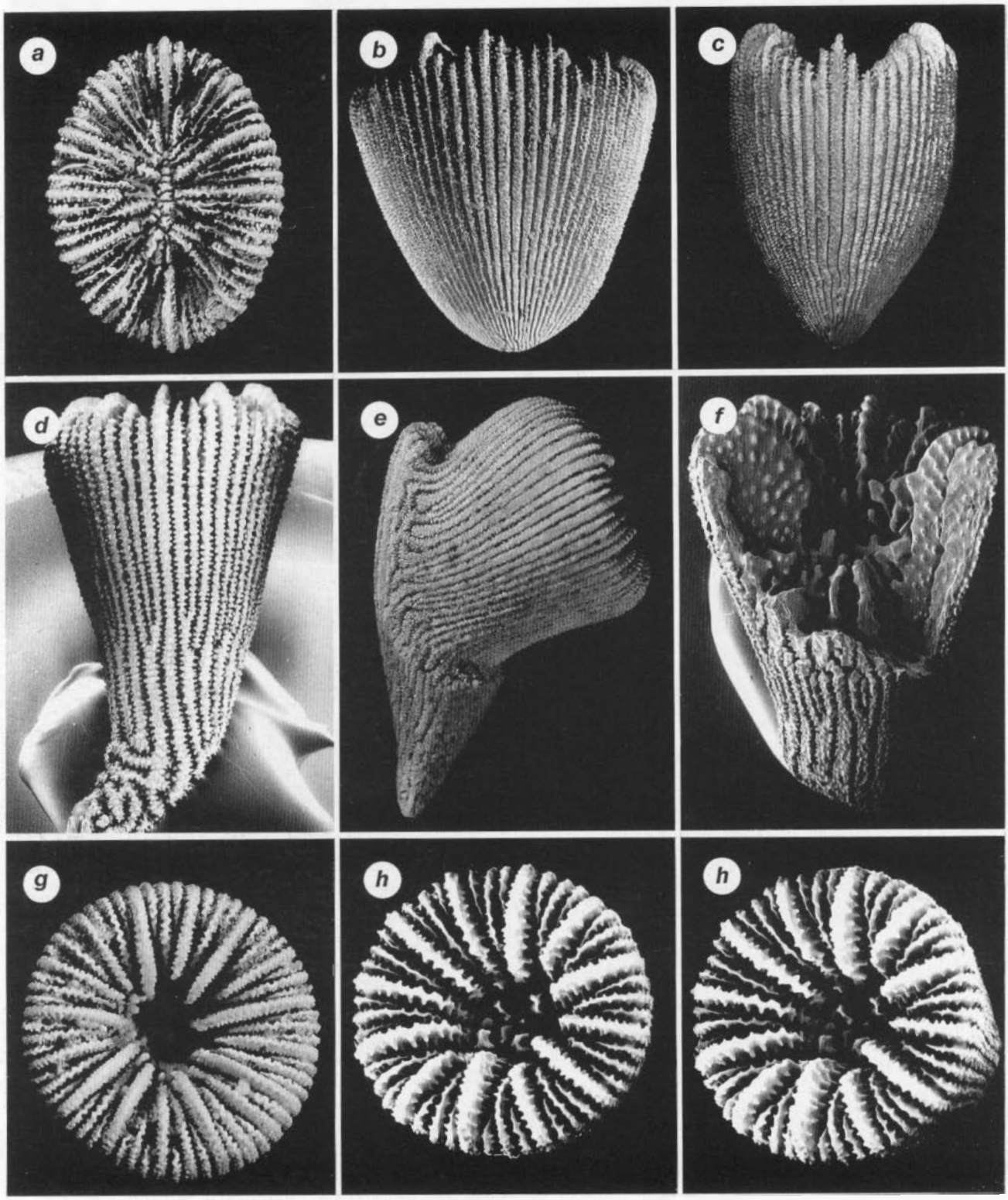


PLATE 28. *Tropidocyathus pileus* (a-c, NZOI Stn P14, USNM 94176): a-c, calicular, side, and edge views of same corallum, all x 3.3. *Thrypticotrochus multilobatus* (d, h, BS438, USNM 94179; e, g, BS833, MoNZ; f, NZOI Stn K818): d-e, side views showing regeneration from fragments, x 13.1, x 6.6, respectively; f, fractured corallum revealing multiple paliform lobes, x 13.2; g-h, calicular views (h is a stereo pair), x 8.1, x 14.8, respectively.

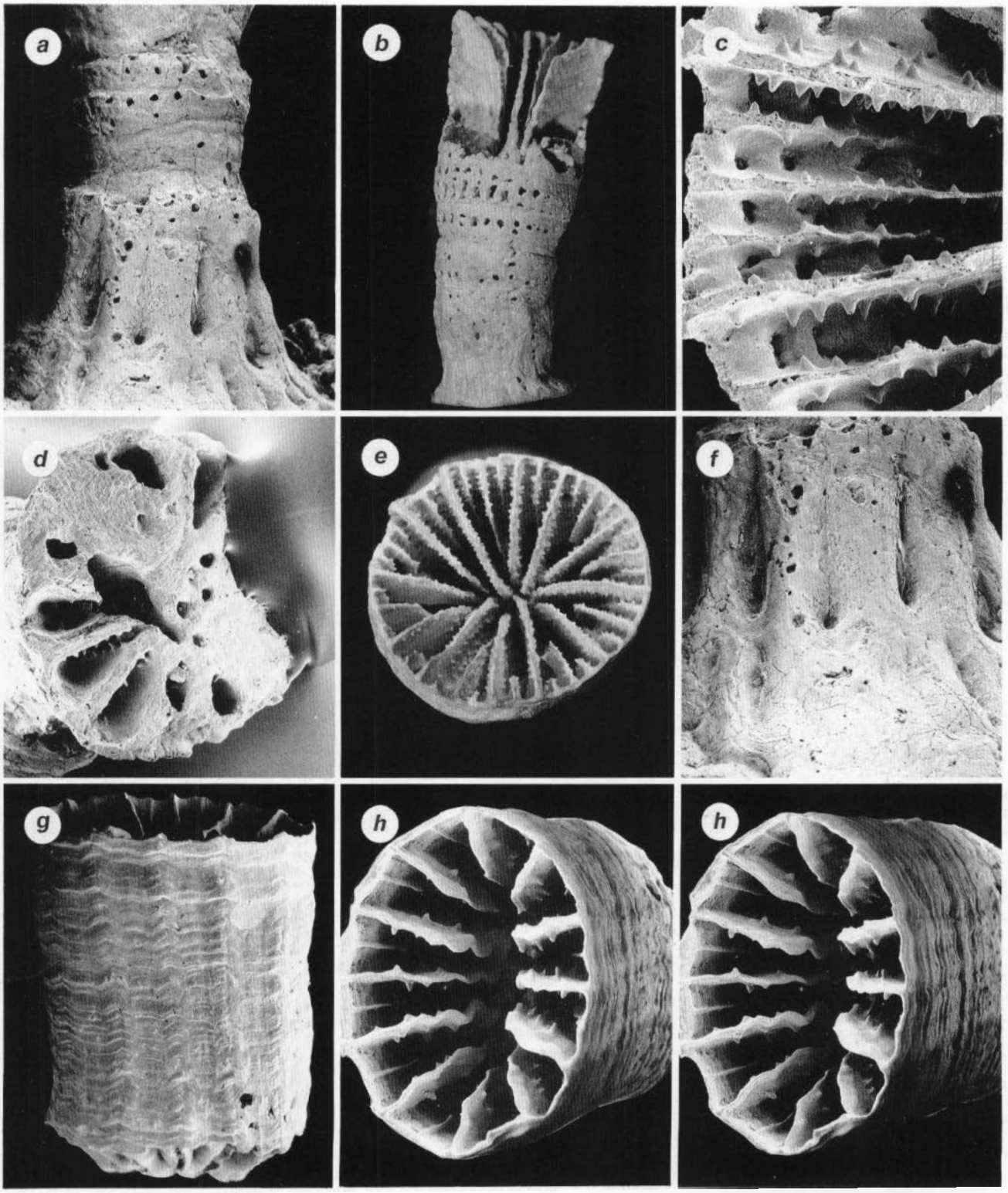


PLATE 29. *Pedicellocyathus keyesi* (a-f, holotype and paratypes from BS833): a, f, side views of pedicel structure, x 11.8, x 16.8, respectively; b, damaged corallum illustrating pedicel and thecal pores, x 5.3; c, view of thecal pores from within calice, x 32; d, cross section through pedicel revealing hollow rootlet structures, x 21.4; e, calice of holotype, x 6.7. *Truncatoguynia irregularis* (g-h, MoNZ, BS434 (CO236)): g-h, side and stereo calicular views of same specimen, x 13.7, x 15.8, respectively.

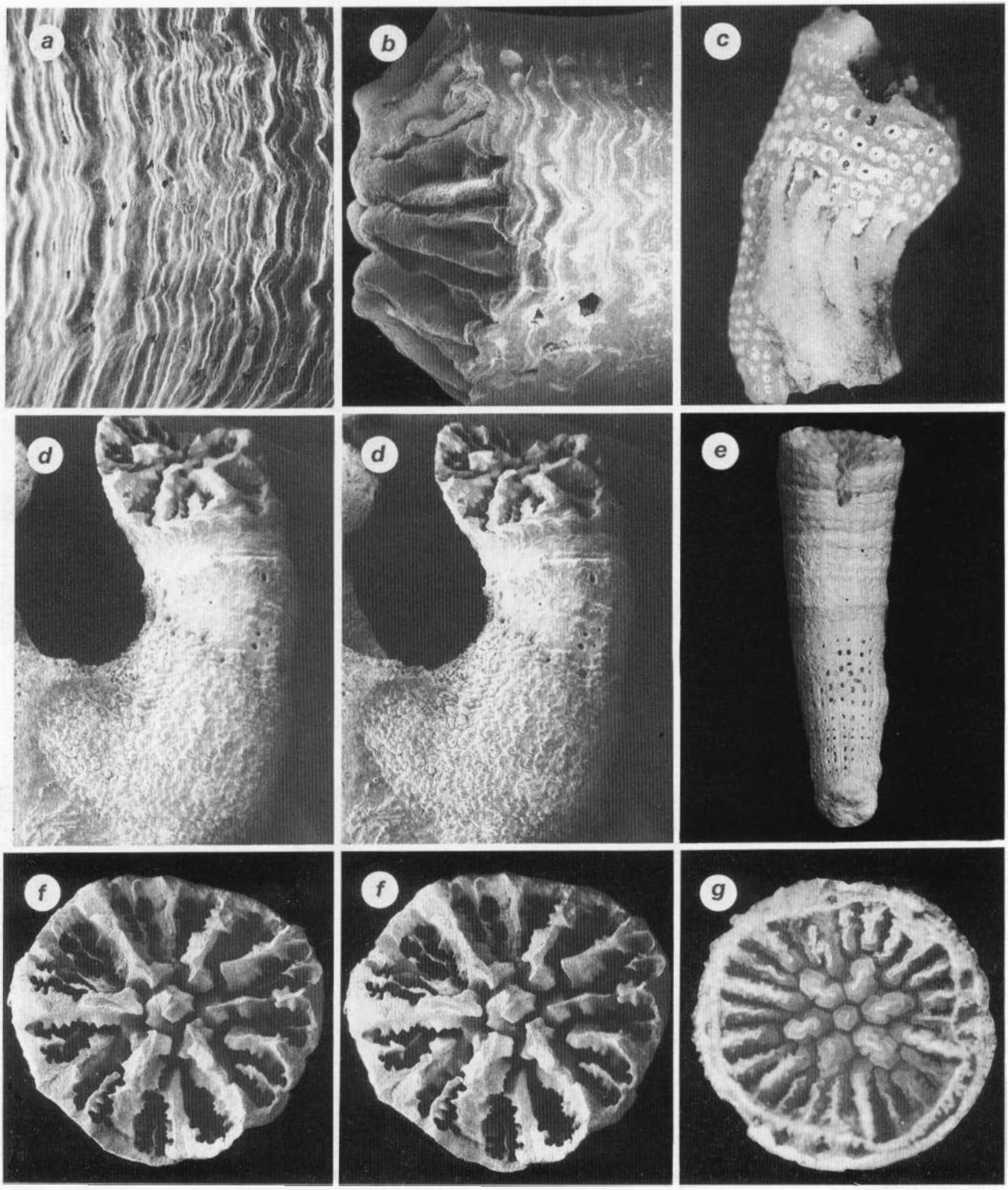


PLATE 30. *Truncatoguynia irregularis* (a-b, BS434, MoNZ CO236): a, fine horizontal thecal striations, x 34; b, basal scar, x 21.5. *Stenocyathus vermiformis* (c, *Eltanin* Stn 1411, USNM 47448; d, f, NZOI Stn S572, USNM 94368; e, NZOI Stn B319, USNM 47447; g, NZOI Stn D160, USNM 47451): c, corallum base illustrating solid, exothecal root-like deposits, x 9.3; d, stereo view of granular stereome at corallum base, x 13.5; e, worn corallum illustrating coenosteal pores, x 4.8; f, g, stereo and normal calicular views, x 26, x 11, respectively.

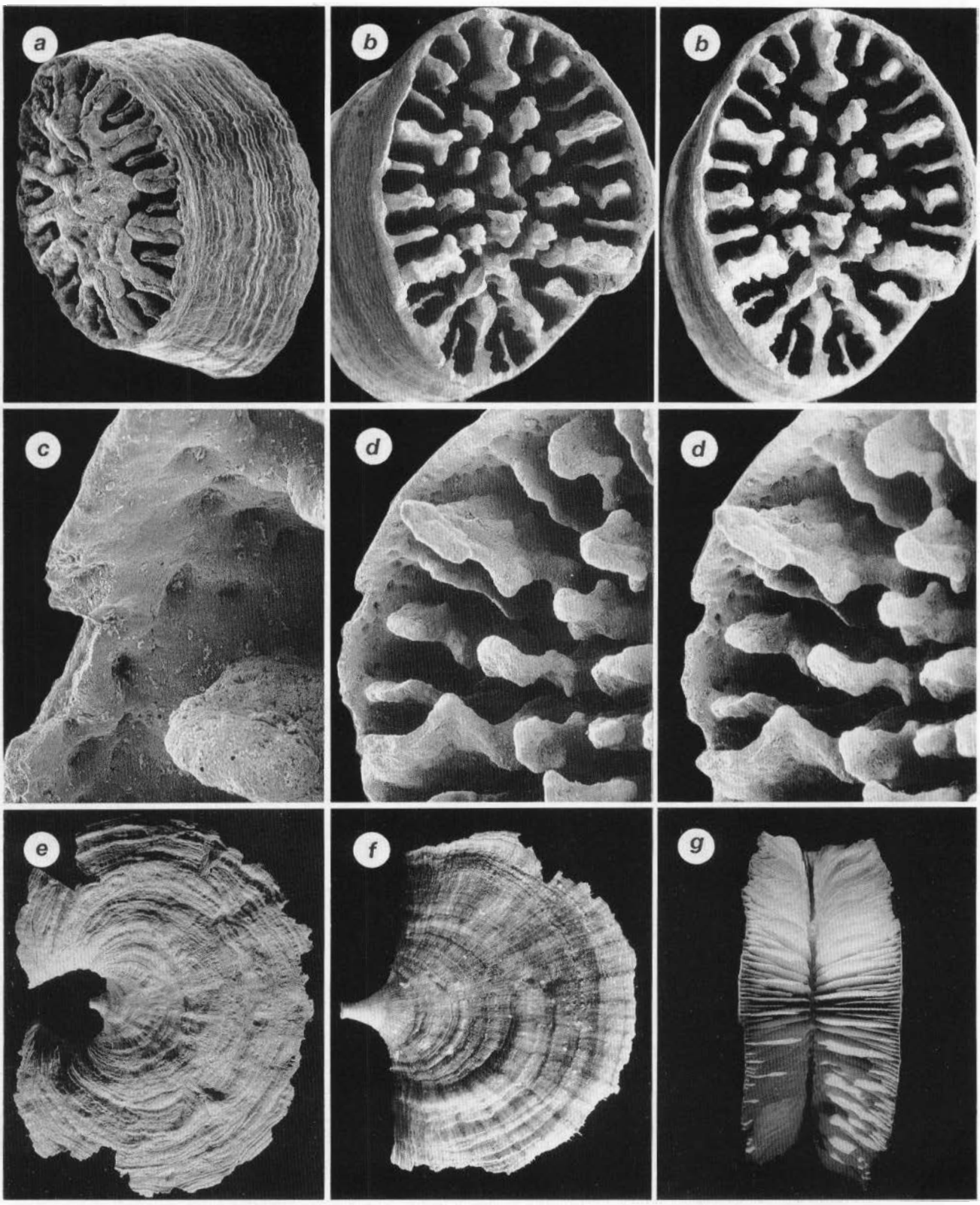


PLATE 31. *Temnotrochus kermadecensis* (a-d, BS441, USNM 94287, paratypes): a, basal scar ot an anthocyathus, x 36; b, stereo view of calice, x 36; c, view of thecal pore indentations from within calice, x 270; d, stereo view of portion of calice, x 70. *Flabellum knoxi* (e, NZOI Stn G293, USNM 94331; f-g, NZOI Stn G697, USNM 94332): e, a highly recurved corallum, x 0.66; f-g, side and calicular views of same specimen, both x 0.91.

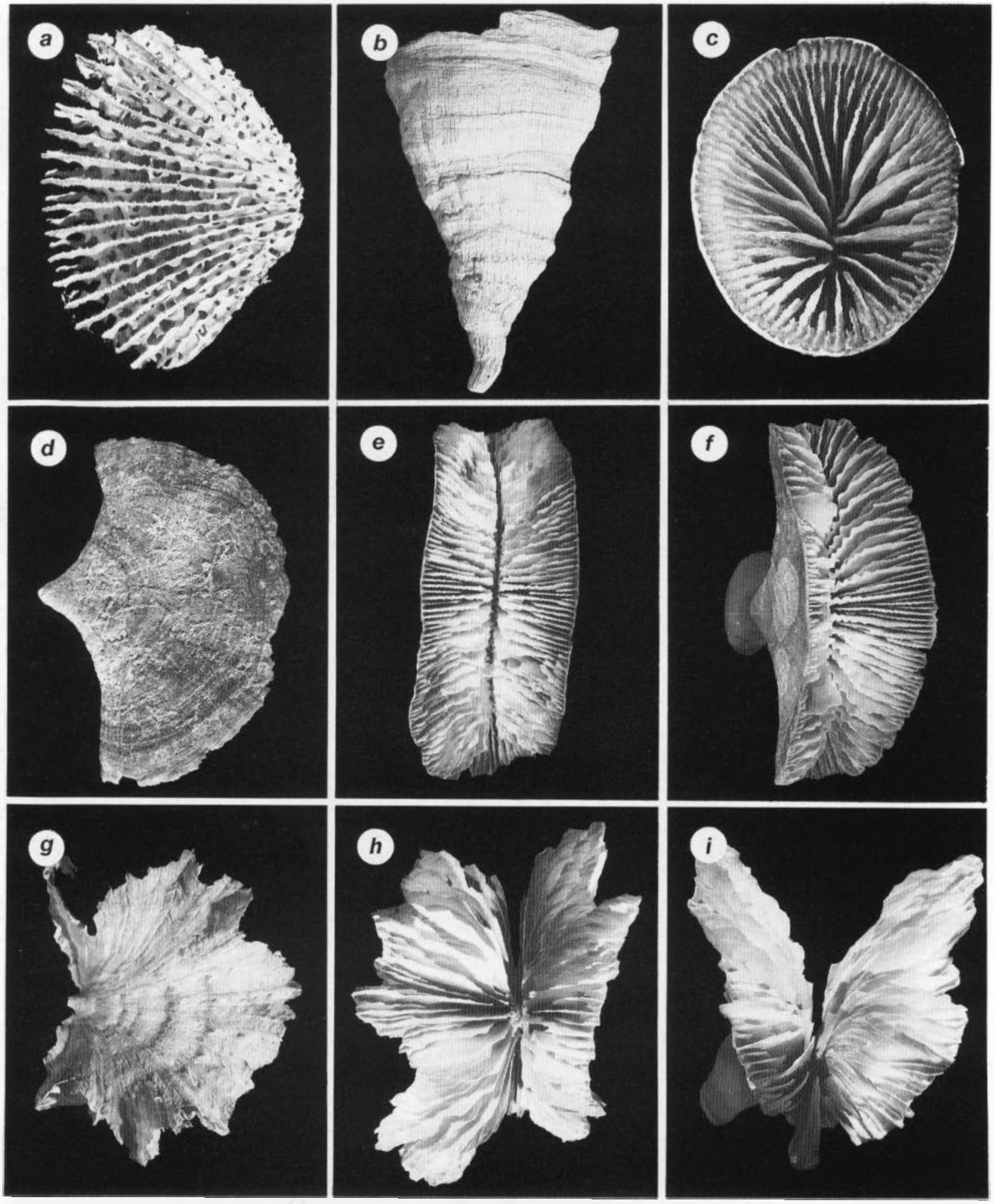


PLATE 32. ***Flabellum knoxi*** (a, NZOI Stn I716, USNM 94334): a, columellar remnant of a worn specimen, x 1.7. ***Flabellum impensum*** (b-c, *Eltanin* Stn 2143, USNM 47373): b-c, side and calicular views of same specimen, x 1.6, x 2.0, respectively. ***Flabellum angiostomum*** (d-f, NZOI Stn I97, USNM 94323): d-f, side, calicular, and oblique calicular views of same specimen, all x 1.4. ***Flabellum lowekeyesi*** (g, *Eltanin* Stn 1850, USNM 82929; h-i, off Cape Brett, paratype, USNM 45601): g, side view, x 1.2; h-i, calicular and edge views of a paratype, both x 1.2.

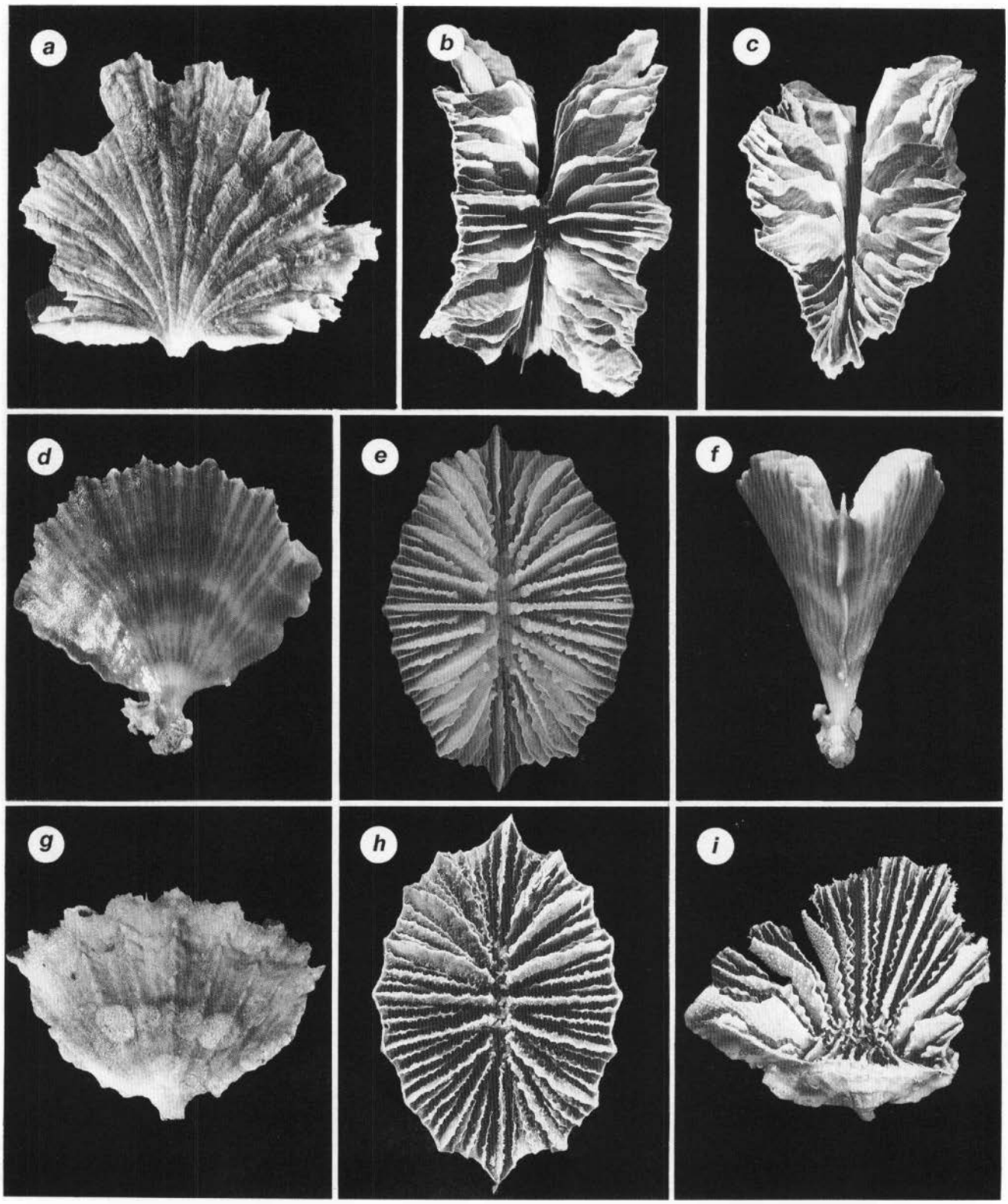


PLATE 33. *Flabellum messum* (a-c, NZOI Stn T226, USNM 94325): a-c, side, calicular, and oblique calicular views of same specimen, all x 1.3. *Flabellum aotearoa* (d-f, NZOI Stn P14, USNM 94336; i, NZOI Stn J699, USNM 94337): d-f, side, calicular, and edge views of same specimen, x 2.0, x 2.3, x 1.9, respectively; i, broken corallum revealing highly sinuous inner septal edges, x 1.8. *Flabellum hoffmeisteri* (g-h, NZOI Stn K829, USNM 94324): g-h, side and calicular views of different specimens, both x 1.6.

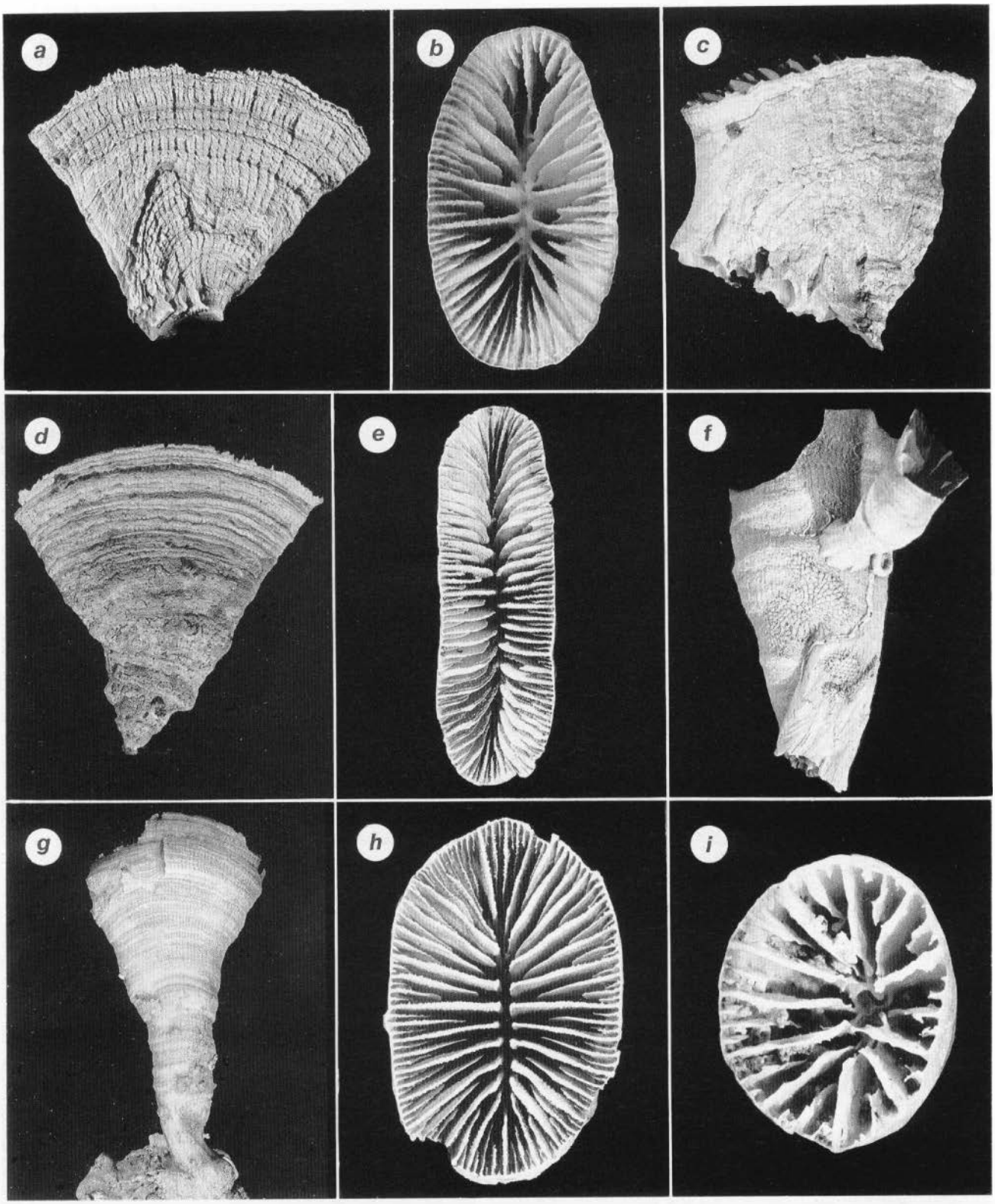


PLATE 34. *Monomyces rubrum* (typical form) (a, NZOI Stn I56, USNM 94349; b-c, NZOI Stn M774, USNM 94353): a, c, side views of two coralla illustrating lateral polycyclic rootlets, x 2.0, x 3.2, respectively; b, calicular view of specimen in figure 34c, x 3.6. *Monomyces rubrum* forma *latum* (d-e, NZOI Stn B200, USNM 80138): d-e, side and calicular views of same specimen, x 1.0, x 1.3, respectively. *Monomyces rubrum* forma *nobile* (f-h, NZOI Stn E848, USNM 94341; i, Stn 932, AIM AK76317): f, corallum base showing elongate contiguous rootlet, x 2.2l g-h, side and calicular views of same specimen, x 0.89, x 1.9, respectively; i, juvenile specimens reported by Ralph and Squires (1962) as *Flabellum gracile*, x 6.3.

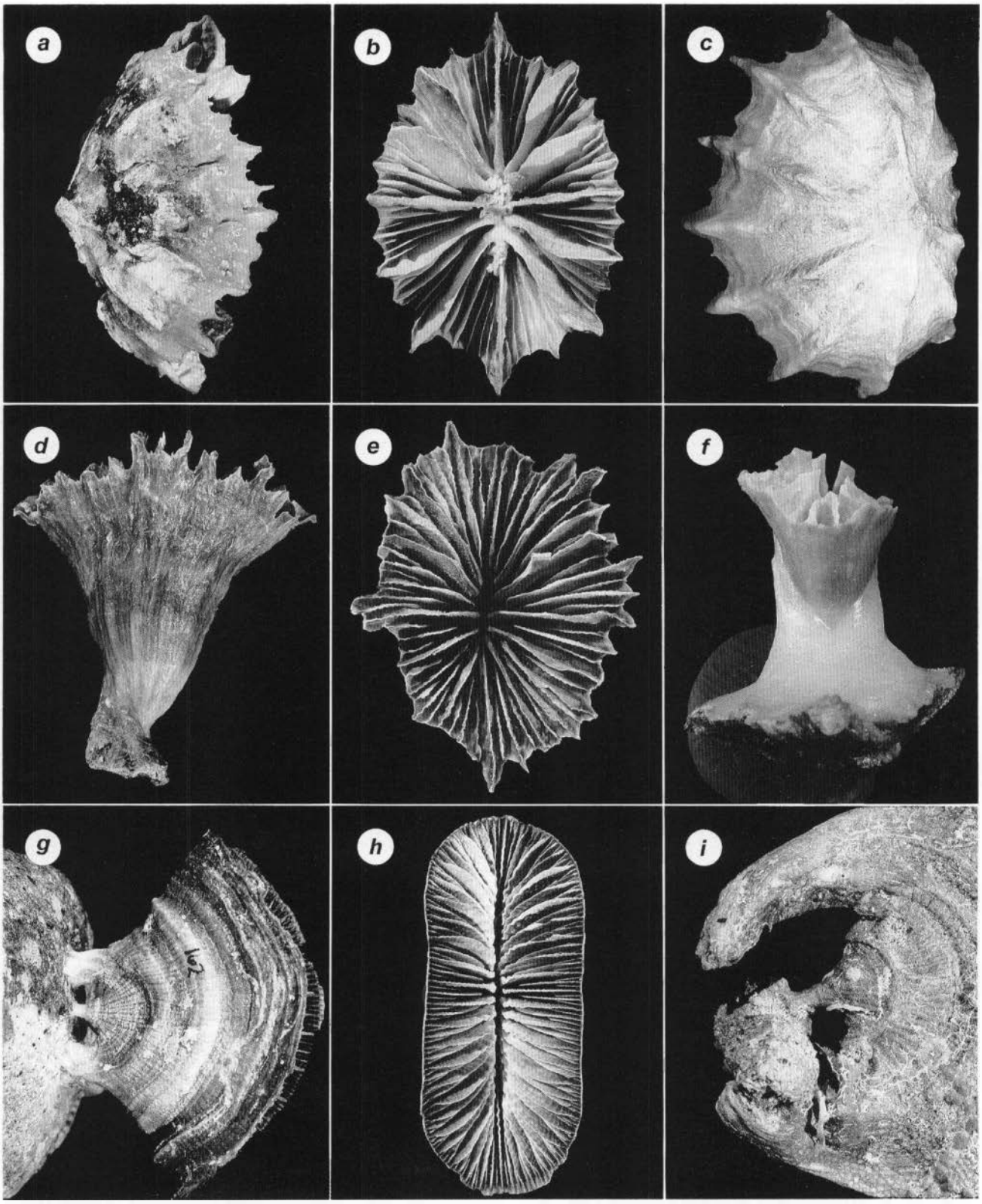


PLATE 35. ***Flabellum apertum*** (a-b, holotype of *Flabellum raukawaensis*, MoNZ CO186; c, NZOI Stn E757, USNM 94291): a-b, side and calicular views of holotype, both x 1.25; c, oblique basal view, x 1.3. ***Polymyces wellsi*** (d-f, NZOI Stn E731, USNM 94304): d-e, side and calicular views of same specimen, x 1.25, x 1.6, respectively; f, base of a broken specimen showing contiguous basal rootlets, x 3.6. ***Rhizotrochus flabelliformis*** (g-h, BS720, MoNZ CO162; i, NZOI Stn P10, USNM 94303): g-h, side and calicular views of same specimen, both x 1.6; i, base of large corallum showing well-developed lateral rootlets, x 1.5.

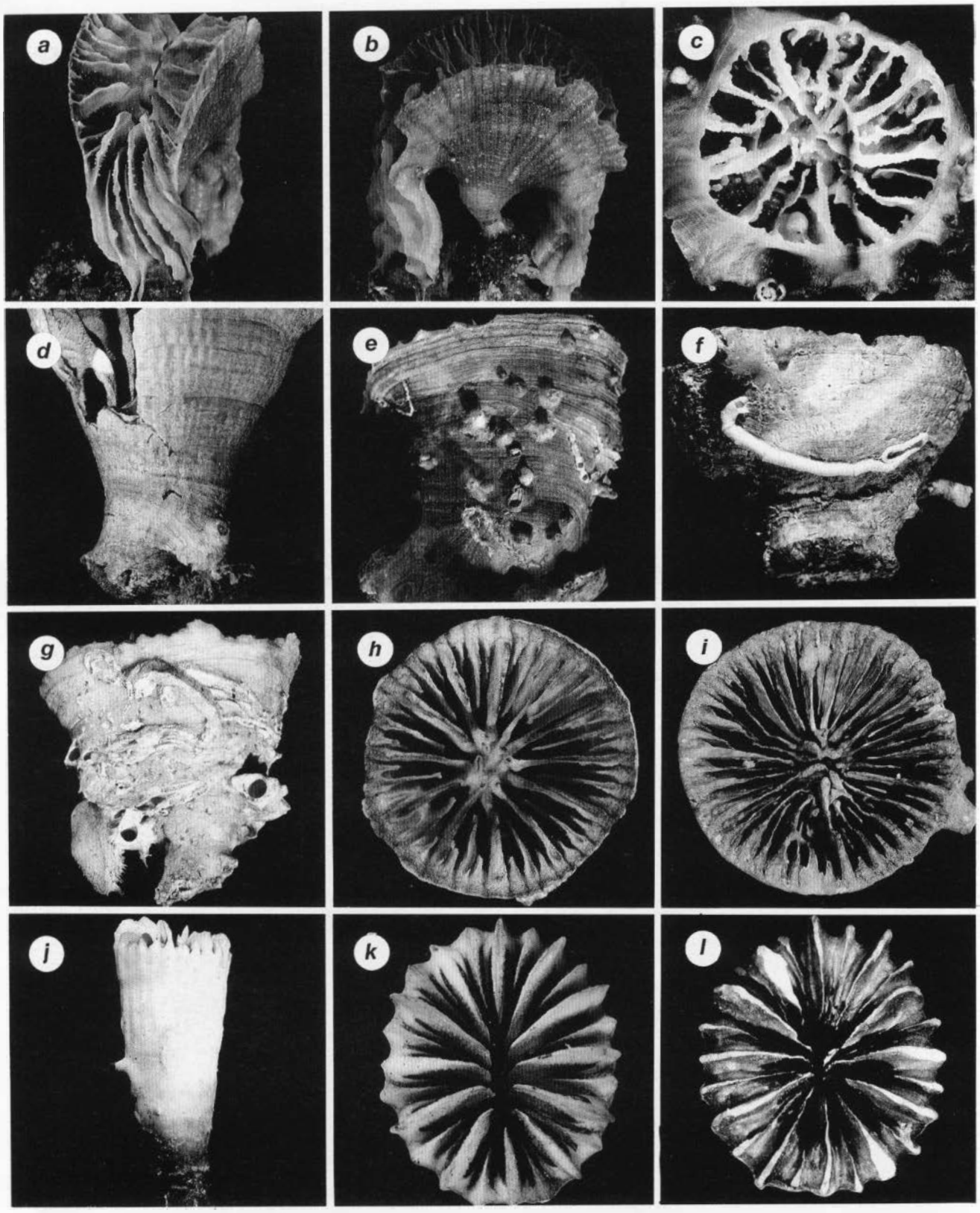


PLATE 36. *Rhizotrochus flabelliformis* (a-b, NZOI Stn J679, USNM 94300): a-b, juvenile corallum in process of anchoring lateral rootlets, x 3.4, x 2.9, respectively. *Gardineria hawaiiensis* (c, e, NZOI Stn K830, USNM 94308; d, NZOI Stn E731, USNM 94306; f, i, NZOI Stn I97, USNM 94307): c, early stage showing polycyclic development, x 3.5; d, large specimen with massive pedicel, x 2.3; e, side view showing epitheca, x 2.5; f, i, side and calicular views of a large specimen, both x 1.7. *Gardineria* sp. (g-h, NZOI Stn I743, USNM 94312): g-h, side and calicular views of a highly encrusted specimen, both x 2.3. *Javania pachytheca* (j-k, holotype; l, NZOI Stn T226, USNM 94286): j-k, side and calicular views of holotype, x 1.7, x 4.3, respectively; l, calicular view of a worn specimen, x 3.9.

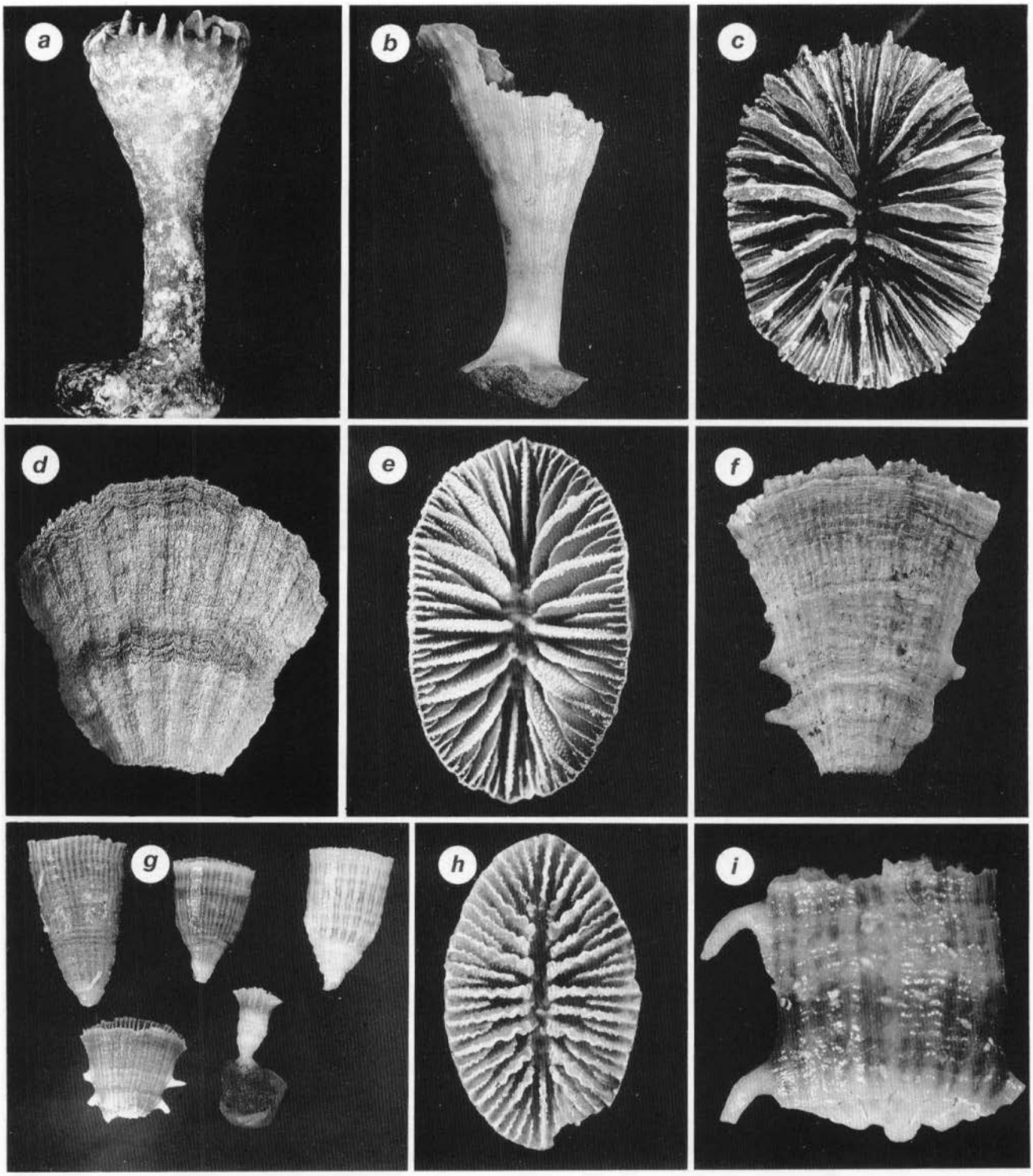


PLATE 37. *Javania pachytheca* (a, NZOI Stn T226, USNM 94285): a, side view, x 2.5. *Javania lamprotichum* (b, NZOI Stn K858, USNM 94283; c, NZOI Stn T256, USNM 94282): b, side view showing stereome-reinforced base, x 1.4; c, view of large, worn corallum, x 1.6. *Truncatoflabellum paripavoninum* (d-e, NZOI Stn T243, USNM 94278): d-e, side and calicular views of same specimen, x 2.1, x 2.6, respectively. *Truncatoflabellum dens* (f, h, NZOI Stn K858, USNM 94274; g, BS441, USNM 94276): f, h, side and calicular views of same specimen, x 3.6, x 4.2, respectively; g, series of five coralla, including four anthocauli and one anthocyathus (lower left), x 1.8. *Truncatoflabellum phoenix* (i, NZOI Stn C531, USNM 82010 paratype): i, side view of a short anthocyathus, x 8.9.

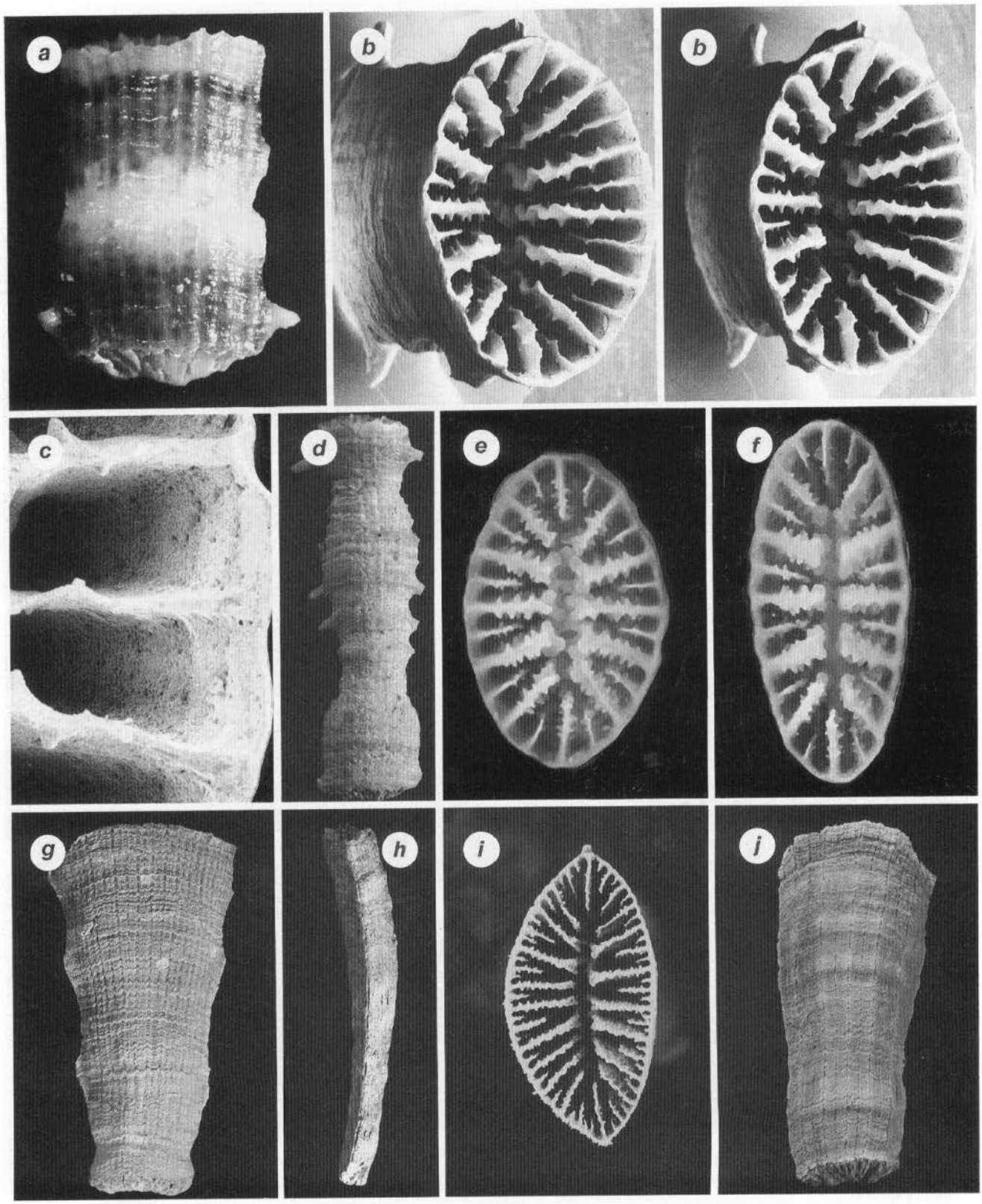


PLATE 38. ***Truncatoflabellum phoenix*** (ac, e, holotype, USNM 94616; d, f, paratype, NZOI Stn C531, USNM 82010): a, e, side and calicular views of holotype, x 8.1, x 12.4, respectively; b, stereo view of calice of a paratype, x 14.1; c, view from within the calice of three septa, x 66; d, elongate corallum, x 4.1; f, a highly compressed calice, x 13.0. ***Truncatoflabellum arcuatum*** (g, i, holotype; h, NZOI Stn C640, paratype, USNM 94280): g, i, side and calicular views of holotype, x 2.9, x 4.2, respectively; h, edge view of a worn specimen, x 1.6. ***Placotrochides scaphula*** (j, NZOI Stn G941, USNM 94273): j, side view of large anthocyathus, x 2.4.

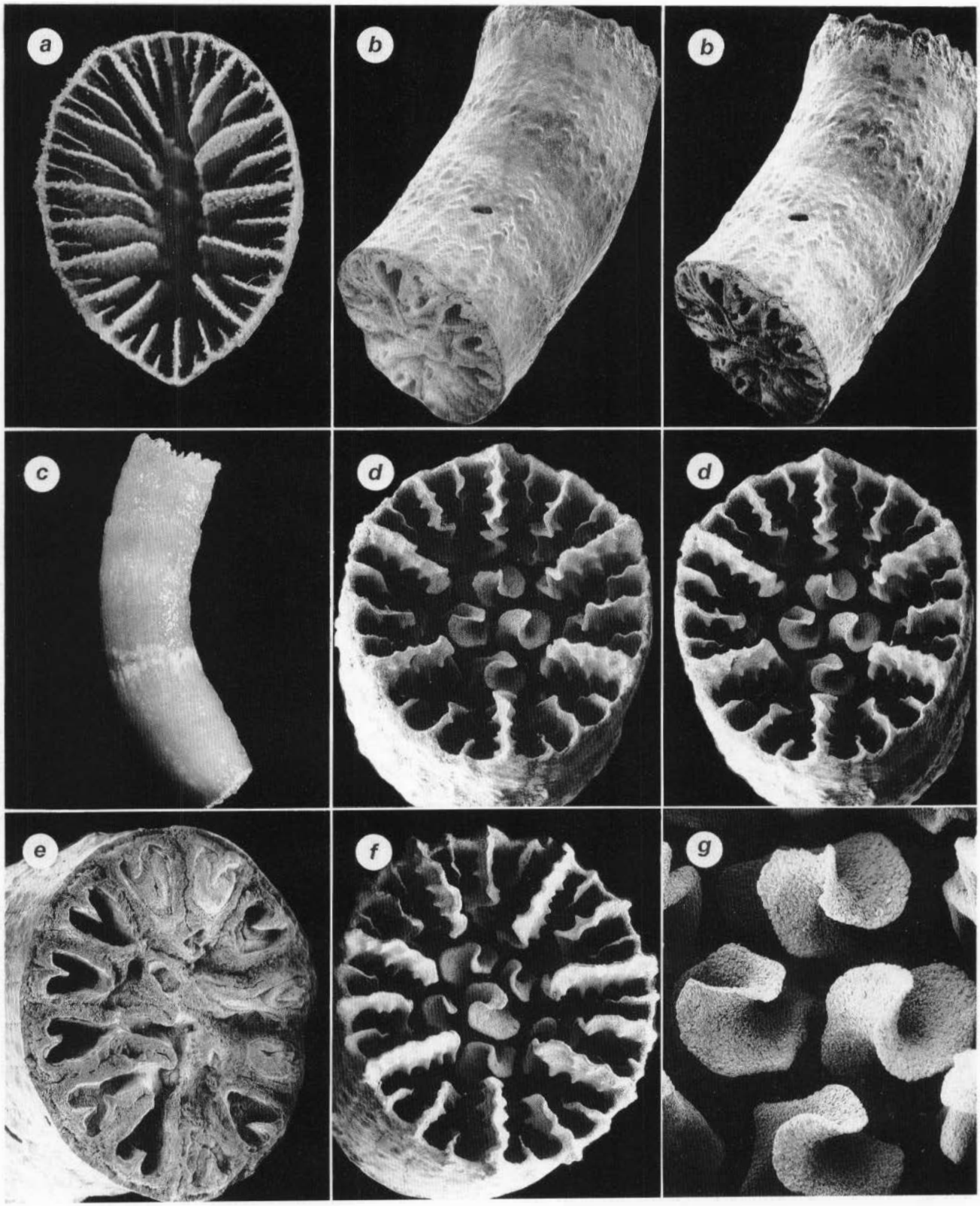


PLATE 39. *Flacotrochides scaphula* (a, NZOI Stn G941, USNM 94273): a, calicular view, x 4.9. ***Falcatoflabellum raoulensis*** (b, d-g, USNM 94313; c, holotype, CO258, MoNZ): b, d, stereo views of side of corallum and calice of hexamerally symmetrical specimen, x 14, x 23, respectively; c, holotype, x 6.3; e, basal attachment scar of anthocyathus, x 25.5; f, calice of specimen with 7 primary septa, x 23; g, enlargement of columella of specimen of fig. 39d, x 69.

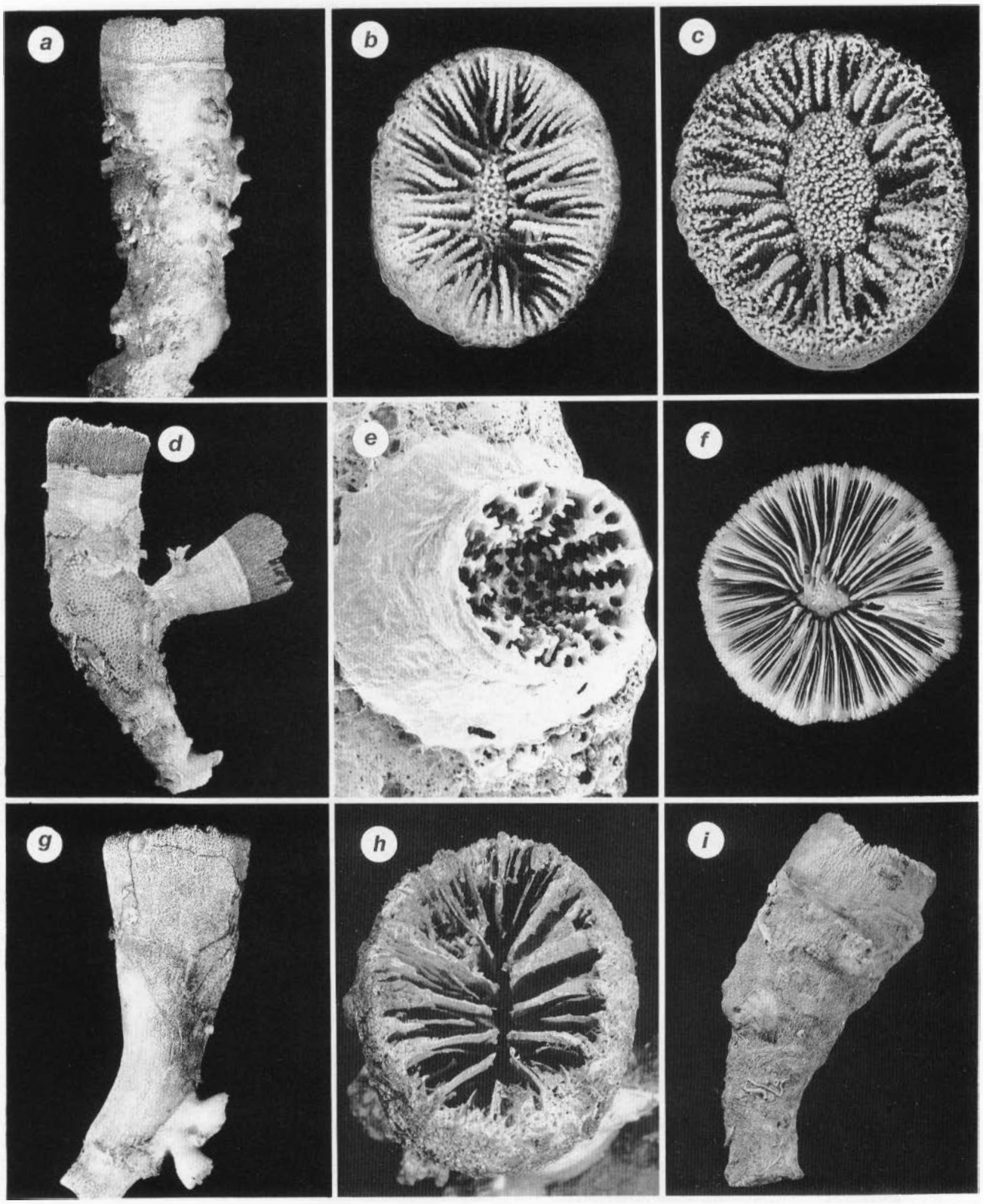


PLATE 40. ***Balanophyllia chnous*** (a-b, holotype, BM(NH) 1929.10.22.25; c-d, BS897, USNM 94226; e, BS895, MoNZ): a-b, side and calicular views of holotype, x 2.1, x 4.4, respectively; c, calice of specimen with a large columella, x 5.4; d, side view of encrusted corallum, x 1.6; e, juvenile corallum, x 17.6. ***Balanophyllia gigas*** (f, L1182, AIM AK33937, *Dendrophyllia japonica* of Ralph and Squires (1962); g-h, BS630, MoNZ CO123: f, h, calicular views, x 1.5, x 2.3, respectively; g, side view of a corallum, x 1.2. ***Balanophyllia crassitheca*** (i, NZOI Stn J686, USNM 94228): i, side view of an elongate corallum, x 1.4.

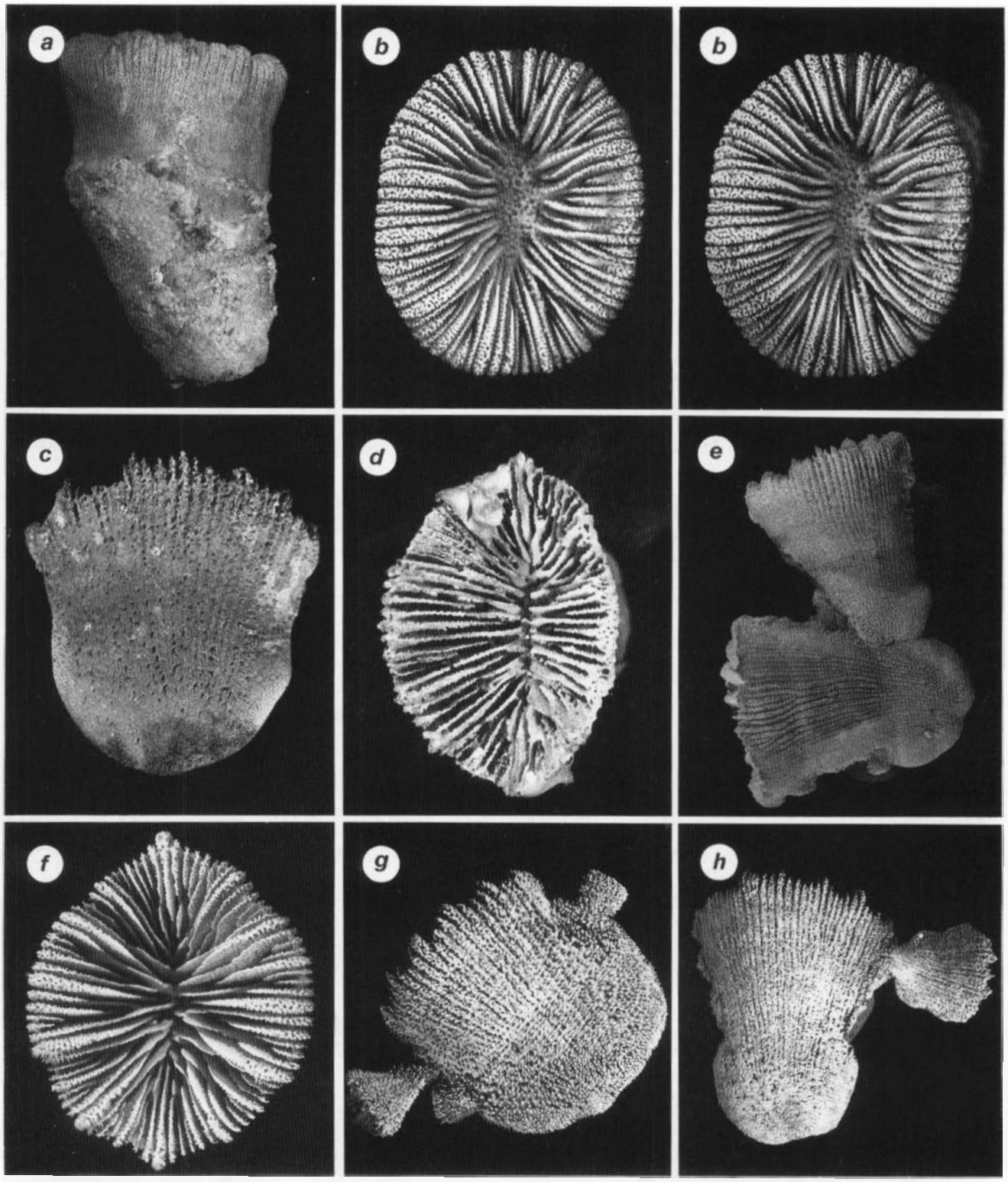


PLATE 41. *Balanophyllia crassitheca* (a-b, holotype): a-b, side and calicular stereo views of holotype, x 2.2, x 3.6, respectively. *Endopachys grayi* (c-d, holotype of *E. oahense*, USNM 20822; e, NZOI Stn P2, USNM 94210; f-g, NZOI Stn P1, USNM 94209; h, NZOI Stn E864, USNM 94208): c-d, side and calicular views of *E. oahense*, x 3.0, x 3.6, respectively; e, g-h, several coralla demonstrating asexual budding from thecal edges, x 1.7, x 3.5, x 2.1, respectively; f, calice, x 3.3.

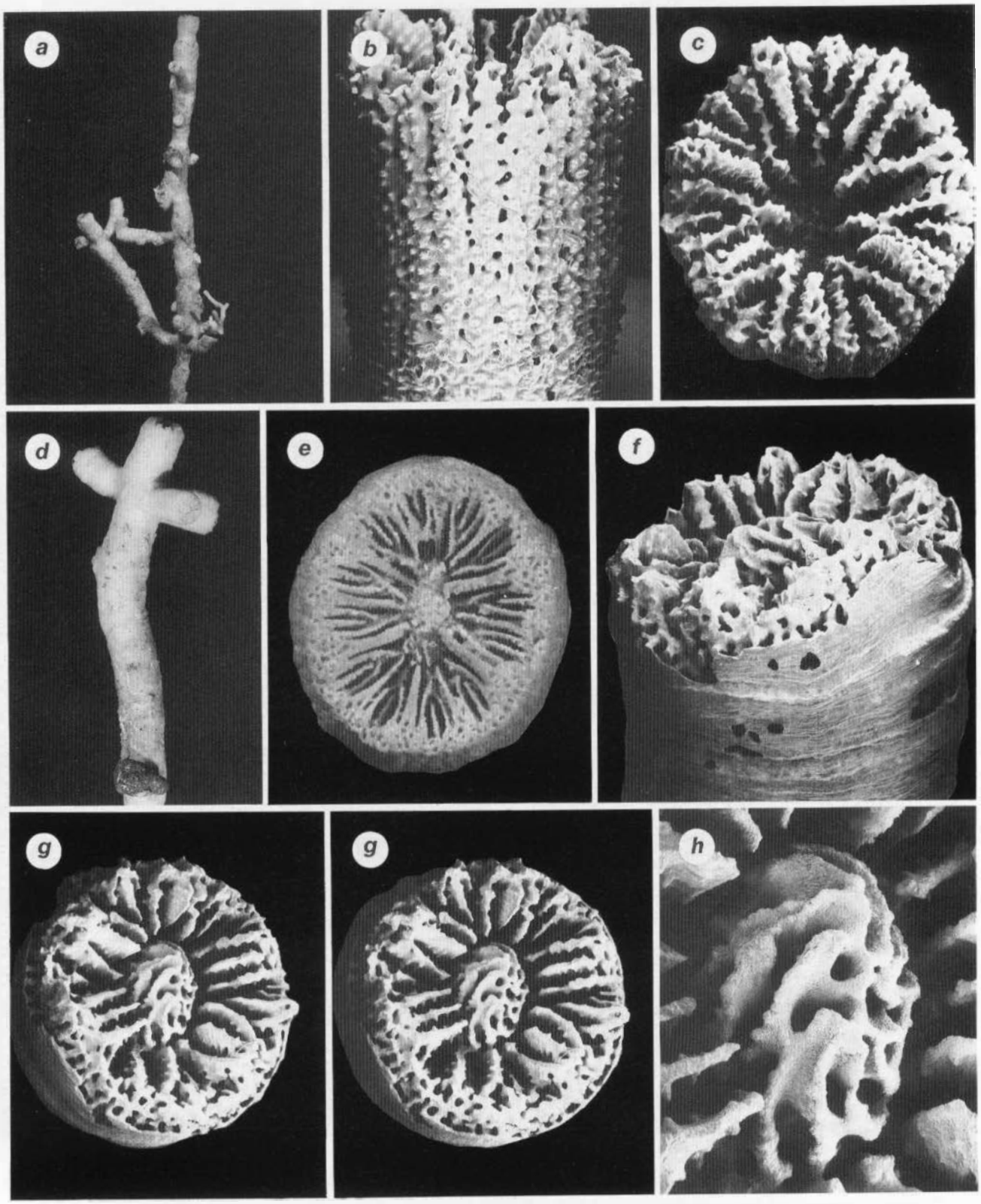


PLATE 42. *Eguchipsammia gaditana* (a, BS310, MoNZ CO83; b-c, NZOI Stn C530): a, colony, x 0.75; b, theca of upper corallite showing epitheca towards base, x 16.6; c, calice, x 16.2. *Eguchipsammia fistula* (d, f-h, NZOI Stn K842, USNM 94240; e, syntype, *Siboga* Stn 105, ZMA 564): d, colony, x 1.25; e, g, calicular and stereo calicular views, x 6.5, x 12.7, respectively; f, epitheca of upper corallite, x 15.7; h, swirled columella, x 4.0.

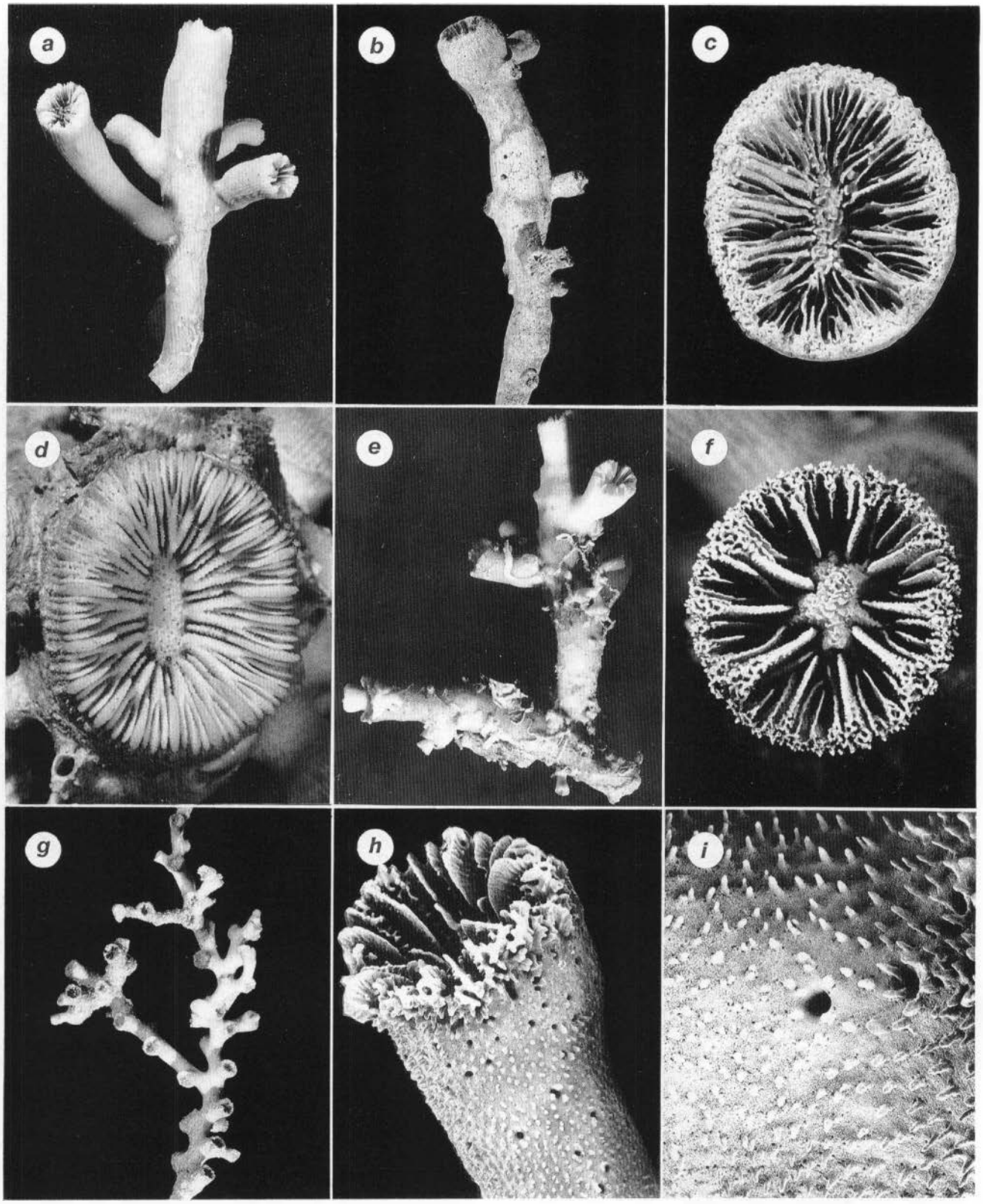


PLATE 43. *Eguchipsammia japonica* (a, NZOI Stn J711, USNM 94214; b-c, *Eltanin* Stn 1718, USNM 79500): a, slender corallites, x 0.95; b, more typical, robust corallum, x 0.48; c, calice, x 2.7. ***Cladopsammia eguchii*** (d, L1630, AIM AK76949): d, calice, x 4.9. ***Dendrophyllia arbuscula*** (e-f, BS571, MoNZ CO231): e-f, colony and calice from same colony, x 0.95, x 5.7, respectively. ***Dendrophyllia alcocki*** (g, NZOI Stn E859, USNM 94260; h-i, NZOI Stn B490, USNM 79490): g, colony, x 0.92; h, oblique view of a distal corallite, x 12.3; i, arrangement of coenosteal spines, x 34.

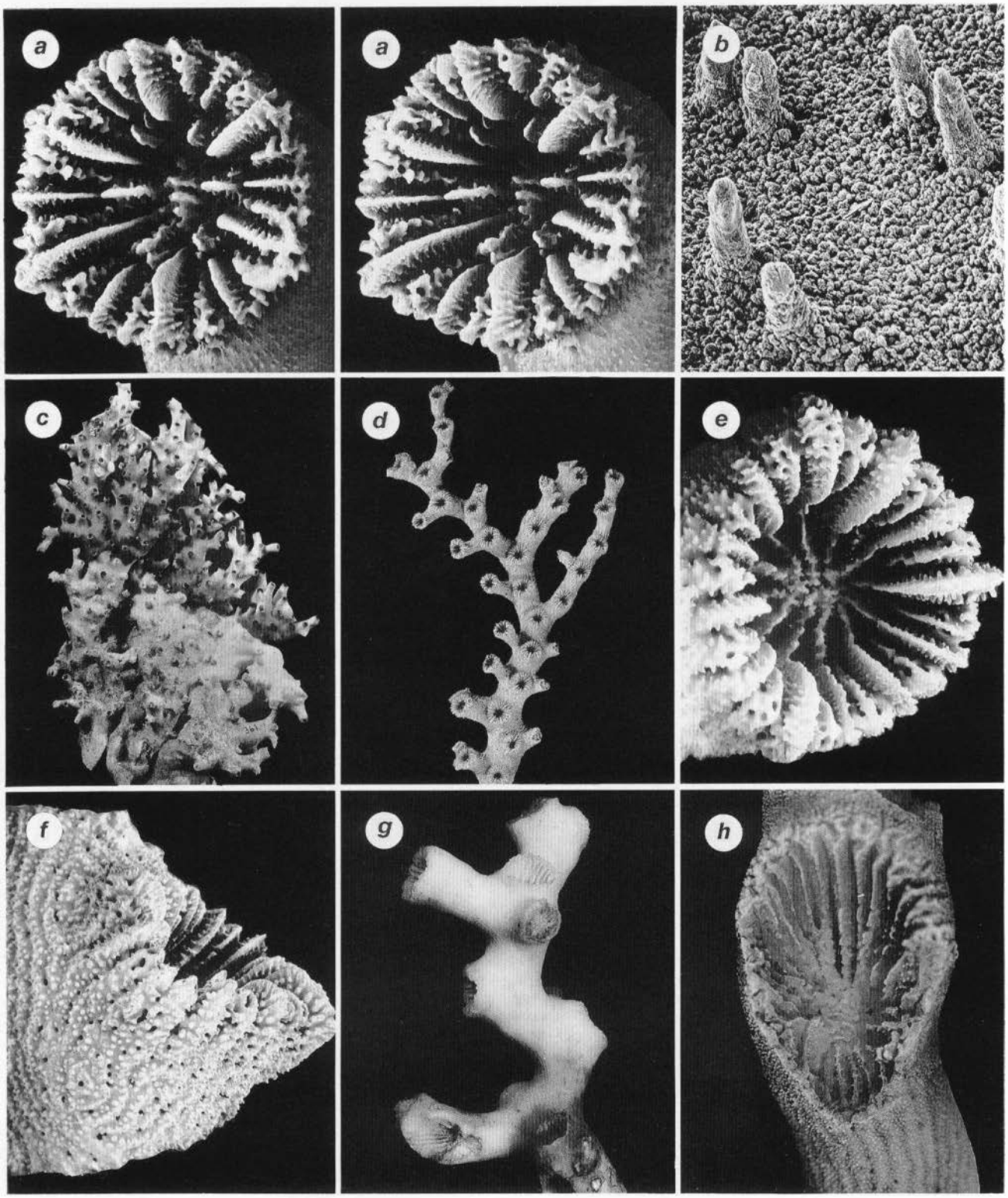


PLATE 44. *Dendrophyllia alcocki* (a-b, NZOI Stn B490, USNM 79490): a, stereo view of a calice, x 14.5; b, coenosteal spines, x 230. ***Enallopsammia rostrata*** (c, CO361, MoNZ; d, NZOI Stn K846, USNM 94205; e-f, NZOI Stn P8, USNM 94206): c, a massive, unifacial colony, x 0.28; d, branch of the "delicate" form, x 1.3; e-f, calicular and side views of a rostrate corallite, x 12.6, x 10.6, respectively. ***Enallopsammia marenzelleri*** (g-h, *Eltanin* Stn 1411, USNM 47535): g, a branch, x 1.8; h, broken corallite revealing columella and inner septal edges, x 2.2