New Zealand Thecate Hydroids
Part I.—Campanulariidae and Campanulinidae

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Abstract

REVIEWS the New Zealand hydroid literature; keys the New Zealand families of thecate hydroids, the genera and species of New Zealand Campanulariidae and Campanulinidae; describes and discusses the systematic status of the New Zealand species of these two families resulting in the following changes: *Eucope annulata* von Lendenfeld transferred to the F. Campanulinidae, *Campanularia fruticosa* (Esper) to the F. Sertulariidae; *Gonothyraea parkeri* (Hilgendorf) recognised as a synonym of *G. loveni* (Allman), *Silicularia campanularia* (von Lendenfeld) a synonym of *S. bilabiata* (Coughtrey) forma *subtropica, Clytia compressa* Totton a synonym of *C. johnstoni* (Alder), *Obelia coughtreyi* Bale a synonym of *O. longissima* (Pallas) and *Orthopyxis formosa* Trebilcock a synonym of *O. crenata* (Hartlaub) forma *subtropica* n. forma. *Campanularia gelatinosa* (Pallas) and *Othopyxis mollis* (Stechow) are recorded from New Zealand for the first time. *Clytia johnstoni, Obelia geniculata, O. australis, Orthopyxis crenata* and *Silicularia bilabiata* give evidence that erect stem and gonothecal characters vary with latitude. Growth forms are distinguishable in *O. geniculata, Orthopyxis crenata* and *S. bilabiata.*

INTRODUCTION

THE suborder Thecata contains families in which the feeding and reproductive zooids as well as the stem and rooting system are protected by a chitinous perisarc in contrast to the Athecata, where the zooids are usually naked. Thecate hydroids in general are larger and more conspicuous than athecates, and the former suborder has the greater number of species. For this reason, the New Zealand thecate hydroids are being revised before the athecates. Elsewhere, for example, North America and Britain, thecate hydroids are well known and have been monographed either in toto, or at the family level. Such is not the case in New Zealand. Records of the known species are scattered throughout the literature. It is convenient here to review the literature of our hydroids, as the thecate hydroids make up by far the greater part of our hydroid fauna.

The pioneer era in this country coincided with the time when shore collecting was in vogue for the amateur naturalist as well as the professional scientist, and much hydroid material was classified in this early period, 66 species being described between 1843 and 1896. Hutton, Coughtrey, Hilgendorf and Farquhar wrote mainly for New Zealand journals, but a number of papers were written by workers outside New Zealand and published overseas.

In just over 100 years of publication only 2 check lists of the hydroids have been made, namely those of Farquhar (1896) and Hutton (1904). Bale (1924), however, briefly reviewed the literature, recognised 9 new species, reduced others to synonymy, and redescribed several species hitherto imperfectly known. Totton (1930) in the "Terra Nova" Reports, described 27 new species and also determined the status of other imperfectly known species, and Ralph (1953) gave a key to the species of athecate hydroids and their medusae.

The first account of New Zealand hydroids was by Gray (1843) in Diffenbach's "Travels in New Zealand". Nearly ten years passed before Busk (1852) recorded *Sertularia elongata* Lamouroux in his report of the Polyzoa and Sertularians collected on the voyage of the H.M.S. "Rattlesnake". No precise locality is given for this

species, but it is probable that it came from the Bay of Islands as the ship spent a week in this locality. Another twenty years passed before Hutton's paper (1873) appeared in the Transactions and Proceedings of the New Zealand Institute. In this period many papers by various authors appeared—viz., Carter (1873); Coughtrey (1875, 1876 and 1876a); Allman (1876, 1885 and 1888); Kirchenpauer (1864, 1872, 1876 and 1884); D'Arcy Thompson (1879); von Lendenfeld (1885 and 1886); Bale (1882, 1884, 1886 and 1889); Hamilton (1883); Marktanner-Turneretscher (1890) and Farquhar (1895). Of all these papers only those by Coughtrey, Hamilton and Farquhar exclusively concern New Zealand hydroids. All hydroid species and their synonyms, etc., known prior to 1896 are given in Farquhar's check-list of that year. Two years later Hilgendorf (1898) described "Hydroids from the neighbourhood of Dunedin," and in 1901 Hartlaub reported species from various localities round the New Zealand coast in his "Hydroiden aus dem Stillen Ocean". A paper by Dendy on *Pelagohydra mirabilis,* the only pelagic hydroid of the fauna, was published in 1902. This early period of relatively extensive research could be said to end with the publication of the hydroid section in Hutton's (1904) "Index Faunae Novae Zealandiae".

Between 1904 and 1924 Bale referred briefly to some New Zealand hydroids in his papers on Australian hydroids in the Proceedings of the Royal Society of Victoria and in F.I.S. "Endeavour" reports from the same country, and Hilgendorf (1911) compares a few thecate species from the Kermadec Islands with New Zealand material. H. B. Kirk (1915) described a new species, *Ascidioclava parasitica,* from the pharyngeal region of a tunicate, and in 1917 Jaderholm noted 10 species from New Zealand in his "Hydroids from the South Seas". Bale's 1924 paper is referred to above.

More recent publications are Findlay (1928) "Notes on New Zealand and Australian Gymnoblastic hydroids"; Fyfe (1928) on a variety of *Cordylophora lacustris* from Otago; Trebilcock (1928) "New Zealand Hydroids" in the Proceedings of the Royal Society of Victoria, and Jaderholm (1926) reported a small collection of New Zealand hydroids in his "Uber einige antarktische und subantarktische Meeren".

Up to 1928 almost without exception hydroids are described from collections taken in the intertidal region, but in 1930 Totton described many new species and species new to New Zealand from dredgings made by the "Terra Nova" off Cape Maria van Diemen, North Cape and the Three Kings Islands. Percival (1938) briefly noted the finding of the second specimen of the unique *Pelagohydra mirabilis.* Reference to New Zealand hydroids more especially in relation to their distribution and possible relationship with other hydroid faunas are found in the papers of North American writers, notably Fraser (1946) and Australian writers Briggs and Gardiner (1931) and Blackburn (1937, 1938 and 1942). Vervoort (1946) discussed and described, together with hydroids from several other localities, some New Zealand material in the collections of the Rijksmuseum Natural Hist. and the Zoological Museum, Amsterdam. Three papers by Ralph (1947, 1953 and 1956) complete the literature on New Zealand hydroids.

The Campanulariidae and Campanulinidae were selected for Part 1 of the New Zealand thecate hydroids as they number between them some of the most widely distributed essentially cosmopolitan and consequently best known intertidal hydroids—e.g., *Obelia geniculata* and *Clytia johnstoni.* The campanulinids can be quickly distinguished from the campanularians as the former have an operculum, often pyramid-shaped, closing the mouth of the hydrotheca. This structure is most readily seen when the hydranth is retracted within the hydrotheca. Also, campanulinid hydrothecae are ovato-conic or tubular, not bell-shaped as are the majority of campanularian hydrothecae. In general, the species of both families have small, delicate, erect stems under 5·0 cm in height, but species with very tall, erect stems

up to 60·0 cm are known. The stem is very variable in form. Frequently a genus will include species with three different stem habits, for example one species may have the hydrothecal pedicel arising directly from a creeping stolon as a simple structure with a single terminal hydrotheca (i.e., truly stolonal), another may have the stem slightly and irregularly branched, and yet another may show profuse and regular sympodial branching. Usually the stem is monosiphonic with a single central axis from which the hydrothecae and/or branches may arise. Some species are polysiphonic with two or more stem tubes from which hydrothecae and/or branches originate. In both families the reproductive zooid may produce a free medusa, or a fixed sporosac, or a reproductive body intermediate in organisational structure between these two extremes.

Differences of opinion exist on the limitation of genera in the two families. Particularly is this true of the F. Campanulariidae. Nutting, in his monograph of this latter family, gives a summary of the various classifications put forward before 1915, and concludes that none of them are entirely satisfactory. The same can be said of the two classifications in current usage, namely those based primarily on the characters of the erect stem (cf. Broch and others) and those based on the structure produced by the reproductive zooid (cf. Fraser, 1944, p. 110). As far as possible the characters of the erect stem and hydrotheca have been used here for separating the genera, as these structures are the ones most frequently found in collections of hydroids, but the genera *Campanularia, Obelia, Gonothyraea* and *Clytia* are distinguished from each other by the structure produced by the reproductive zooid, whether free medusa, or sporosac, etc.

From the above it will be realised that the erect stems of many species are strikingly similar in habit, form and hydrothecal structure and that the difficulties of separation met at the specific level will be very similar to those at the generic level. Therefore, just as generic status may be doubtful if the structure produced by the reproductive zooid is not known, so the specific status is frequently difficult to determine when the gonotheca is unknown. Keys to the genera and species in the F. Campanulariidae present greater problems than in most other families of thecate hydroids and for convenient and successful use it is often necessary for a genus or species to occur at several places in the key.

MATERIAL AND METHODS

The descriptions given below have been made from material collected round the coast of the main islands of New Zealand, the Three Kings Islands off the northern tip of New Zealand, the Chatham Islands to the east, and subantarctic islands to the south. The collections range from intertidal waters down to approximately 350 fathoms. Where possible living specimens were observed, but in the majority of cases, only preserved material was available for study. As, however, specific descriptions in the thecate hydroids are based almost entirely on the skeletal structure, even dried material is of some value.

Well extended hydranths are obtained when specimens are narcotised with magnesium chloride (cf. Pantin, 1948, p. 6). In preparing permanent whole mounts, material stained with acetic-acid-alum carmine gave the most satisfying results, but quickly made and good slides showing skeletal and nematocyst detail can be obtained by staining and mounting or simply mounting directly into polyvinyl alcohol (Salmon & Ralph, 1955).

Measurements of size, slide numbers and figures given for the species are derived from the author's personal collection of thecate hydroids unless otherwise stated. This collection is lodged with the Zoology Department, Victoria University College, Wellington. Where species have many synonyms only an abbreviated list is given here, but a reference source for full synonymy is included.

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KEY TO THE NEW ZEALAND FAMILIES OF THECATE HYDROIDS

1	(10)	Hydrotheca radially symmetrical, but may be curved; or, if bilaterally symmetrical, is pedicellate.	
2	(9)	Hydrothecae deep enough to enclose the retracted hydranth; or, if not, bilaterally symmetrical, large and thick-walled, not saucer-shaped.	
3	(8)	Hydrotheca not attached to the substratum.	
4	(5)	Hydrothecae with true operculum; operculum of converging segments forming a pyramid-like or conical structure when closed over the aperture, more or less circular when open .. .	CAMPANULINIDAE, Hincks, 1868
5	(4)	Hydrotheca without operculum.	
6	(7)	Hydrotheca usually bell-shaped; pedicellate, free, not immersed in accessory tubes of polysiphonic stem, margin entire or toothed; hypostome, club- or trumpet-shaped; gonotheca single .. .	CAMPANULARIIDAE Hincks, 1868
7	(6)	Hydrotheca usually tubular or elongate bell-shaped, free, or immersed in the accessory tubes of a polysiphonic stem; hypostome conical; nematophores may be present; gonothecae in clumps ("coppinia" or "scapus") or single (g *Hebella*)	LAFOEIDAE Hincks, 1868
8	(3)	Hydrotheca partly attached to substratum; very short pedicel attaches it to hydrorhiza	LINEOLARIIDAE Allman, 1864
9	(2)	Hydrothecae shallow, reduced to a saucer-shaped "hydrophore" unable to enclose the retracted hydranth; margin entire	HALECIIDAE Hincks, 1868
10	(1)	Hydrotheca bilaterally symmetrical; sessile, with rare exceptions (e.g., g. *Thyroscyphus*, F. Sertulariidae); one side adnate to stem or branch for at least part of length.	
11	(14)	Nematophores absent.	

12 (13) Hydrothecal margin entire, no operculum: gonotheca single, may arise from inside hydrotheca — SYNTHECIIDAE Marktanner-Turneretscher, 1890.

13 (12) Hydrothecal margin toothed (with rare exceptions—e.g., *Sertularella edentula* Bale); operculum with up to 4 valves present: gonotheca single, usually arising from the axil of stem, branch or hydrotheca (rarely from inside the hydrotheca) — SERTULARIIDAE Hincks, 1868

14 (11) Nematophores present; hydrothecae with wide apertures usually attached in single rows to one side of the branches: gonotheca single; or reproductive zooid protected by modified branches or portions of branches forming a "corbula" — PLUMULARIIDAE Hincks, 1868

Family CAMPANULARIIDAE Hincks, 1868

Hydrotheca usually bell-shaped, not sessile, or attached to, or immersed in the stem or branches; diaphragm may be present; hydranth with club, or trumpet-shaped proboscis: reproductive zooids produce sessile sporosacs, medusoids, or free medusae; the medusae usually have marginal lithocytes, and the gonads on the radial canals.

Twenty-one species of the F. Campanulariidae were previously recorded from New Zealand. These are: *Billardia novae-zealandiae; Tulpa diverticulata; Campanularia carduella* and *Campanularia fruticosa; Clytia johnstoni, Clytia compressa* and *Clytia elongata; Orthopyxis caliculata, Orthopyxis crenata, Orthopyxis formosa, Orthopyxis delicata; Gonothyraea parkeri; Obelia geniculata, Obelia australis, Obelia coughtreyi, Obelia nigrocaulus, Obelia nodosa* and *Obelia pygmaea; Silicularia bilabiata* and *Silicularia campanularia;* and *Eucope annulata.*

The present study has resulted in the following changes: *Eucope annulata* is transferred to the F. Campanulinidae as *Phialella quadrata,* and *Campanularia fruticosa* as *Thyroscyphus fruticosa* to the F. Sertulariidae; *Gonothyraea parkeri* (Hilgendorf, 1898) a synonym of *G. loveni* (Allman, 1859); *Silicularia campanularia* (von Lendenfeld, 1883) a synonym of *S. bilabiata* (Coughtrey, 1875) forma *subtropica; Clytia compressa* Totton, 1930 a synonym of *C. johnstoni* (Alder, 1856); *Obelia coughtreyi* a synonym of *O. longissima* (Pallas, 1766) and *Orthopyxis formosa* Trebilcock, 1928 a synonym of *O. crenata* (Hartlaub, 1901) forma *subtropica* n. forma. *Orthopyxis mollis* (Stechow, 1919) and *Campanularia gelatinosa* (Pallas, 1766) are recorded from New Zealand for the first time. The amended list gives New Zealand a total of 18 species, and of these 14 species belong to four genera—viz., *Campanularia* (2 species); *Clytia* (2 species); *Orthopyxis* (4 species) and *Obelia* (6 species). The other four genera are small, with one species each for g. *Billardia,* g. *Gonothyraea,* g *Silicularia* and g. *Tulpa.* Of the total fauna 40% are known only from New Zealand As stated above, New Zealand campanularians are predominantly littoral, a feature they share in common with campanularians in other parts of the world, but in our waters *Billardia novae-zealandiae* has been collected from 100 fathoms, *Tulpa diverticulata* from 300 fathoms, and *Clytia johnstoni* from 250–350 fathoms.

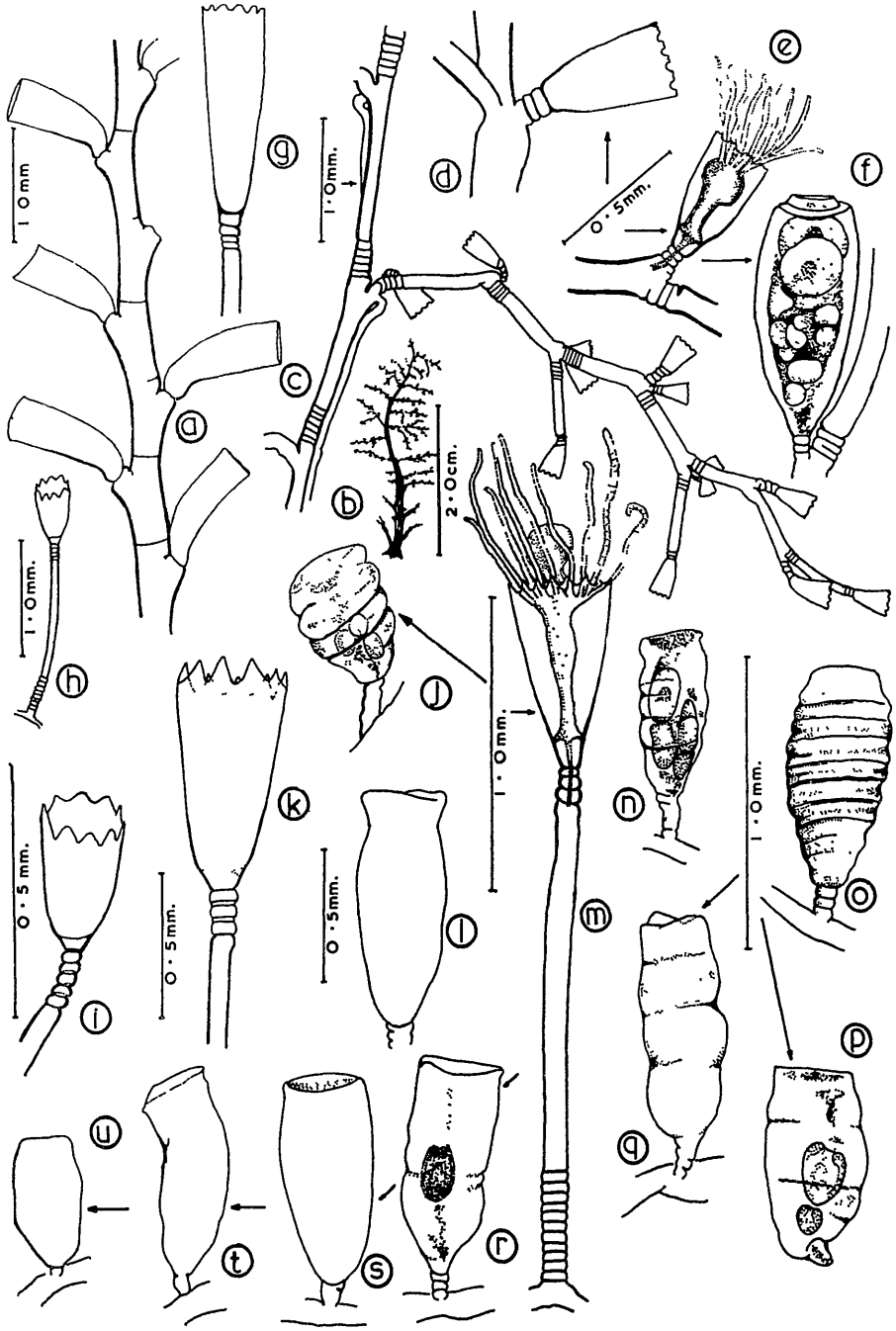
KEY TO THE NEW ZEALAND GENERA OF F. CAMPANULARIIDAE

1 (4) Hydrothecae with obviously thickened walls, often ½ or more than ½ width of the internal cavity in thickness, greatest thickness usually found in proximal region; characteristically a single subspherical structure between the base of the hydrothecae and the distal stem region; pedicels of hydrothecae not branched, arising directly at irregular intervals from creeping stolons; reproductive zooid produces a medusoid structure.

2	(3)	Hydrothecae bilaterally symmetrical with thick walls leaving a cavity too small for complete retraction of the hydranth; hydranth with rounded retractible caecum	SILICULARIA Meyen, 1834
3	(2)	Hydrothecae radially symmetrical with thick walls, but hydranth completely retractible into hydrotheca; hydranth without caecum	ORTHOPYXIS L. Agassiz, 1862
4	(1)	Hydrothecae with thin walls; characteristically lacking a single large subspherical thickening between base of hydrotheca and distal stem region; pedicels arising variously: reproductive zooid producing a free medusa, sessile sporosac, or a grade of organisation intermediate between these two extremes.	
5	(6)	Hydrotheca very deep, length 3 to 4 times width, and very large, rarely less than 2.0 mm and up to 4.0 mm in length; with everted margin, and narrowing rather abruptly below the margin; hydrothecal pedicels arising directly from a creeping stolon, or borne on branches of an erect main stem: reproductive zooid producing a sessile sporosac	TULPA Stechow, 1919
6	(5)	Hydrotheca not very deep, length rarely more than twice width, rarely more than 1.5 mm in length and generally shorter.	
7	(8)	Hydrotheca abruptly curved at the base, rather more tubular than bell-shaped, margin entire, circular; erect stem only known with sympodial branching habit: gonotheca replacing hydrotheca	BILLARDIA Totton, 1930
8	(7)	Hydrotheca not abruptly curved at the base, bell-shaped; margin entire or toothed; erect stem showing various growth habits.	
9	(16)	Erect stem showing sympodial growth.	
10	(13)	Reproductive zooid producing free medusae.	
11	(12)	Medusae saucer-shaped with about 16 tentacles at liberation: margin of hydrotheca entire, toothed, or waved	OBELIA Péron & Lesueur, 1809
12	(11)	Medusae globular and four tentacles at liberation: margin of hydrotheca rarely without teeth	CLYTIA Lamouroux, 1816
13	(10)	Reproductive zooid not producing free medusae.	
14	(15)	Reproductive zooid producing a sessile sporosac but planulae develop within the gonotheca	CAMPANULARIA Lamarck, 1816
15	(14)	Reproductive zooid produces sporosac that emerges through gonothecal aperture becoming extra capsular but remaining attached while planulae develop in sac-like acrocyst	GONOTHYRAEA Allman, 1864
16	(9)	Erect stem not showing sympodial growth, pedicel of hydrotheca directly from the stolons.	
17	(18)	Reproductive zooid producing free globular medusae, with 4 tentacles at liberation: margin of hydrotheca rarely without teeth	CLYTIA Lamouroux, 1816
18	(17)	Reproductive zooid producing a fixed sporosac and planulae developing within the gonotheca: margin of hydrotheca toothed or entire	CAMPANULARIA Lamarck, 1816

Genus BILLARDIA Totton, 1930.

Erect stem simple or branched; older stems fascicled, hydrothecae from one to three on an internode, alternating, arising from short apophyses on sympodial stem and branches; branches alternate, one from below proximal theca of each stem internode; no sarcothecae; hydrothecae long, abruptly curved at base, inoperculate, with basal septum, adnate for a very short distance or entirely free, margins entire and circular: gonothecae replacing hydrothecae, smooth and compressed or annulated. (Totton.)



TEXT-FIG. 1.—a, *Billardia novae-zealandiae* Totton. b-f, *Campanularia gelatinosa* (Pallas), g, *Clytia elongata* Marktanner-Turneretscher (after Markt.-Turneretscher Pl. 3, Fig. 11*). h–u, *Clytia johnstoni* (Alder), h–j from R. Tamar, England; k–l from North Cape (after Totton's (1930) Text-fig. 6a and c for "*Clytia compressa*"); m, erect stem; n–o, gonothecae, from Auckland; p–u, gonothecae, from Bay of Islands.

* Scale of original figure not given by author

Totton is uncertain of the affinities of the genus *Billardia* but considers it most nearly related to *Hincksella* Billard. The former genus is known from New Zealand by only one species, *B. novae-zealandiae,* recorded originally by Totton (1930) from northern New Zealand localities, the Three Kings Is., and off Cape Maria van Diemen. Totton thought it possible that the structures he described as gonothecae may have been only parasitised and hypertrophied hydrothecae, but material recently to hand from Cook Strait of *B. novae-zealandiae* shows unmistakable gonothecae, and these are in general as described by Totton—viz., compressed (markedly so in the present specimens), about twice the length of the hydrothecae, and with a basal flexure similar to the hydrothecae. A few gonothecae in the Cook Strait material have an irregular slit-like distal aperture as described for *B. novae-zealandiae* but it is not a constant feature. The majority of gonothecae have a smooth conical apex without visible opening. Mostly, the wall of the gonotheca is smooth, but the walls of a few show distinct undulations (Fig. 1a, b). The reproductive zooids within the gonothecae are inadequate in my Cook Strait specimens to determine with certainty the sex of the colony, but it appears to be male. A very closely allied species to *B. novae-zealandiae,* namely *B. subrufa* (Jaderholm) with annulated gonothecae, is recorded from the Antarctic. Both are sublittoral.

Billardia novae-zealandiae Totton, 1930. Text-figs. 1, a; and 1A, a-d.

1930. *B. novae-zealandiae* Totton, p. 150, Text-fig. 8.

Erect stem with sympodial growth, up to 3·0 cm in height, branched or unbranched; stem diameter 0·25 to 0·37 mm, internode length 0·62 to 1·83 mm; internode length of branch 1·5 mm, width 0·22 mm; hydrotheca tubular, with abrupt bend near the base, but no thickening of perisarc at the bend; may have a slight upward curve at the distal end, 0·93 mm to 1·12 mm in length, 0·24 to 0·34 mm in greatest diameter: gonotheca in place of hydrotheca, compressed, about twice as long as hydrotheca, adpressed to hydrocaulus, with slit-like distal aperture, but apex often without visible opening, smooth and conical; basal flexure similar to that of hydrotheca; walls usually smooth but may be undulated; 1·75 mm to about 2·5 mm in length and about 0·60 mm in width viewed from the broader side.

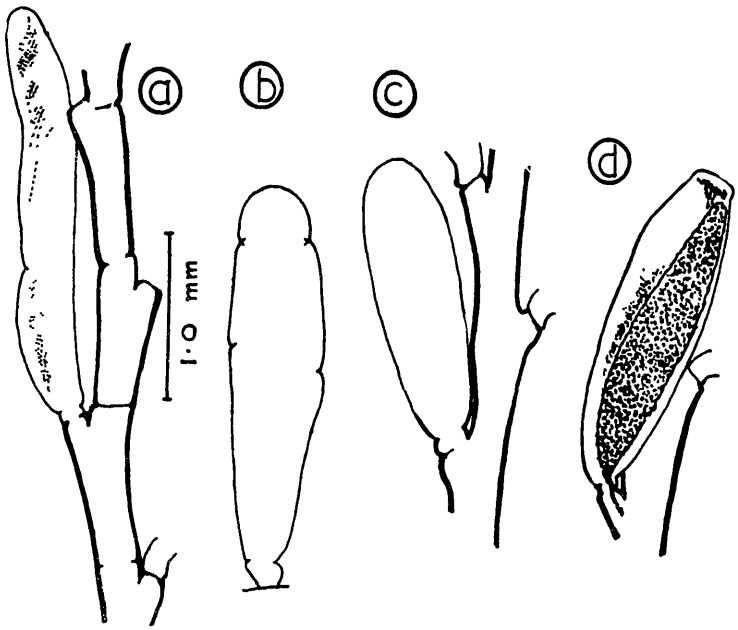
Locality: Type locality, Stn. 144 ("Terra Nova"), Three Kings Islands, 100 fathoms. Off Cape Maria van Diemen, 35 to 40 fathoms; "Alert" Stn. 4A, N.E. Stephen Is., Cook Strait, 1 mile offshore, 100 fathoms (W. H. Dawbin), 28/12/51, 446; Cook Strait Stn. GUJ (55), 40 to 100 fathoms, (Zoo. Dept. V.U.C.), 23/2/56, 519.

Genus Campanularia Lamarck, 1816

Colonies truly stolonal with pedicels of hydrothecae arising directly from creeping stolons, or irregularly branched or erect stems with regular sympodial branching; hydrothecae characteristically bell-shaped, with an entire or toothed margin: reproductive zooids produce sporosacs that remain within the gonotheca while the planulae develop.

Key to the New Zealand Species of *Campanularia*

1	(2)	Hydrotheca cup-shaped with heavy and swollen base and everted lip (head thistle-like); colony stolonal; stems small (2.0 mm): gonotheca pedunculate, oviform, with truncated summit	? *Campanularia carduella* Allman, 1885
2	(1)	Hydrotheca deeply bell-shaped, margin toothed, each tooth bicuspidate; colony with branched polysiphonic erect stems: gonotheca "nearly obconical" with distinct collar	*Campanularia gelatinosa* (Pallas, 1766)



TEXT-FIG. 1A.—a–d, *Billardia novae-zealandiae* Totton. a, gonotheca, narrow view; b–d, gonothecae broader view.

C. carduella is known to me only from the literature. Allman's (1885) specimens were in too poor condition for him to determine the structure produced by the reproductive zooid and the generic status of the species is doubtful. The type locality is given simply as " New Zealand ". The " thistle-head " shape of the hydrotheca is distinctive, but it must be remembered that Allman described the species from poorly preserved and dried material. Other characters, namely those of the erect stem, the tumid base of the hydrotheca and the gonotheca, bring to mind *Orthopyxis caliculata,* a fairly common intertidal species from New Zealand coastal waters.

The reproductive zooid in specimens from Lake Ellesmere assigned here to *Campanularia* as *C. gelatinosa* appears to produce a simple sporosac. The generic status of this material seems clear, as there is no evidence that an acrocyst is formed to receive the developing sporosac as in the g. *Gonothyraea.* Nutting (1915) and Fraser (1946) list *Campanularia integra* McGillivray as occurring in this country. The only reference to this species in New Zealand waters appears to be that of Coughtrey (1875), but a year later (*Trans. N.Z. Inst.,* Vol. 8, p. 299) Coughtrey recognised his specimens as *C. caliculata* Hincks (now *Orthopyxis caliculata*). It seems probable that Nutting and Fraser were using Coughtrey's original 1875 record.

? Campanularia carduella Allman, 1885

1885. ***Campanularia carduella*** Allman, p. 132, Pl. 17, **Figs. 1 and 2.**

Hydrocauli ½in, springing from a creeping stolon and annulated at the distal end; hydrothecae cup-shaped, with tumid base and everted lip; head " thistle-like "; gonotheca large, springing from the stolon and borne on the well-defined peduncle, oviform in shape with a truncated summit. (Allman.)

TYPE LOCALITY: New Zealand.

DISTRIBUTION: Known only from New Zealand and not recognised by any worker since Allman's original account.

Campanularia gelatinosa (Pallas, 1766). Text-fig. 1, b-f.

1766. *Sertularia gelatinosa* Pallas, Elenchus Zoophytorum, p. 116.
1915. *Oblearia gelatinosa* (Pallas) Nutting, p. 87, p. 24, Figs. 1–5
1944. *Campanularia gelatinosa* (Pallas) Fraser, p. 118. Pl. 20, Fig. 89 (synonymy).

Erect stems, sympodial, polysiphonic, growing in clusters and up to 35·0 mm in height; larger branches as well as main stems polysiphonic; proximal polysiphonic region of stem dark brown, distal monosiphonic region of stem distinctly lighter in colour; 3 to 5 annulations on the main stem above the junction with branch and 3 to 5 annulations at base of each branch; proximal internodes of main stem about 1·0 mm in length by 0·13 mm in width, distal about 0·68 mm in length and 0·093 mm in width; proximal and distal branch internodes about 0·43 mm in length and 0·07 mm in width; hydrothecal pedicels either completely annulated with from 3 to 6 annulations, or longer, with from 3 to 6 proximal and distal annulations and with a smooth or undulated central region; hydrothecae tapering gradually from margin to base, deep, 0·27 to 0·39 mm in length, and 0·18 to 0 25 mm in width at the margin; margin with about 10 teeth, each tooth bicuspidate: gonothecae arising from axil of stem, branch or hydrotheca and borne on a short pedicel with 2 to 3 annulations, rather broad truncate distal end gradually tapering to the base, 0·75 to 0 94 mm in total length and about 0·25 mm in greatest width, a distinct colar about 0·062 mm deep and 0·187 mm in diameter around the terminal aperture.

Locality: Type locality, coasts of Belgium (Pallas). Lake Ellesmere, near mouth of Selwyn River, drift (G. Knox), 7/4/47, 242*.

Distribution: Europe; North and Central American waters; Arctic; Mediterranean; Patagonia; New Zealand.

Genus Clytia Lamouroux, 1816

Colonies either truly stolonal with pedicels of hydrothecae arising directly from creeping stolons, or erect stem branched irregularly but sometimes extensively; hydrothecal margin toothed with rare exceptions: reproductive zooids producing free medusae, spherical or bell-shaped with four marginal tentacles when liberated.

Key to the New Zealand Species of *Clytia*

1	(2)	Colonies stolonal; hydrothecae very deeply campanulate—i.e., length almost 4 times the breadth; 0.41 to 0.87 mm in length and 0.12 to 0.25 mm in width; 12 long blunt marginal teeth: gonotheca unknown	? *Clytia elongata* Marktanner-Turneretscher, 1890.
2	(1)	Colonies may be slightly branched or stolonal, without branches, or both habits may occur; hydrothecae variable in shape from broadly campanulate to deeply campanulate—i.e., length up to 3 times the breadth; marginal teeth variable in shape, sharply pointed or slightly rounded, 7 to 16 in number: gonotheca oval or oblong, walls variable, with up to 12 distinct annulations or with 1 to 2 undulations, or smooth; slightly compressed, barrel-shaped, pedicel with up to 3 annulations	*Clytia johnstoni* (Alder, 1856)

Three species of *Clytia* previously recorded from this country are *Clytia johnstoni* (Alder, 1856) from French Pass (Hartlaub, 1901), *? Clytia elongata* Marktanner-Turneretscher, 1890 from Auckland, and *Clytia compressa* Totton, 1930 from North Cape *C. compressa* was described only from New Zealand, and is shown below to be a synonym of the cosmopolitan *C. johnstoni*. ? *C. elongata* is also known from

* Slide number in Author's collection.

Australia (Ritchie, 1911) and Goa, Natal (Warren, 1908), but no material has come to hand in the present study.

The status of ? *C. elongata* is obscure; Ritchie draws attention to the distinctive character of the long, narrow hydrotheca which is almost 4 times as long as broad. Totton (1930) considers *C. compressa* Totton and the specimens from French Pass described by Hartlaub (1901) as *C. johnstoni,* are distinct from ? *C. elongata.* The reproductive structures of ? *C. elongata* are unknown, and the species is assigned to g. *Clytia* on the characters of the erect stem. The hydrothecal length (0·41 to 0 87 mm) of Marktanner-Turneretscher's material from Auckland is very similar to that known for other specimens of the g. *Clytia* from the same locality here recognised as *C. johnstoni* (Fig. 1, m) but the ratio of length to breadth is very different. As Ritchie (1911) points out, in ? *C. elongata,* the very long narrow hydrotheca almost 4 times as long as broad is distinctive. Other material of *C. johnstoni* from the Chatham Islands (Fig. 3, b) shows one hydrotheca nearly 3 times as long as broad and with rounded marginal teeth like those described for *C. elongata,* but in the majority of specimens of all known material of *C. johnstoni* from this country the hydrothecae are only 2 to 2½ times as long as broad. Without knowledge of the reproductive structures the generic status of the species must remain in doubt. The known characters of the hydrotheca of ? *C. elongata* mark it as distinct from other species of *Clytia* from this country.

The material from French Pass which Hartlaub assigned to *Clytia johnstoni* was regarded by Totton as more nearly allied to *C. compressa* Totton than to *C. johnstoni.* Totton distinguishes *C. compressa* from *C. johnstoni* on the shape of the marginal teeth of the hydrotheca which are pointed in *C. compressa* with the ends of the teeth less rounded than the emarginations, and on the characters of the gonotheca which is generally slightly compressed, barrel-shaped and not annulated. The characters of the hydrotheca and gonotheca in *C. johnstoni* in New Zealand are shown to exhibit considerable variation. The material described by Hartlaub as *C. johnstoni* from French Pass displays the characters anticipated for specimens in the latitude of French Pass—viz., pointed hydrothecal teeth and annulated gonothecae. (While Hartlaub mentions " numerous gonothecae " in his material he does not describe them or mention them as in any way atypical, from which it can be assumed they were annulated as generally is the case in *C. johnstoni.*) Hartlaub's material is here recognised as *C. johnstoni.*

A wide variety of characters have been recorded for the erect stems of *C. johnstoni.* Stems are usually annulated proximally and distally, with the central region smooth, but irregular waves and annulations are known to occur and rarely, completely annulated stems are found (Hincks 1868, p. 144). Although usually truly stolonal in habit, erect stems are known to branch, the branches being a replica of the main stem. Branches turn abruptly upwards and run almost parallel to the main stem or other branches. Annulations are absent on the originating stem immediately above its junction with the branch except in those rare instances when stems are annulated or wavy throughout. The hydrothecal length varies from about 0·40 mm to 1·12 mm, and its length to breadth ratio may be such that the cup is described as inversely conical, or cylindrical—i.e., approximately two and a-half times as long as broad. The number of prominent marginal teeth varies from 7 to 16, and these are either sharply pointed or " pointedly rounded " (Kramp, 1918, p. 163): gonothecae arise either from the hydrorhiza or stem and are attached by a short, usually annulated pedicel; oval to oblong in shape, walls usually annulated but annulations vary greatly in number, from about 4 to 12.

New Zealand material of *Clytia* from the Bay of Islands, Auckland, off Cape Palliser and Taylor's Mistake, Christchurch, is fertile and possesses erect stem and gonothecal characters that vary within the limits described above for *C. johnstoni.* It was observed, however, that specimens from the Bay of Islands at the northern

end of the range all have smaller hydrothecae with more sharply pointed teeth and only about a quarter the number of annulations on the gonothecal wall than in material from Taylor's Mistake at the southern end of the range. Erect stems of infertile colonies from New Plymouth, Moeraki, Karitane, Chatham Islands and Dunedin determine them in our present knowledge as *C. johnstoni,* and they are here assigned to that species, but it will be realised that without knowledge of the reproductive zooid the generic status of this material must remain in doubt. Text-fig. 2 gives a diagrammatic presentation of the variation in maximum hydrothecal height, teeth shape and gonothecal annulations, etc., from south to north of the range of *C. johnstoni* in New Zealand.

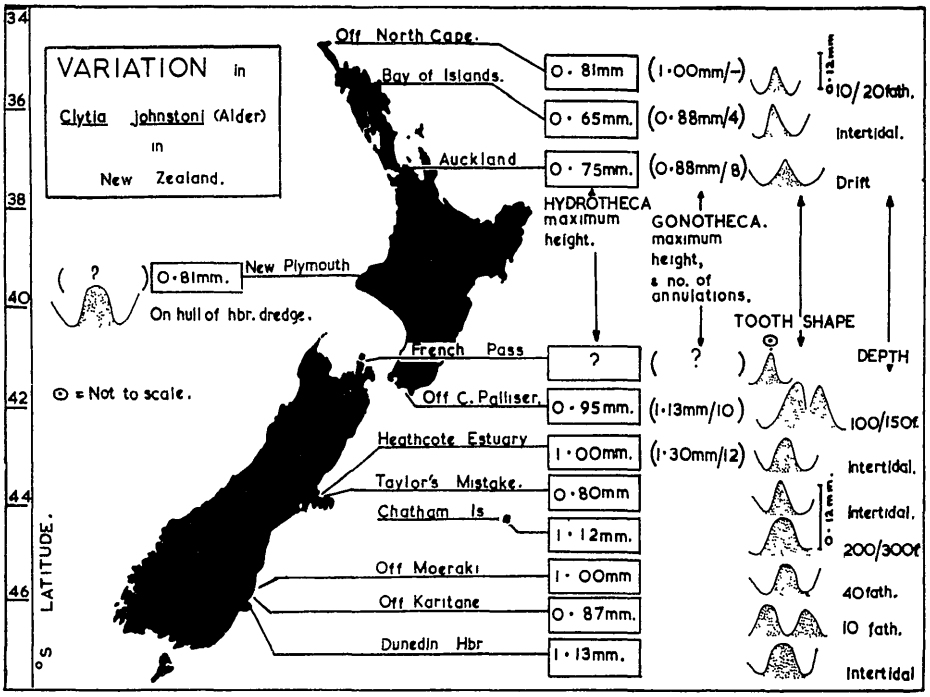
Specimens from the northern end—viz., the Bay of Islands and Auckland, show that *C. compressa* Totton, 1930 is a synonym of *C. johnstoni.* The characters and range of variation shown by erect stems and hydrothecae of *C. johnstoni* from Auckland and the Bay of Islands are similar to those described by Totton for *C. compressa* from North Cape. Gonothecae of colonies from the above localities, however, show a gradation of characters from Auckland northward to North Cape. Gonothecae of *C. johnstoni* from Auckland in general, have regularly annulated walls (with up to 8 annulations) and as described for the species; a few, however, have walls that are irregularly annulated (Fig. 1, n) while Bay of Islands gonothecae (Fig. 1, p-u) have about 32% showing clear indications of up to 4 annulations and 68% with smooth walls. Gonothecae of *C. compressa* are typically slightly compressed, barrel-shaped, smooth without annulations, but are often irregularly folded (Totton, 1930, p. 147). From the above evidence of the erect stem and gonotheca, Totton's material of *Clytia* from North Cape is here regarded as a synonym of *C. johnstoni* (Alder).

Thus *C. johnstoni* shows considerable variation from south to north in its New Zealand range. Colonies from about 47° S. to 44° S. have tall stems and long hydrothecae about 0·56 to 1·12 mm, and the hydrothecal teeth either sharply pointed or somewhat rounded and gonothecae about 1·30 mm in length and walls with up to 12 annulations; while those from 40° S. to 34° S. have the shortest stems, hydrothecae 0·40 to 0·81 mm in length, hydrothecal teeth sharply pointed and gonothecae from 0·50 to 1·0 mm in length, and with walls variable from distinctly annulated (up to 8 annulations) to smooth, without annulations. On the present evidence growth forms are not clearly distinguishable, but as further material becomes available for study it seems probable that specimens from the above three latitudinal populations will be shown to be subantarctic, intermediate and subtropical forms of *C. johnstoni.*

Judging only from descriptions, the North American species *C. cylindrica* Agassiz, 1862, *C. edwardsi* (Nutting, 1901) and *Clytia minuta* (Nutting, 1901), may prove to be also synonyms of *C. johnstoni. C. cylindrica* shows a striking general resemblance to material from the Bay of Islands and North Cape, and *C. edwardsi* and *C. minuta,* species with branched erect stems up to 3·0 cm (Fraser, 1946, p. 216), are in general similar to branched colonies from the South Island. However, Fraser's description and figures (1937, 1944, 1946) of the height attained by the erect stem of *C. edwardsi* do not agree. In 1937 and 1944 the maximum size is described as "25 or 30 mm," but figures (natural size) show stems about 5·0 mm. The latter size appears the more correct, as in 1946 Fraser gives the maximum height as "about 3 mm". The maximum stem height of *C. minuta* also is variously recorded. Nutting (1915, p. 61) gives "about 6 mm", and Fraser (1944, p. 143), "2 cm or more" but his Pl. 25, Fig. 116 a, shows an erect stem 13·0 mm in length. The available evidence points to both species possessing small branched stems similar to those of some branched colonies from New Zealand here recognised as *C. johnstoni.*

? **Clytia elongata** Marktanner-Turneretscher, 1890. Text-fig. 1, g. (After Marktanner-Turneretscher, Pl. III, Fig. 11.)

1890. *?Clytia elongata* Marktanner-Turneretscher, p. 215, Pl. III, Fig. 11.



TEXT-FIG. 2.—Diagram of variation in erect stem and gonotheca of *Clytia johnstoni* (Alder) in New Zealand. (Data from off North Cape, after Totton, 1930; and from French Pass, after Hartlaub, 1901.)

1896. *Clytia* (?) *elongata* Marktanner-Turneretscher. Farquhar, p. 461.
1908. *Clytia* (?) *elongata* Marktanner-Turneretscher. Warren, p. 339, Text-fig. 20.
1911. *Clytia* (?) *elongata* Marktanner-Turneretscher. Ritchie, p. 815.

Colony stolonal; hydrorhiza " thread-shaped " and 0·03 to 0·06 mm in diameter; hydrothecal pedicels comparatively short, 0·38 to 1 17 mm in length and 0·048 to 0·06 mm in diameter, annulated proximally and distally with about 3 to 4 rings, intermediate portion variable, either smooth or with a few annulations or indefinitely corrugated, a terminal stem spherule may be present; hydrothecae long and slender almost cylindrical, 0·41 to 0·87 mm in length and 0·12 to 0·25 mm in width at the mouth, 10 to 12 long but rounded marginal teeth separated by deep, semi-circular embayments; reduplication of margin uncommon; diaphragm poorly developed; gonotheca unknown. (Data from Marktanner-Turneretscher and Ritchie [1911]).

LOCALITY: Type locality, Auckland, New Zealand, on *Halecium parvulum* Bale.
DISTRIBUTION: New Zealand. New South Wales (Australia). Goa (Natal).

Clytia johnstoni (Alder, 1856). Text-figs. 1, h-u; 3, a-f.

1901. *Clytia johnstoni* (Alder). Hartlaub, p. 364.
1924. *Clytia johnstoni* (Alder). Bale, p. 232.
1930. *Clytia compressa* Totton. Totton, p. 146, fig. 6.
1944. *Clytia johnstoni* (Alder). Fraser, p. 138, Pl. 24, Fig. 111, synonymy.

Colony stolonal or slightly and irregularly branched, hydrorhiza flattened on the attached side and sometimes bearing a flange of perisarc 0·031 to 0·66 mm in width; diameter of hydrorhiza 0·12 to 0·21 mm; unbranched erect stems 1·0 to 7·0 mm in length and 0·062 to 0·12 mm in width; both branched and unbranched typically annulated at the two extremes, with the central region smooth—4 distal annulations and 7 proximal, but this is quite variable and completely annulated stems are known; stems when branched usually have the branches turning abruptly upwards,

running almost parallel to the main stem; usually no annulations on stem above its junction with a branch; hydrothecae variable in shape from inverted cone to cylindrical when they are about 2½ times as long as broad; 0·45 to 1·12 mm in length and 0·25 to 0·62 mm in width at the circular aperture; 7 to 16 marginal teeth variable in shape from sharply pointed to rounded at the tip, and when the teeth are rounded the interspaces may be more rounded than the teeth; hydranths with trumpet-shaped proboscis and up to 16 tentacles: gonothecae arise either from the hydrorhiza or the stem, attached by a short annulated, waved or almost smooth pedicel 0·093 to 0 40 mm in length; oblong, oval or barrel-shaped in broad view, truncate at the distal end; 0·50 to 1·30 mm in total length, 0·25 to 0·40 mm in greatest breadth, walls annulated to smooth.

LOCALITY: Type locality, Brighthelmstone, Sussex (Ellis). "Terra Nova" Stn. 134, near North Cape, 11 to 20 fathoms (Totton, 1930); intertidal rock pool on brown algae, Moturoa Is., Bay of Islands (P.M.R.), 28/11/50, 21; Piha, Bay of Islands (M. Laird), —/2/51, 111; Glendowie, Auckland, drift on *Sargassum* (D. Kulka), 470; back of crab, hull of New Plymouth Harbour dredge ("Paritutu"), (J. H. Sorensen), 5/5/54, 435; Stn. 53, Cook Strait (Victoria University College), 23/2/56, 471; French Pass (Hartlaub, 1901); Heathcote Estuary, Christchurch (P.M.R.) 15/11/51, 249; Taylor's Mistake, Christchurch (G. Knox), —/—/—, 229; off Moeraki, 40 fathoms (P.M.R.), 11/2/51, 64; off Karitane, 10 fathoms ("Grace," Hanson Bros.), 30/11/51, 265; Portobello Reef, intertidal on algae (E. J. Batham), 26/3/51, 175; Stn. 7, "Chathams Expedition 1954", 2/1/54, Chatham Expedition Slide No. 2.

DISTRIBUTION: Europe, North and South America, Africa, Asia, Arctic, Antarctic, New Zealand, Chatham Islands.

Genus GONOTHYRAEA Allman, 1864

Erect stem showing sympodial branching; hydrothecae campanulate, with thin walls; reproductive zooid producing fixed medusiform sporosacs, furnished with tentacles; sporosacs extruded into a sac at the summit of the gonotheca, in which sac the planulae are developed. (Fraser.)

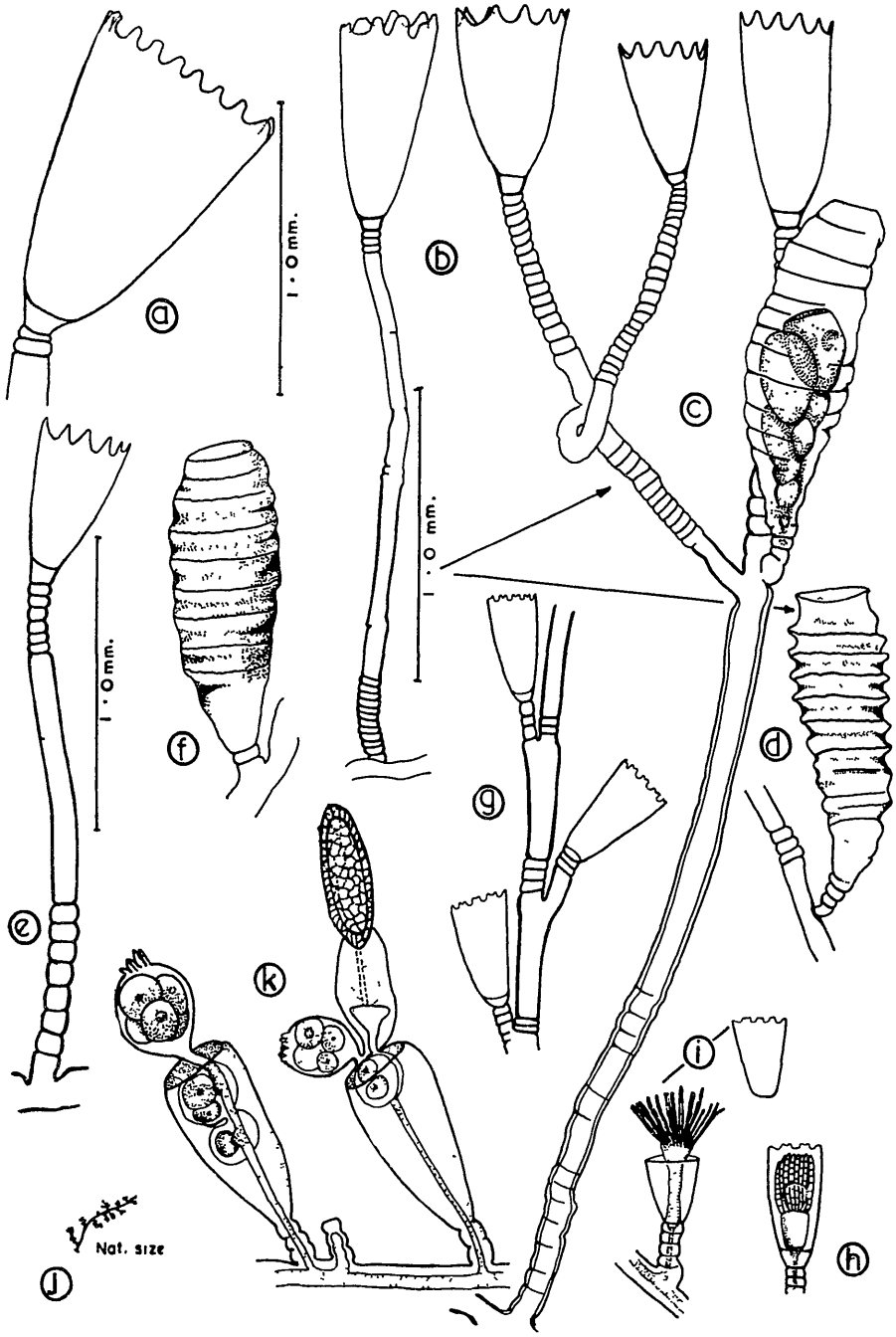
The genus is known for New Zealand by only one species recorded originally from Dunedin by Hilgendorf, in 1898, as a new species *Calycella parkeri* which was recognised by Bale (1924) as a member of the g. *Gonothyraea* probably identical with *G. hyalina* Hincks 1866, which it resembles in the character of the erect stem.

G. hyalina Hincks is, however, very closely related to *G. loveni* (Allman, 1859), "so much so that the species have often been confused" (Broch, 1918, p. 170). This appears to be the case with New Zealand and Tasmanian material. *G. hyalina* is characterised by Broch as having "fine narrow furrows running from the teeth someway over the side of the hydrotheca". Fine narrow furrows were not observed by Hodgson (1950, p. 6) in his Tasmanian specimens or by Hilgendorf or Bale for New Zealand material. Evidently their material is *G. loveni* and not *G. hyalina.* Unfortunately New Zealand material of this genus has not come to hand in the present collections Examination of material of *G. loveni* from the R. Tamar, England, and the eastern coast of Canada, confirms this opinion.

Gonothyraea loveni (Allman, 1859). Text-fig. 3, g-k.

1898. *Calycella parkeri* Hilgendorf, p. 205, Pls. XVII and XVIII, Fig. 3.
1924. *Gonothyraea parkeri* (Hilgendorf). Bale, p. 231.
1950. *Gonothyraea hyalina* Hincks. Hodgson, p. 6, Fig. 10.

Hydrocaulus monosiphonic, branched, attaining a height of about 3 cm; stem flexuous, jointed, giving rise to a branch, hydrotheca or both at each joint; stem annulated at the base and distal to each joint as are the branches; hydrothecae alternate, elongate, campanulate, hyaline; aperture circular, margin castellated, the denticles being indented at the top; hydrothecae are borne on annulated (up to



TEXT-FIG. 3.—a–f, *Clytia johnstoni* (Alder). a, from Dunedin Harbour; b, from Chatham Islands; c, from Heathcote Estuary, Christchurch; d, from off Cape Palliser; e–f, from North America (after Fraser, 1944, Pl. 24, fig. 111 b and d). g–k, *Gonothyraea loveni* Allman, g and h (after Hodgson, 1950, figs. 8 and 10*); i–k, (after Hilgendorf, Pl. 17, Figs. 3 and 3b, Pl. 18, Fig. 1*).

* No size scale given by author.

20 rings), slightly tapering pedicels: sexes separate; gonotheca large, axillary to the branch or hydrotheca, urn-shaped with a flattened top, supported by a ringed pedicel; gonophores become extra-capsular at maturity but are not liberated. (Hodgson.)

LOCALITY: Type locality, Shetland, Scotland. Dunedin Harbour, wharf piles (Hilgendorf, 1898).

DISTRIBUTION: England; Russia; Norway; Greenland; Iceland; North America; Tasmania; New Zealand.

Genus OBELIA Péron & Lesueur, 1809

Erect stem with regular sympodial growth and either monosiphonic or polysiphonic; hydrothecae with thin walls, margin entire, or toothed: reproductive zooids producing free medusae that when liberated possess more than eight marginal tentacles, but no oral tentacles; 8 interradial lithocytes present. (Fraser.)

KEY TO THE NEW ZEALAND SPECIES OF *Obelia*

1	(2)	Hydrothecal pedicel on clearly thickened "knee" process of the internode; not more than 3 annuli above the node; stem perisarc thick; margin of hydrotheca entire	*O. geniculata* (Linnaeus, 1758)
		Hydrocaulus short, 5.0 mm to 20.0 mm in length, unbranched: gonotheca about 0.62 to 0.75 mm in length, 0.25 mm in breadth	forma *subtropica*
		Hydrocaulus of intermediate height, 12.0 to 22.0 mm in length, not more than 50% branched; gonotheca about 0.75 mm in length, 0 25 to 0 31 mm in breadth	forma *intermedia*
		Hydrocaulus tall, 20 0 mm to 40.0 mm in length, more than 50% frequently over 80% branched; gonotheca about 0.90 mm in length and 0.37 mm in breadth	forma *subantarctica*
2	(1)	Hydrothecal pedicels not on "knee" processes of the internode; characteristically more than 3 annuli above the node, stem perisarc thin, rather delicate; margin of hydrotheca entire or waved.	
3	(4)	Hydrothecae on distal ends of branches only, marked difference in colour in proximal and distal regions of the erect stem, the proximal region being black and the distal branches "quite transparent"; 6 to 7 annuli above the node; generic status doubtful, structure produced by the reproductive zooid unknown	? *O. nigrocaulus* Hilgendorf, 1898
4	(3)	Hydrothecae not confined to the distal ends of the branches; no marked contrast between the proximal and distal stem colour, colour changes when present gradual	
5	(6)	Hydrothecae not constricted at the level of the diaphragm, deeply bell-shaped, length clearly greater than width; diaphragm always sharply oblique; margin entire but may be sinuous in old hydrothecae; primary and secondary stem branching alternate; gonothecae somewhat tapered at each end with distinct collar.	*O. australis* von Lendenfeld, 1885
6	(5)	Hydrothecae usually constricted at the level of the diaphragm; diaphragm slightly oblique or horizontal, both positions may occur in hydrothecae of the one erect stem,	

		but overall, one position is dominant; length to breadth ratio variable; margin entire or waved; primary and secondary branching, etc., alternate or otherwise.	
7	(10)	Hydrothecae with diaphragm usually horizontal.	
8	(9)	Erect stems tall, and those over 35.0 mm in length with primary branches strictly alternate, secondary and tertiary series, etc., usually forked; margin undulated or entire; gonotheca broadest at the distal end, aperture wide with slightly elevated collar; wall smooth or undulated	*O. longissima* (Pallas, 1766)
9	(8)	Erect stems short, about 15.0 mm in height; branching ?; hydrothecal margin entire; gonotheca ?	? *O. pygmaea* Coughtrey, 1876. (Possibly a young stem of *O. longissima*)
10	(7)	Diaphragm usually oblique; erect stem short, about 15 mm in height; primary and secondary branching alternate; hydrothecal margin distinctly waved; gonotheca with 3 or 4 inflations, and aperture usually has obvious collar .	*O. nodosa* Bale, 1924

Six species of *Obelia*—viz., *O. geniculata* (Linnaeus, 1758), ? *O. pygmaea* Coughtrey, 1876, *O. australis* von Lendenfeld, 1885, *O. nigrocaulus* Hilgendorf, 1898, *O. coughtreyi* Bale, 1924, and *O. nodosa* Bale, 1924, were recorded previously from New Zealand waters. *O. coughtreyi* will be shown to be *O. longissima* (Pallas, 1766), ? *O. pygmaea, O. nigrocaulus* and *O. nodosa* are recorded only for New Zealand; *O. australis* is known also from several Australian localities, Tasmania and the Gulf of Manaar; *O. longissima* is widely distributed in North American and European waters, and *O. geniculata* throughout the waters of both northern and southern hemispheres.

In New Zealand waters *O. geniculata* is found principally on the east coast of both the North and South Islands and in the subantarctic area. A discussion of the correlation between size and branching and latitudinal distribution is given by Ralph (1956). *O. australis* is known from the east coast of the South Island and Wellington and the Bay of Plenty in the North Island, *O. longissima* from the east coast of the South Island and ? *O. pygmaea, O. nigrocaulus* and *O. nodosa* only from their respective type localities, Otago Harbour and Waitakerei. The type locality of *O. nodosa,* Waitakerei, is usually spelled without the final "i" and is an inland township. Presumably the collector of *O. nodosa* (Chilton) meant the well known west coast beach of Bethells, the road to which is routed through Waitakere.

The generic status of ? *O. pygmaea* and *O. nigrocaulus* from Otago Harbour is doubtful as the structures produced by the reproductive zooid are unknown. The erect stem height of these species is described as being about 15.0 mm, but ? *O. nigrocaulus* can be easily distinguished from ? *O. pygmaea* and from other *Obelia* species from this country as the proximal portion of the stem in the former species is black but "quite transparent" distally, and the hydrothecae are found only on the distal ends of the branches. The characters described and figured by Coughtrey (1876a) for ? *O. pygmaea* are inadequate for determination of its specific status. As known at present, ? *O. pygmaea* is most nearly related to *O. longissima* (Pallas) as the figured fragment of the stem and branch of the former species shows the hydrotheca with variable length to breadth ratio, either deeply bell-shaped or broadly bell-shaped with length and breadth nearly equal, an entire margin and a horizontal diaphragm. *O. longissima* is known from Little Papanui, on the Otago coast, but in this locality it shows the hydrotheca deeply bell-shaped and usually with a waved margin. ? *O. pygmaea* as described from Otago Harbour has erect stem characters rather similar to some material of *O. longissima* from Christchurch, further

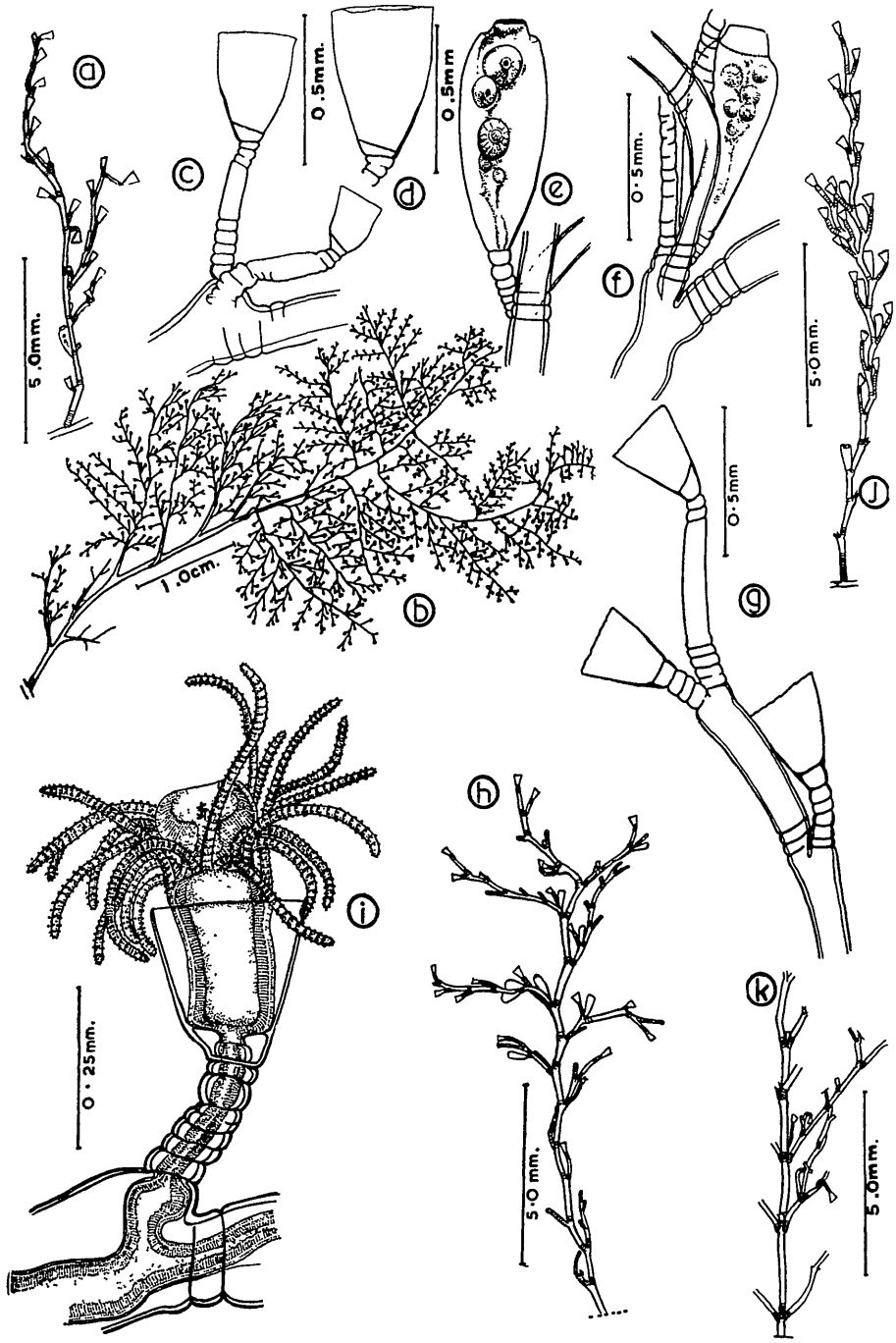
north, in which the hydrotheca is variable in shape and the margin usually entire. No type specimen is known to exist for either ? *O. pygmaea* or ? *O. nigrocaulus.*

O. nodosa and *O. coughtreyi* were described as new by Bale in 1924 from material collected respectively at ? Bethells, Auckland and Taylor's Mistake, Christchurch. A footnote by Chilton to page 1 of Bale's paper states that the material examined by Bale was deposited with the Canterbury Museum. This was made available to me for study. Unfortunately none of the mounted material was labelled as holotype, but by checking Bale's descriptions and figures of the species against the mounted specimens it seems certain that the slides loaned to me by the Canterbury Museum were those from which Bale derived the specific descriptions of *O. nodosa* and *O. coughtreyi.* These slides are now labelled. *O. nodosa* is Canterbury Museum slide No. 12, and *O. coughtreyi* (now *O. longissima* (Pallas)), Canterbury Museum Slide No. 10. Spirit material of both species was clearly labelled as paratype. Some of this material is now mounted, *O. nodosa* on Slide No. 13 and *O. coughtreyi* on Slide No. 11.

Bale (1924) describes *O. coughtreyi* from Taylor's Mistake as a species with erect stems " about 1 inch in height, monosiphonic (?) slightly flexuous below, very strongly above; internodes with a few distinct rings at the lower end, at the top supporting a hydrotheca with a ringed peduncle; a branch or a gonotheca or both springing from the axil; hydrotheca campanulate, margin of young hydrotheca with from 10 to 14 undulations, old hydrotheca undulations obscure, margin appearing simply ragged; diaphragm often appearing somewhat oblique: gonotheca on short annulated peduncle, large, widest at the distal end with shallow, scarcely tubular collar; wall may be slightly undulated."

On the evidence of the *Obelia* material in the present collection from the type locality of *O. coughtreyi,* Taylor's Mistake, and from other South Island locations, principally Kaikoura, and Little Papanui, Dunedin, *O. coughtreyi* is a synonym of the very variable and essentially cosmopolitan *O. longissima* (Pallas). Some *Obelia* colonies from Taylor's Mistake have erect stems from about 6·0 mm to 80·0 mm, these latter being nearly four times the height of Bale's specimens of *O. coughtreyi.* The hydrothecae and gonothecae are, however, similar to those of the latter species. This suggests that Bale's material of *O. coughtreyi,* although mature, had not reached maximum height. The different branching habit of the short and tall stems also suggests this conclusion. Branching in short stems up to about 40·0 mm and still in active growth, is alternate and similar in habit to that described by Bale for *O. coughtreyi,* but tall stems above this height have the primary branches alternate, but the secondary, tertiary, etc., forked, the arms of the fork spreading in opposite directions so that the whole stem has a conical appearance (Fig. 5, e). Stem fragments of the " paratype " collection of *O. coughtreyi* (Fig. 4, k) give some indication of forked secondary branching. Other *Obelia* material, notably that from Kaikoura, possesses similar hydrothecal and gonothecal characters to that from Taylor's Mistake, and therefore to *O. coughtreyi,* but tall erect stems from Little Papanui, although showing a similar branching habit to tall stems described above, have hydrothecae with the length clearly greater than the breadth (Fig. 5, f) instead of almost equal, and an undulating margin on many old as well as newly formed hydrothecae (Fig. 5, g). The gonothecae of specimens from Little Papanui are the same as those known on tall colonies from Taylor's Mistake and Kaikoura—i.e., rather truncate at the distal end with slightly elevated collar, and sometimes with undulated walls (Fig. 5, h). Clearly these colonies from Little Papanui also, as well as those described above, are closely related if not identical with what Bale considered as *O. coughtreyi.*

Broch (1918), Jaderholm (1917) and others have shown that the hydrothecal margin of *O. longissima* (Pallas) may be entire or waved, the cup deeply or broadly bell-shaped; the stem sometimes with the secondary branches forked, at others



TEXT-FIG. 4.—a–h, *Obelia australis* von Lendenfeld. a–e, from Wellington Harbour; f–h, from Lyttelton Harbour; i, *Obelia geniculata* (Linnaeus). j–k, *Obelia longissima* (Pallas) erect stems from Taylor's Mistake (from Bale's " type " material for " *O. coughtreyi* ").

alternate, and that the gonothecae may have undulated walls. These are the characters shown by material from the South Island locations described above and determine such material as *O. longissima* and *O. coughtreyi* becomes a synonym of this cosmopolitan species.

Examination of the type material of *O. nodosa* from Waitakere, Auckland, suggests that this species also may have been described from specimens that had not reached maximum height and that the material may be only a growth form of *O. longissima.* The erect stems are short, about 15·0 mm in height; the hydrothecae have the length and breadth nearly equal and a waved margin; the gonotheca usually has 3 or 4 very clearly marked inflations. These characters are those of a young colony of *O. longissima,* but except for this material is not known from the North Island. The type material of *O. nodosa* is inadequate for a firm decision on the status of the species, and for the present *O. nodosa* is recognised as distinct, the gonothecae having 3 or 4 well marked inflations, being narrower at the distal end, and having a taller collar than the gonothecae of *O. longissima* from the South Island.

Colonies of *O. australis* von Lendenfeld show that tall, much branched erect stems are to be found in colder-water regions and that height and branching decreases in warmer water, as stems from Wellington Harbour (Intermediate zone) are 50.0 mm to 80.0 mm in height (Fig. 4, b) while those from Tauranga and Tasmania (Subtropical zone) are known only up to 20·0 mm and 40·0 mm respectively. Some doubt as to the specific status of *O. australis* has been expressed (Hartlaub, 1905, p. 580; Mayer, 1910, p. 246), but as Blackburn (1937, p. 175) remarks, the strongly oblique diaphragm of *O. australis* as at present known separates it from the closely allied *O. dichotoma.*

Obelia australis von Lendenfeld, 1885. Text-fig. 4, a-h.

1885. *O. australis* von Lendenfeld, pp. 604 & 920, Pl. XLIII, Figs. 19–22.
1901. *O. australis* von Lendenfeld. Hartlaub, p 367.
1924. *O. australis* von Lendenfeld. Bale, p. 231
1928. *O. australis* von Lendenfeld. Trebilcock, p 2.
1952 *O. australis* von Lendenfeld. Ralph & Hurley, p. 8.

Erect stem sympodial, monosiphonic up to 80 0 mm in length, tall stems with primary branches regularly alternate, otherwise branching irregular; proximal internodes 1·30 mm to 1·75 mm in length and 0 093 to 0·21 mm in width; about 12 annulations at base of stem, 3 to 5 distal to the hydrothecal pedicels and from 6 to 10 at the junction of each branch and the stem; hydrothecal pedicels annulated throughout or at proximal and distal end with central region smooth, if completely annulated up to 20 annulations but usually about 12, if with smooth central region about 6 proximal annulations and about 4 distal; hydrothecae alternate, with delicate thin walls not constricted at the level of the diaphragm, which is very oblique, hydrothecae 0·37 to 0 53 mm in length, 0 25 to 0 37 mm in breadth at the margin; margin usually entire but may be undulated; hydranth with 12 to 20 tentacles· gonotheca urn-shaped (somewhat tapered at each end) arising by short pedicel with from 3 to 6 annuli from axil of a branch, hydrotheca or both; distinct collar surrounding small terminal aperture; gonotheca 0 80 to 1·125 mm in total length, 0 25 to 0 31 mm in greatest width, which occurs at a point about ⅔ from proximal end; collar about 0·125 mm in diameter and about 0·062 mm deep.

Locality: Type locality, laminarian zone, Sumner, Christchurch, New Zealand. Tauranga, Bay of Plenty, drift (P.M.R.), 12/2/53, 329; Wellington Harbour, wharf-pile (P.M.R.), —/11/50, 437; French Pass (Hartlaub, 1901); Lyttelton (Bale, 1924), Canterbury Mus. Slide No. 9; St. Clair, Dunedin (Trebilcock, 1928).

Distribution: New Zealand; Australia; Tasmania; Ceylon.

Obelia geniculata (Linnaeus, 1758). Text-fig. 4, i.

A description of this species and its varietal forms is given by Ralph (1956). It should be noted, however, that the Antarctic Convergence lies approximately 12 degrees further south of the Chatham Islands (cf. Mackintosh, 1946) than is shown in Ralph's Text-figs. 1, a and 2, a.

1875. *Laomedea geniculata* (Linnaeus). Coughtrey, p. 290, Pl. XX, Fig. 42.
1876. *Obelia geniculata* (Linnaeus). Idem, p. 299.
1876a. *Obelia geniculata* (Linnaeus). Idem, p 24
1890. *Obelia geniculata* (Linnaeus). Marktanner-Turneretscher, p. 208, Pl. III, Fig. 9.
1898. *Obelia geniculata* (Linnaeus). Hilgendorf, p. 204.
1901. *Obelia geniculata* (Linnaeus). Hartlaub, p. 362.
1915. *Obelia geniculata* (Linnaeus). Nutting, p. 73, Pl. 18, Figs. 1–5 (synonymy).
1924. *Obelia geniculata* (Linnaeus). Bale, p. 230.
1928. *Obelia geniculata* (Linnaeus). Trebilcock, p. 2.
1946. *O. geniculata* Linnaeus. Mendes, p. 551, Pl. 2, Figs 14–15.
1950. *O. geniculata* Linnaeus Hodgson, p. 3, Figs. 1–3.

forma **subtropica**

1946. *O. geniculata* Linnaeus. Mendes, p. 551, Pl. 2, Figs. 14–15.
1950. *O. geniculata* Linnaeus. Hodgson, p. 3, Figs. 1–3.

LOCALITY: Bay of Islands, intertidal rock pool (P.M.R.), 29/11/50; Glendowie, Auckland (J. Trevarthen), —/11/54, 456.

forma **intermedia**

LOCALITY: Wellington Harbour (P.M.R.), 15/3/53, 457; Menzies Bay, Christchurch (B. Allison), 1/5/49, 459; Dunedin Harbour (P.M.R.), 26/11/51, 266.

forma **subantarctica**

LOCALITY: Off Cape Turakirae (L. R. Richardson), —/1/56, 458; pole of beacon, Stn. 69/52, 14 fath., 43° 25·2′ S/172° 56·7′ E (= off Kaikoura), H.M.N.Z.S. "Lachlan", 26/3/52, 291; Stn. 2, Mernoo Bank (drift) "Chatham Exped., 1954" 23/1/54, Chatham Exp. slide No. 1; Antipodes Is. (R. K. Dell), 7/11/50, 158; Macquarie Is., Lusitania Bay, 29/8/48, A.N.A.R.E. Slide No. 1; Kerguelen, —/2/50, A.N.A.R.E. Slide No. 2.

forma **indet.**

LOCALITY: Rangitoto Is., Auckland (Hartlaub, 1901); Island Bay, Wellington (Trebilcock, 1928); Kapiti Is., drift, 24/5/51, 162; Titahi Bay, intertidal rock pool (M. Davidson), 16/6/51, 166; New Brighton, Christchurch (Trebilcock, 1928); Sumner, Christchurch (C. Chilton), —/4/03, Canterbury Museum Slide No. 6; Oamaru (C. B. Morris), 30/4/11, Canterbury Museum Slide No. 7; Campbell Is. (Jaderholm, 1926); Auckland Is. (Hickson & Gravely, 1907).

DISTRIBUTION: Of widespread occurrence in both northern and southern hemispheres.

Obelia longissima (Pallas, 1766). Text-figs. 4, j & k; 5, a-h.

1766. *Sertularia longissima* Pallas. Elenchus zoophytorum, p. 119.
1868. *Obelia longissima* (Pallas). Hincks, p. 154, Pl. XXVII.
1918. *Laomedea longissima* (Pallas). Broch, p. 167.
—— *Obelia flabellata* (Hincks). Broch, p. 167.
1924. *Obelia coughtreyi* Bale, p. 230, Fig. 2.
1944. *Obelia flabellata* (Hincks). Fraser, p. 157, Pl. 28, Fig. 129.
1953. *Obelia longissima* (Pallas). Russell, p. 302, Text-fig. 185c.

Erect stem sympodial, monosiphonic, up to 80·0 mm in length; primary branches on erect stems above about 35 0 mm in length, regularly alternate, secondary, tertiary, etc., branches usually forked; tall erect stems conical in general appearance; stems up to 35·0 mm in length, branches irregular, alternate in arrangement; main stem with 6 to 16 annulations at the base; stem internodes, 1·062 to 2·12 mm in length about 0·19 mm in width; branch internodes 0·62 mm to 0·88 mm in length; 4 to 8 annuli on the main stem above the nodes, 2 to 4 on the branches; hydrothecal

pedicel annulated throughout (5 to 7 annuli), or annulated at each extremity with 3 to 4 annuli and middle region smooth; hydrothecae usually longer than wide, but some with length and breadth equal; 0·31 to 0·43 mm in length, 0·25 to 0·37 mm in width at the margin; margin of hydrotheca variable, smooth, undulated or toothed; diaphragm usually straight but may be oblique; hydranth with about 18 to 26 tentacles: gonotheca borne on short pedicel with 2 to 4 annuli in axil of stem, branch or hydrotheca; gonotheca rather variable in shape, usually tapering from broad truncate distal end to pedicel; wall usually smooth but may have distinct undulations; 0·85 mm to 1·0 mm in length, 0·25 to 0·35 mm in greatest width; collar about terminal aperture small, 0·031 to 0·062 mm in height, 0·12 to 0·21 mm wide.

LOCALITY: Type locality, coasts of Belgium (Pallas). Pole of beacon, Stn. No. 69/52, 14 fathoms, 43° 25·2S/172° 56·7 E (= off Kaikoura), H.M.N.Z.S. "Lachlan," 26/3/52, 291; Taylor's Mistake, Christchurch (B. Allison), 18/9/55, 460; Heathcote Estuary, Christchurch (P.M.R.), 15/11/51, 247; Little Papanui, Dunedin (E. Batham), 25/4/55, 461.

DISTRIBUTION: Wide occurrence in both northern and southern hemispheres.

? **Obelia pygmaea** Coughtrey, 1875.

1876a. ? *Obelia pygmaea* Coughtrey, p. 25, Pl. 111, Fig. 3.

Stems profuse arising from a filamentous hydrorhiza; hydrocauli branching, up to ¾in in height, very delicate and transparent; branches ringed above their origin with the hydrocaulus, and hydrocaulus strongly ringed above the branch origin; internodes with from 6 to 20 rings irregularly arranged; hydrotheca broadly campanulate with entire rim; extremity of branches have 2 hydrothecae; pedicels of hydrothecae with from 10 to 15 rings: reproductive zooid unknown. (Coughtrey.)

TYPE LOCALITY: Dunedin.

DISTRIBUTION: New Zealand, and not recognised by any worker since Coughtrey's original account; is possibly a young form of *O. longissima.*

Obelia nodosa Bale, 1924. Text-fig. 5, i-k.

1924. *Obelia nodosa* Bale, p. 230, Fig. 1.

Hydrorhiza, 0·125 to 0·187 mm in diameter; erect stem about 15·0 mm in height, with irregular alternate branching, monosiphonic, or may be slightly fasciculated at the base, nearly straight below, flexuous above; proximal internodes about 1·0 mm in length, distal 0·5 mm, 3 to 6 annuli above the node; hydrothecal pedicel annulated throughout or annuli at proximal and distal extremities and smooth middle region, when incompletely annulated 8 to 13 annuli in proximal region and 4 to 6 distally; 9 to 12 annuli above junction of hydrocaulus and hydrorhiza; hydrotheca length and width about equal, 0·31 to 0·37 mm in length and 0·25 to 0·31 mm in width, margin usually slightly everted, and undulated; diaphragm usually oblique: gonotheca axillary, 0·875 to 1·0 mm in length and 0·25 to 0·31 mm in breadth at the widest point, with 3 to 4 distinct equal to subequal inflations, terminal aperture rather narrow about 0·12 mm in diameter with collar about 0·093 mm in height, pedicel short, 3 to 5 annuli. Description from Bale's type material (Canterbury Museum Slide No. 12).

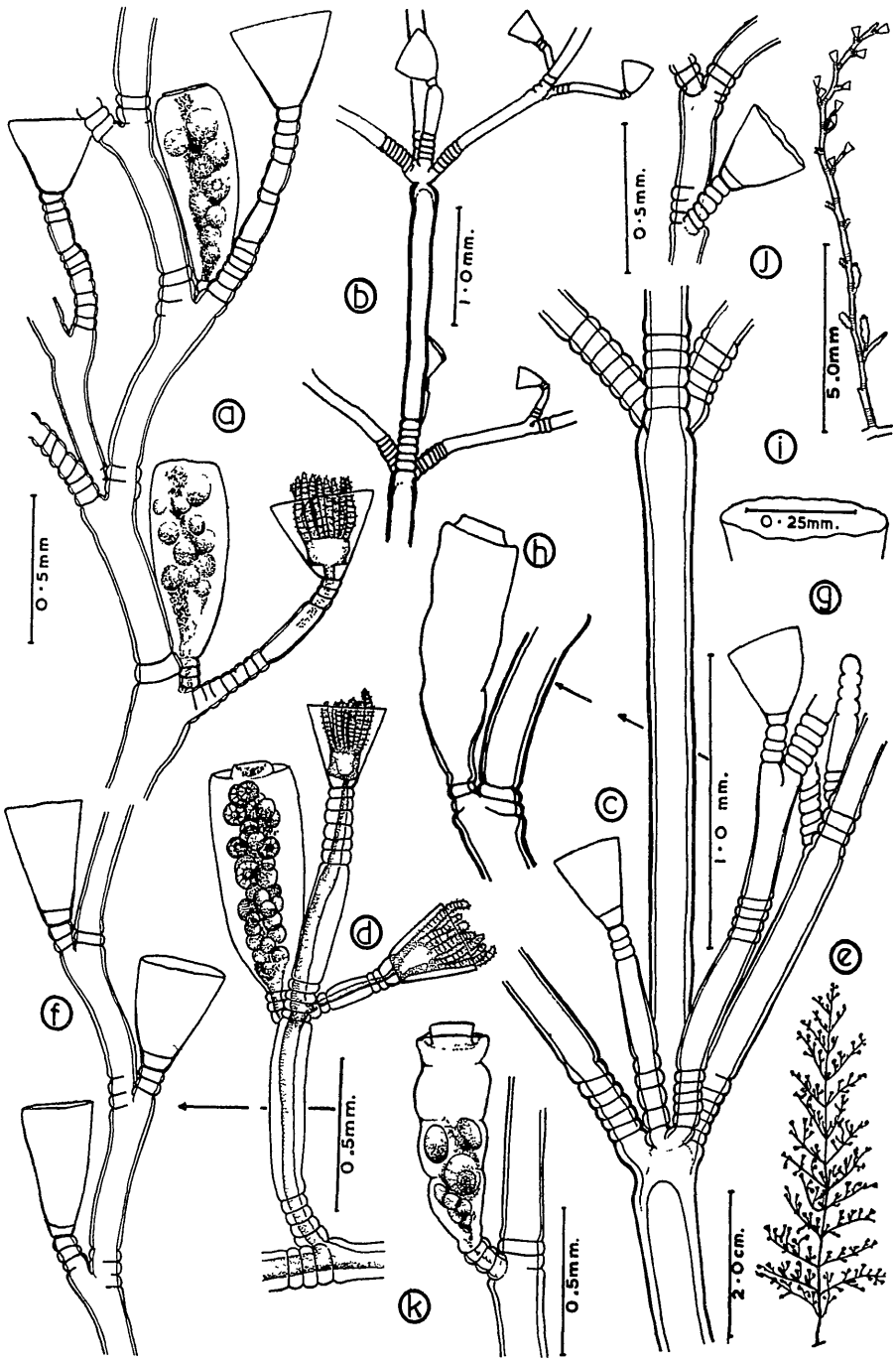
LOCALITY: Known only from the type locality, Waitakere, Auckland.

? **Obelia nigrocaulus** Hilgendorf, 1898.

1898. *Obelia nigrocaulus* Hilgendorf, p. 203, Pl. XVII, Fig. 1.

Stem irregularly branched, branches annulated with 6 to 7 annulations at the proximal end of the internode; basal part of the stem deep black, median region dark brown, upper region light brown, distal branches "quite transparent"; hydrothecae only on the distal ends of branches, pedicels annulated and almost as long as the thecae; margin entire: reproductive zooid and gonotheca unknown.

LOCALITY: Type locality, Dunedin Harbour, on stones under wharves. Not known other than the original material, apparently no longer available.



TEXT-FIG. 5.—a, *Obelia longissima* (Pallas) portion of erect stem from Taylor's Mistake (from Bale's "type" material for "*O. coughtreyi*"); b–h, *O. longissima*. b, from Taylor's Mistake; c–e, from off Kaikoura; f–h, from Little Papanui, Dunedin. i–k, *Obelia nodosa* Bale (from Bale's type material).

Genus Orthopyxis Agassiz, A., 1865

1862. *Clytia* (*Orthopyxis*) Agassiz.
1865. *Orthopyxis* A. Agassiz.
1883. *Eucopella* von Lendenfeld (in part).

Erect stem unbranched arising from a stolon; hydrotheca radially symmetrical with thick walls but within which the hydranth can be completely retracted; hydranth without a body "caecum": reproductive zooid produces a eumedusoid without mouth or digestive cavity.

The status of this genus has been discussed at length by Fraser (1918, p. 347) and Bale (1914, p. 72 and 1919, p. 331). *Orthopyxis* A. Agassiz not *Eucopella* von Lendenfeld, is now generally recognised as the proper genus for species with the above characters.

Key to the New Zealand Species of Orthopyxis.

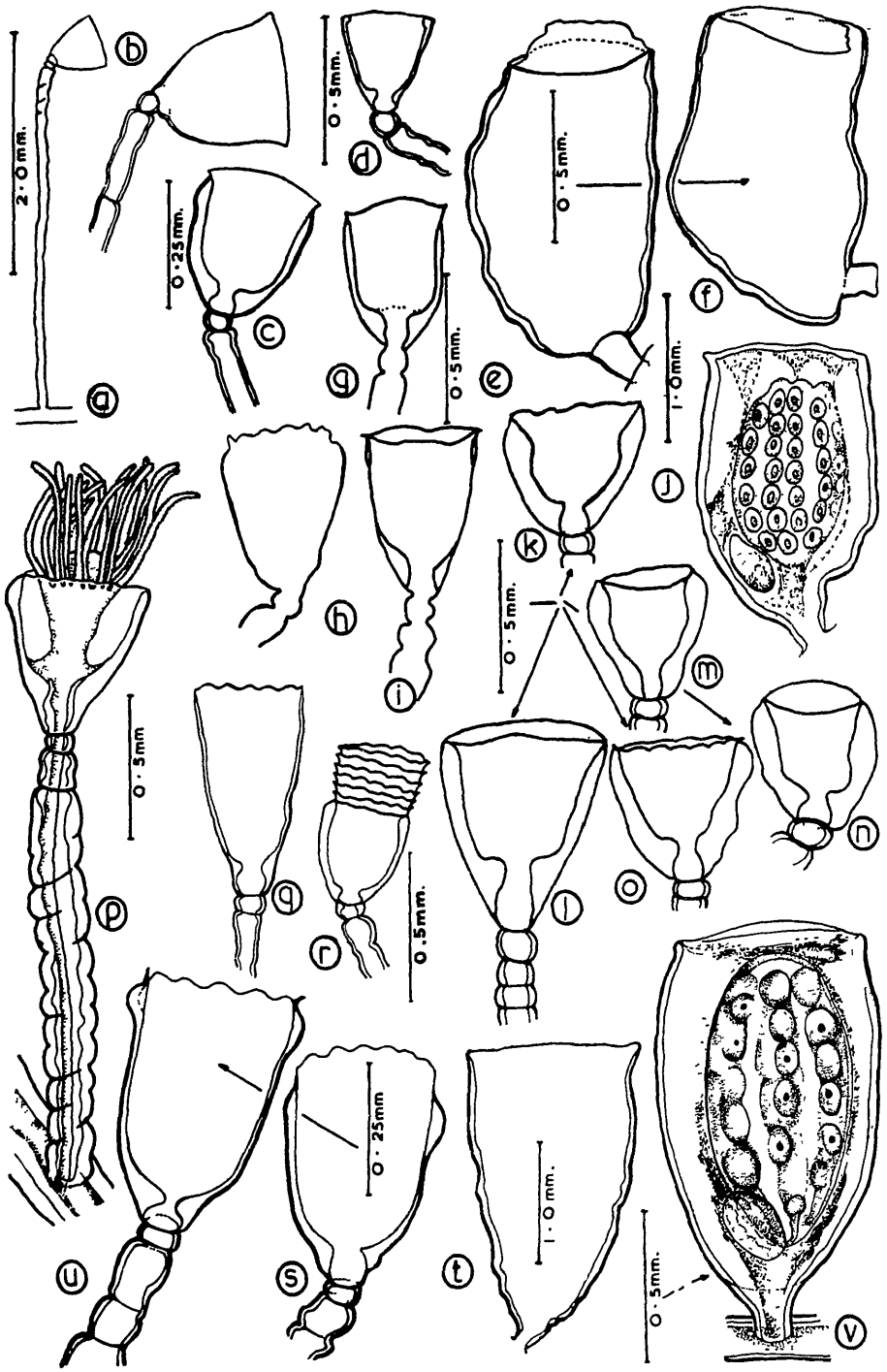
1	(2)	All hydrothecae with smooth margin: hydrotheca variable in shape, sometimes laterally compressed so that narrow and broader sides distinguishable; narrow sides may have a submarginal swelling; gonotheca slightly compressed, truncate but rounded at the distal end, up to 1·8 mm in length . . .	*O. caliculata* (Hincks, 1853)
2	(1)	Not all hydrothecae with smooth margin.	
3	(4)	Margin of hydrotheca variable, smooth, wavy or toothed and these variations found on the hydrothecae of one colony but in no constant percentage: gonothecae strongly compressed, about 1.75 mm in length, truncate at distal end with 2 lateral projections	*O. crenata* (Hartlaub, 1901) forma *crenata*
4	(3)	Margin of hydrotheca toothed.	
5	(6)	Hydrotheca elongate bell-shaped; length about twice the width, 0.40 to 0.50 mm in length; margin with 8 to 12 rather tall, bluntly pointed teeth: gonotheca not compressed, oval in general appearance, pedicel annulated or with 2 to 4 well defined twists .	*O. mollis* (Stechow, 1919)
6	(5)	Hydrotheca broadly bell-shaped, length and width often almost equal.	
7	(8)	Hydrotheca with 12 to 14 low rounded teeth; double and multiple margins of common occurrence; walls variable in thickness but narrow sides usually thicker than broader sides: gonotheca as for *O. crenata* forma *typica*	*O. crenata* forma *subtropica* n. forma.
8	(7)	Hydrotheca with 8 to 15 well defined teeth, higher than those of *O. crenata* forma *subtropica;* hydrotheca slightly compressed, widening considerably from the base to the aperture, which is nearly circular; gonotheca "pear-shaped" about 1.2 mm in length	*O. delicata* Trebilcock, 1928

Four species of *Orthopyxis* were previously recorded for this country, *O. caliculata* (Hincks, 1853), *O. crenata* (Hartlaub, 1901), *O. delicata* Trebilcock, 1928 and *O. formosa* Trebilcock, 1928. A fifth species *O. mollis* (Stechow, 1919) is here recorded for the first time from New Zealand. Of the above, *O. caliculata* is essentially cosmopolitan. *O. crenata* has been recorded also from Gambier Is. (Billard, 1905), Tierra del Fuego (Hartlaub, 1905), Sargasso Sea (Billard, 1907), "S.W. Australia" (Stechow, 1925) and the Mediterranean (Picard, 1951, as *Campanularia crenata* forma *intermedia*). *O. delicata* is known only from New Zealand, while *O. mollis* is known from the Mediterranean (Picard, 1951). It is shown below that Hartlaub's (1905), Billard's (1907) and Picard's (1951) records are not *O. crenata* as at present known. *O. formosa* Trebilcock is here regarded as a subtropical form of *O. crenata*.

The New Zealand material of the genus *Orthopyxis* is difficult to separate into species, which has been the common experience with *Orthopyxis* in other countries. Authors rarely agree on the species of the genus. The characters of the hydrotheca have been widely used in specific determination, particularly the structure of the margin, the general form, and position of bands of thickening in relation to the margin. All workers agree that these hydrothecal characters are variable and therefore likely to be unreliable for separating species. Many hydrothecae must be observed before the full range of variation is known, and this applies also, but to a lesser extent, to the gonothecal characters. Examination of insufficient material has led to much confusion in species, and as Broch (1948, p. 16) says, only " a thorough revision based upon detailed examination both of the polyps and gonophores will separate species of the entangled *Orthopyxis*-group ". Such a project is outside the scope of this paper.

It appears from some New Zealand material of *O. caliculata* that the Australian species *O. macrogona* is a growth form of the cosmopolitan *O. caliculata.* This New Zealand material shows many hydrothecae somewhat compressed as in *O. macrogona* with the narrow sides thicker than the broader sides and with a distinct submarginal swelling (Fig. 6, c and d), but this rarely forms a complete annulus as is described for *O. macrogona.* The gonothecae of the above New Zealand material are smaller, but of a shape similar to those described for *O. macrogona.* Other material from New Zealand of *O. caliculata* has the wall of the hydrotheca more evenly thickened (Fig. 6, b) as described and figured by Hincks (1868), but the gonothecae larger than the above material, almost as large (1·45 mm in length) as those of *O. macrogona* (about 1·65 to 1·87 mm in length). This view that *O. macrogona* may only be a form of *O. caliculata* is in agreement with von Lendenfeld, who originally recognised his material as a distinct form of *O. caliculata.* This form was raised by Bale to full specific status as *O. macrogona,* bceause the hydrothecae were more compressed, the walls thickened by a submarginal band, and the gonothecae were larger than those known for *O. caliculata.* The New Zealand material clearly *O. caliculata* shows that such characters are sufficiently variable to be unreliable for distinguishing *O. macrogona* as a separate species.

Only two species of *Orthopyxis* are known in which the margin of the hydrotheca is variable in form, *O. crenata* originally described by Hartlaub (1901) from French Pass, New Zealand, and now known from several other New Zealand and Southern Hemisphere localities, and *O. everta,* known from several localities on the Pacific coast of North America. Stechow (1925, p. 211) examined material of *O. everta* from Monterey Bay, California, and concluded that although a constant resemblance exists between it and *O. crenata* forma *crenata,* the former species is larger and more robust, with hydrothecae about 0·65 to 0·95 mm in length and 0·48 to 0·60 mm in breadth; and hydrocauli up to 6·0 mm. Other material of *O. everta* from the Pacific coast of North America, however (Fraser, 1937, Pl. 16, Fig. 78), shows hydrothecae of 0·56 and 0·67 mm in length and 0·40 and 0·45 mm in breadth, sizes similar to those known for the larger specimens of *O. crenata.* Hydrothecae of *O. crenata* range in length from 0·37 to 0·68 mm, and in this range 40% are 0·50 mm in length. There is no significant change in size of the hydrotheca from south to north as there is in the closely allied campanularian *Silicularia bilabiata* (Coughtrey) (Ralph, 1956). Because of the wide variation in hydrothecal size that may occur in *O. everta,* it seems clear that *O. everta* and *O. crenata* cannot be separated on this character alone. Stechow does not compare the gonothecae. The characters of these structures, however, determine the species as distinct. The greater compression, very truncate distal end and the two lateral projections from it (Fig. 6, t & v) clearly separate the female gonothecae of *O. crenata* (male gonotheca unknown) from those of *O. everta.* (Fraser, 1937, Pl. 16, Fig. 78.)



TEXT-FIG. 6.—a–f, *Orthopyxis caliculata* (Hincks). g–v, *Orthopyxis crenata* (Hartlaub, 1901). g–p and v, *O. crenata* forma *crenata*. g–j (after Hartlaub, 1901, Pl. 22, Figs. 27, 29 and 30); k, l and p, from Wellington Harbour; m–o, from Lyttelton Harbour; v, gonotheca, from Otago Harbour; q–u, *O. crenata* forma *subtropica*. q and r, from Blueskin Bay, Otago; s and t, from Waitemata Harbour entrance (Glendowie) Auckland; u, from Waitemata Harbour, Auckland (from Trebilcock's "type" material of "*O. formosa*").

O. mollis, O. delicata and *O. crenata* forma *subtropica* from New Zealand belong to the group of *Orthopyxis* species in which the hydrothecal margin is uniformly toothed. The narrow, elongate, bell-shaped hydrothecae of *O. mollis* (Fig. 7, g) are distinctive and readily distinguish this species from *O. delicata* and *O. crenata* forma *subtropica.* The marginal teeth of the hydrotheca, however, do not exhibit the slight indentation of the tip described by Picard (1951) for *O. mollis.* In a few cases, the pedicel of the gonotheca appears annulated as originally described by Stechow (1919) and not just strongly twisted as in Picard's specimens. It is probable that the full range of hydrothecal and gonothecal characters of *O. mollis* has not yet been observed.

The hydrothecae of *O. delicata* are more broadly bell-shaped than those of *O. mollis.* In *O. delicata* the hydrotheca widens considerably from base to aperture, which is nearly circular, and the walls are usually evenly thickened. Gonothecae are absent on the specimens of *O. delicata* in the present collection. The specific status of this material is therefore somewhat doubtful because of the similarity of the hydrotheca of *O. delicata* to that of *O. lennoxensis* (Jaderholm) from Patagonia. The erect stems of *O. delicata* in the present collection, however, although of smaller size, possess hydrothecae with characters identical with those of the type of *O. delicata* kindly loaned me by Lieut.-Colonel Trebilcock. The tall hydrothecal teeth and the hydrothecal shape of Billard's (1907) material of ? *O. crenata* from the Sargasso Sea recall *O. delicata* Trebilcock from New Zealand. Billard's material, known to me only from the literature, lacked gonothecae, so its specific status is doubtful.

The hydrothecae of *O. crenata* forma *subtropica* differ from those of *O. delicata* as they are usually more compressed with the narrow sides thicker than the broader sides, double and multiple margins are of common occurrence and the teeth are lower. Not all records of *O. crenata* (see above) in which the margin of the hydrotheca is described as toothed can be recognised as *O. crenata* forma *subtropica.* Although Hartlaub's (1905) material of *O. crenata* from Tierra del Fuego and that which Picard (1951) records as *Campanularia crenata* forma *intermedia* Stechow from Rovigno, in the Adriatic (both of which are known to me only from the literature) bear a general resemblance to the erect stem of *O. crenata* forma *subtropica* the marginal teeth of the hydrotheca in Hartlaub's and Picard's specimens are figured as tall and are more sharply pointed than the low rounded teeth at present known for this form of *O. crenata.* For this reason, Hartlaub's and Picard's records are not recognised here as *O. crenata.* The specific status of their material is doubtful as gonothecae are not known for Hartlaub's specimens and inadequately known for Picard's. Bale (1924), however, and others give Hartlaub's material as a synonym of *O. lennoxensis* (Jaderholm). Mendes (1946) recognises *C. crenata* forma *intermedia* Stechow as *C. intermedia* Stechow and regards this latter species as a synonym of *Campanularia hesperia.* The most that can be said at present is that specimens of "*O. crenata*" described by Hartlaub (1905) and Picard are more nearly related to *O. lennoxensis* and *C. hesperia,* both species with tall, more sharply pointed teeth, than to material with low rounded teeth here recognised as *O. crenata* forma *subtropica.*

Fertile material in the present collection of *O crenata* forma *subtropica* from the type locality, Waitemata Harbour, of *O. formosa* Trebilcock, 1928 demonstrates that this latter species is a synonym of *O. crenata* forma *subtropica.* Trebilcock's (1928, Pl. 1, Fig. 2C) paper shows the hydrotheca of *O. formosa* 1·52 mm in length This is unusually long for any species of *Orthopyxis* in New Zealand—i.e., more than twice the tallest known hydrotheca (0·68 mm in length) found on a colony of *O. crenata* forma *crenata* from Wellington Harbour. It therefore seemed probable that the magnification of × 20 (p. 27 and 28) was a typographical error, and should read × 50. Through the courtesy of Lieut.-Colonel Trebilcock I was able to examine the type of *O. formosa.* It was found that although fairly large, the tallest hydrotheca of

Trebilcock's type specimen was only 0·56 mm in length, a length similar to many hydrothecae of *O. crenata* forma *subtropica* from Waitemata Harbour. The erect stem characters, then, of *O. crenata* forma *subtropica* from Waitemata Harbour are alike in all respects to those known for *O. formosa,* even to " abnormal " hydrothecae figured and described by Trebilcock, and *O. formosa* is regarded here as a synonym of *O. crenata* forma *subtropica.*

Orthopyxis caliculata (Hincks, 1853). Text-fig. 6, a-f.

1875. ***Campanularia integra*** McGillivray. Coughtrey, p. 291.
1876. ***Campanularia caliculata*** Hincks. Coughtrey, p. 299.
1885. ***Campanulina caliculata*** von Lendenfeld. Von Lendenfeld, p. 910.
1896. ***C. caliculata*** var. *macrogona* von Lendenfeld. Farquhar, p. 459.
1924. ***Orthopyxis caliculata*** (Hincks). Bale, p. 232.
1944. ***Eucopella caliculata*** (Hincks). Fraser, p. 146, Pl. 26, Fig. 119. (Synonymy.)

Colony stolonal, hydrorhiza flattened on the attached surface, and with a lateral flange, width about 0·31 mm and flange about 0·062 mm; hydrocaulus unbranched serving as the pedicel of the hydranth, variable in length from 1·0 mm to about 4·0 mm, usually undulated throughout, but may have smooth regions of variable length; pedicel about 0·125 mm in diameter, with thick perisarc about 0·31 mm; single spherule below the hydrotheca about 0·093 mm in diameter; hydrotheca, usually deeper than broad, from 0·31 to 0·43 mm in depth, 0·27 to 0·37 mm in width; usually a thick wall (0·032 mm), margin entire, smooth, and may be slightlv everted, in broad aspect frequently a thickened region of perisarc immediately below the rim may be apparent; hydranth with about 20 tentacles: gonotheca large, 1·00 to 1.25 mm in length, 0·43 to 0·56 mm in width, irregularly ovate, wall smooth, or slightly undulated, variable in thickness, in broad aspect 0·31 to 0·125 mm thick, distal end variable in shape either rounded or truncate; pedicel short about 0·31 mm in length; two elongate oval medusoid gonophores present in gonotheca, one large, and a much smaller one below.

Locality: Type locality, Pegwell Bay, Ramsgate, England. Lyttelton Harbour (von Lendenfeld, 1885); ? Wellington Harbour (Coughtrey, 1875); Dunedin (Canterbury Museum Slide No. 14); Lyttelton Harbour (Canterbury Museum Slide No. 15); New Brighton (Canterbury Museum Slide No. 16); Woodpecker Bay, West Coast (G. Knox), 3/1/52, 393; Paraparaumu beach drift log (P.M.R.), 5/1/52, 274; Anawhata, Auckland (D. Kulka), 5/1/51, 462.

Distribution: Cosmopolitan.

Orthopyxis crenata (Hartlaub, 1901). Text-fig. 6, g-v.

1876a. ? ***Campanularia*** allied to ***C. caliculata*** Hincks. Coughtrey, p. 25, (footnote), Pl. III, Fig. 1.
1901. *Eucopella crenata* Hartlaub, p. 361, Pl. 22, Figs. 27–31, 33–35
1905. *Eucopella crenata* Hartlaub. Billard, p. 332, Fig. 4.
—— Not *Eucopella crenata* Hartlaub, p 568, Fig Q, a, b
1907. Not ***Eucopella crenata*** Hartlaub. Billard, p. 170, Fig. 3.
1915. Not *Orthopyxis crenata* (Hartlaub). Nutting, Pl. 16, Figs. 3–5.
1924. *Orthopyxis crenata* (Hartlaub). Bale, p. 232, Fig. 3.
—— *Eucopella crenata* Hartlaub. Stechow, p. 69.
1925 *Orthopyxis crenata* (Hartlaub). Stechow. p. 210.
1928. *Orthopyxis crenata* (Hartlaub). Trebilcock, p. 3.
—— *Orthopyxis formosa* Trebilcock, p. 2, Pl. I, Fig. 2.
1951. Not *Campanularia crenata* (Hartlaub) forma *intermedia* Stechow, 1919. Picard, p. 345.

forma **crenata**. Text-fig. 6, g-p, and v.

1876. ? ***Campanularia*** allied to ***C. caliculata*** Hincks. Coughtrey, p. 25.
1901. *Eucopella crenata* Hartlaub, p. 361, Pl. 22, Figs. 27–31, 33–35.
1924. *Orthopyxis crenata* (Hartlaub). Bale, p. 232, Fig. 3.
1928. *Orthopyxis crenata* (Hartlaub). Trebilcock, p. 3.

Colony stolonal, 0·75 to 4·0 mm in height; hydrorhiza sometimes circular in cross section, about 0·21 mm in diameter, otherwise more flattened, and tending

to an oval cross section; when of the latter type often with a flanged margin about 0·125 mm in width and with a total width of about 0·37 mm; hydrorhiza usually reticulate; hydrocaulus unbranched, serving as a pedicel for the hydranth, 0.35 mm to 3·5 mm in length and 0 093 to 0·15 mm in breadth, never smooth, usually strongly and evenly undulated throughout, but undulations may be more or less spiralled, perisarc up to 0·04 mm in thickness; a single spherule below the hydrotheca, 0·062 to 0·13 mm in diameter; usually some members of a colony showing definite constrictions in the pedicel marking "growth breaks" or regeneration; hydrothecae exceedingly variable, hydrothecal rims may be smooth, wavy, or definitely crenate with from 12 to 14 well defined teeth; all three rim types may appear on the one colony and when this is the case smooth-rimmed hydrothecae usually contribute less than 30% of the total; when only wavy and crenate rims present, they occur in no fixed proportion but toothed rims are usually dominant; the hydrothecal margin may be slightly everted in all three rim types; hydrothecal shape also very variable with length and breadth nearly equal, or length twice the breadth, or intermediate between these two extremes; hydrothecal length from 0·31 to 0·68 mm and 0·37 to 0·43 mm in breadth; the wall varies in thickness from 0·031 to 0·093 mm in broad view; wall thickening often greatest on narrow side of hydrotheca (this condition not always clearly seen in a mounted specimen); hydranth with about 14 tentacles: gonotheca, 1·25 to 1·75 mm in length, 0·62 to 0·94 mm in breadth, strongly compressed and narrowly oval in cross section with distal end distinctly truncate, perisarc about 0·031 mm in thickness and wall frequently irregularly undulated; usually a constriction immediately below the distal truncate end giving an angular shoulder process to the gonotheca; general aspect "ham-shaped", gradually tapering into the pedicel, which is smooth, and about 0·31 mm in length; 2 elongated oval eumedusoids present in the gonotheca, one large 0·87 to 0·94 mm in length and 0·43 to 0·50 mm in breadth, and a much smaller one below, 0·25 to 0·31 mm long and about 0·187 mm in width; ova about 0·125 mm by 0·093 mm and when present tend to obscure the branches of the four brown radial canals.

LOCALITY: Type locality, French Pass. Opunake beach, drift (P.M.R.), 2/2/53, 311; Makara beach, drift (J. Macken), 19/5/52, 463; Island Bay, Wellington (Trebilcock, 1928); Wellington Harbour (P.M.R.), 14/8/50, 148; French Pass (Hartlaub, 1901); Port Nelson (G. Knox), 4/1/52, 281; Lyttelton Harbour, Christchurch (C. Chilton), —/3/03, Canterbury Museum Slide No. 17 ,1/5/04 Cant. Mus. Slide No. 19; Timaru Harbour (G. Knox), —/5/52, 400; Portobello Marine Biological Station reef, Dunedin (E. J. Batham), 14/2/51, 175.

forma **subtropica** n. forma. Text-fig. 6, q-u

1905. *Eucopella crenata* Hartlaub. Billard, p. 332.
1924. *Eucopella crenata* Hartlaub. Stechow, p. 69.
1925. *Orthopyxis crenata* (Hartlaub). Stechow, p. 210.
1928. *Orthopyxis formosa* Trebilcock, p. 2, Pl. I, Fig. 2.

Latitudinal distribution mainly Subtropical water zone, occasionally Intermediate zone; margin of hydrotheca not variable, always with 12 to 14 well defined but low, rather rounded teeth; double and multiple margins of common occurrence: size of hydrorhiza, erect stem, and gonothecal shape and size as in forma *crenata*.

LOCALITY: Glendowie, Auckland (D. Kulka) —/—/—, 464; rock pool, 10 miles north of Thames, Coromandel Peninsula (P.M.R) 17/2/53, 340; rock pool 7 miles north of Gisborne (P.M.R), 15/2/53, 371; Stn. 17 "Kotuku" Expedition (off Hastings), 6 fathoms (J. Garrick), 22/5/52, 441; rock pool, Lion Island, New Plymouth (P.M.R.), —/2/56, 465; Blueskin Bay, Otago, 10 fathoms (D. E. Hurley), 1/10/52, 434.

DISTRIBUTION: New Zealand; Gambier Isles, west coast of Africa; Australia.

Orthopyxis delicata Trebilcock, 1928. Text-fig. 7, a-d.

1928. *Orthopyxis delicata* Trebilcock, p. 3, Pl. 2, Fig. 1.

Hydrorhiza broad, about 0·125 mm in width, slightly flattened, with small flanged margin; hydrocaulus unbranched serving as a pedicel for the hydrotheca 0·50 to 3·0 mm in height and about 0·12 mm in width with perisarc about 0·031 mm in thickness, strongly and spirally undulated throughout; a single spherule about 0·093 mm in diameter below each hydrotheca; hydrotheca slightly compressed in broad aspect with wide base, but widens considerably towards the aperture, which is nearly circular; walls in broad aspect thickened near the base, becoming thinner towards the rim, in narrow aspect much thinner throughout, no annular thickening round the rim; margin with from 8 to 15 rounded teeth, the emargination being usually the same shape as the tooth, hydrotheca of variable size, 0·25 to 0·50 mm in length and 0·25 to 0·50 mm in width, but in general the cup is deeper than wide: gonotheca on short (0·125 mm) smooth pedicel; somewhat pear-shaped but more rounded on one side than the other, about 1·2 mm in length and 0·62 mm in width.

Locality: Type locality, St. Clair, Dunedin (Trebilcock, 1928). East of Papanui Inlet, 40 fathoms (R. H. Graham), 23/4/30, 41; Palliser Bay, 90 fathoms (J. H. Sorensen), 13/7/51, 170; drift, seaweed holdfast Makara beach (V. Cassie), 25/8/52, 305a; Stn. 49, "Chatham Expedition 1954", 8/2/54, Port Hutt, rock pool, Slide No. 3.

Distribution: Known only from New Zealand.

Orthopyxis mollis (Stechow, 1919). Text-fig. 7, e-k.

1919. *Clytia mollis* Stechow, p. 44, Fig. L.

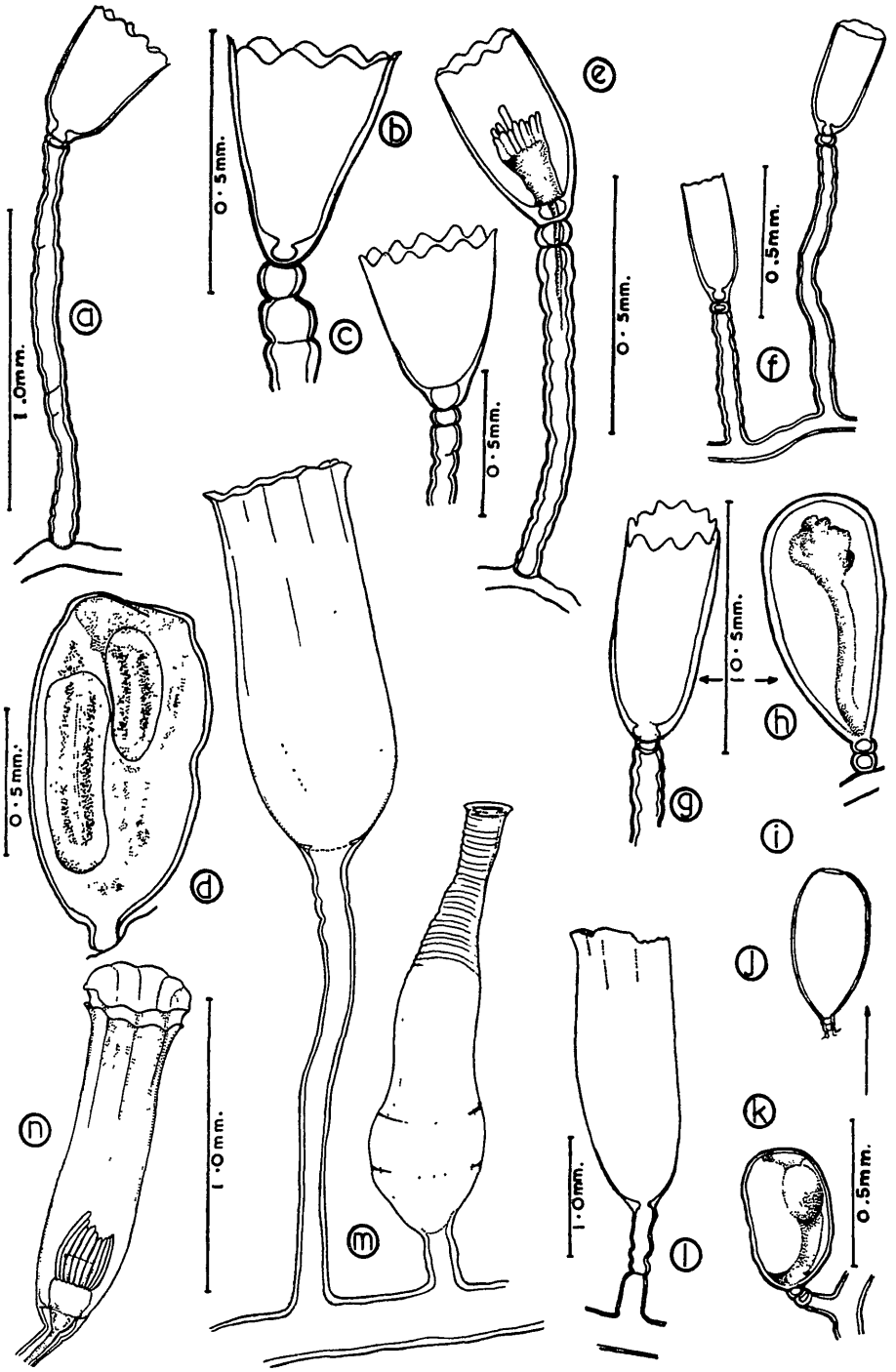
1951. *Clytia noliformis* (McCrady) forme *mollis* Stechow. Picard, p 189.

—— *Campanularia mollis* (Stechow). Picard, p. 344, Fig. 3.

Colony stolonal, hydrorhiza reticulated, from 0·093 to 0·125 mm in diameter, slightly flattened and usually with small flanged margin about 0·031 mm in width; hydrocaulus unbranched 1·0 to 2·25 mm in length and about 0·062 mm in width, serving as a pedicel for the hydrotheca, usually strongly and spirally twisted throughout, this is particularly distinct at the base and immediately below the single spherule between the hydrotheca and the pedicel; spherule about 0·04 mm in diameter; hydrotheca clearly cylindrical, 0·40 to 0·50 mm in length and about 0·21 mm in breadth, margin with from 8 to 12 rather large but bluntly pointed teeth which sometimes have a slight indentation at the tip, emarginations between teeth wide and shallow; "diaphragm" well defined, and at the same level a circle of highly refractile small bead-like structures; hydranth with about 12 tentacles: gonotheca borne on the stolon by a short pedicel with usually from 2 to 4 well defined spiral twists, sometimes annulations occur; 0·50 to 0·62 mm in length and about 0 35 mm wide; in general gonotheca smooth walled and oval in broad outline, more or less compressed, not circular in cross section, wall thickest in the region of the aperture which is small about 0·125 mm wide; distal end rather rounded, not truncate, gonophore a single large eumedusoid with 4 branched radial canals and filling the greater part of the internal space of gonotheca.

Locality: Type locality, "Southern France" (Stechow). Off Cape Campbell, 60 fath. (trawler "Thomas Currell"), 1/6/56, 473; Menzies Bay, Banks Peninsula, intertidal rock pool (G. Knox), —/8/49, 240; Gladstone Pier, Lyttelton Harbour (G. Knox), 25/6/53, 408; north of Ruapati Is., Foveaux Strait, oyster beds, 12 fathoms (G. Knox), —/5/53, 405; Stn. 18, "Chatham Expedition 1954", 21/5/54, Slide No. 4.

Distribution: Southern France; New Zealand.



TEXT-FIG. 7.—a–d, *Orthopyxis delicata* Trebilcock. b and d, from Trebilcock's type material. e–k, *Orthopyxis mollis* (Stechow). l–n, *Tulpa diverticulata* Totton.

Genus SILICULARIA Meyen, 1834. In part.

1883. *Eucopella* von Lendenfeld. In part, pp. 497–583.
1888. *Hypanthea* Allman, p. 25.
1905. *Eucopella* von Lendenfeld. In part. Hartlaub, p. 569.

Colonies stolonal; hydrothecae with greatly thickened walls, and cavity too small to allow the complete retraction of the hydranth, bilaterally symmetrical with oblique margin; body of hydranth with rounded retractible caecum; dioecious, male and female gonothecae from the stolon and of different shape and size; reproductive zooid produces medusoid structures.

Only *Silicularia bilabiata* (Coughtrey, 1875) is known from New Zealand. A description of this species and its varietal forms is given and its status discussed by Ralph (1956).

Silicularia bilabiata (Coughtrey, 1875)

1875. *Campanularia bilabiata* Coughtrey, p. 291, Pl. XX, Figs. 46–49.
1876. *Campanularia bilabiata* Idem, p. 299.
1876a. *Campanularia bilabiata* Idem, p. 25.
1876. *Hypanthea repens* Allman, p. 115.
1883. *Eucopella campanularia* von Lendenfeld, ex parte, p 497, Pl. XXIX, Fig. 15D′, D-½.
1884. *Eucopella campanularia* von Lendenfeld. Bale, p 60.
1888. *Hypanthea hemispherica* Allman, p. 27, Pl. 14, Figs. 2, 2a.
—— *Hypanthea aggregata* Allman, p. 26, Pl. 14, Figs. 1, 1a.
1889. *Eucopella campanularia* von Lendenfeld Bale, p 751, Pl. XIII, Figs. 9–15
—— *Hypanthea georgiana* Pfeffer, p. 54.
1890. *Hypanthea atlantica* Marktanner-Turneretscher, p. 211, Pl. III, Fig. 14.
1896. *Campanularia bilabiata* Coughtrey. Farquhar, p 460.
1898. *Hypanthea bilabiata* (Coughtrey). Hilgendorf, p. 213, Pl. XX, Fig. 5.
—— *Hypanthea asymmetrica* Hilgendorf, p. 212, Pl. XX, Fig. 4.
1901. *Hypanthea asymmetrica* Hilgendorf. Hartlaub, p. 366, Pl. 22, Figs. 24–26.
1903. *Hypanthea repens* Allman. Jaderholm, p. 271
1905. *Eucopella reticulata* Hartlaub, p. 569, Fig. R^1.
—— *Silicularia georgiana* (Pfeffer). Hartlaub, p. 573, Fig. U_1, V_1, W_1
—— *Silicularia atlantica* Markt.-Turneretscher. Hartlaub, p. 580, Fig. C^2.
1914. *Hypanthea bilabiata* (Coughtrey). Bale, p 89.
—— *Silicularia campanularia* (von Lendenfeld). Bale, p 84, Pl XIII, Figs. 1–6.
—— *Eucopella campanularia* von Lendenfeld. Mulder & Trebilcock, p 9.
1915. Non *Hypanthea hemispherica* Allman. Nutting, p. 92, Pl. 25, Figs. 7–8.
—— *Silicularia reticulata* (Hartlaub). Nutting, p 91, Pl. 25, Figs 3–4.
1918. *Silicularia campanularia* (von Lendenfeld). Briggs, p. 35.
1924. *Silicularia bilabiata* (Coughtrey). Bale, p. 233, Fig. 4.
—— *Silicularia campanularia* (von Lendenfeld). Bale, p. 234
1928. *Silicularia bilabiata* (Coughtrey). Trebilcock, p 3.
—— *Silicularia campanularia* (von Lendenfeld). Trebilcock, p. 4.
1929. *Silicularia georgiana* (Pfeffer). Broch, pp. 3–28.
1950. *Silicularia campanularia* (von Lendenfeld). Hodgson, p. 6, Figs. 12, 13.

DISTRIBUTION: New Zealand; Kerguelen Island; Australia; Falkland Islands; South Georgia; off Cape San Roque; Tierra del Fuego Archipelago; Gough Island; Crozet Island; Lord Howe Island; Tasmania; Macquarie Island.

forma **subtropica**

1883. *Eucopella campanularia* von Lendenfeld, ex parte, p. 497. Pl. XXIX, Fig. 15D′, D-½.
1884. *Eucopella campanularia* von Lendenfeld. Bale, p. 60.
1888. *Hypanthea hemispherica* Allman, p. 27, Pl. 14, Figs. 2, 2a.
Non *H. hemispherica* Allman Nutting, 1915, p 92, Pl. 25, Figs. 7–8.
1889. *Eucopella campanularia* von Lendenfeld. Bale, p. 751, Pl. XIII, Figs. 9–15.
1890. *Hypanthea atlantica* Marktanner-Turneretscher, p. 211, Pl. III, Fig. 14.
1898. *Hypanthea asymmetrica* Hilgendorf, p. 212, Pl. XX, Fig. 4
1901 *Hypanthea asymmetrica* Hilgendorf. Hartlaub, p. 366, Pl. 22, Figs 24–26.
1905. *Eucopella reticulata* Hartlaub, p. 569, Fig. R^1.
1914. *Silicularia campanularia* (von Lendenfeld). Bale, p. 84, Pl. XIII, Figs 1–6
—— *Eucopella campanularia* von Lendenfeld. Mulder & Trebilcock, p. 9.

1915. *Silicularia reticulata* (Hartlaub). Nutting, p. 91, Pl. 25, Figs. 3–4.
1918. *Silicularia campanularia* (von Lendenfeld). Briggs, p. 35.
1924. *Silicularia campanularia* (von Lendenfeld). Bale, p. 234.
1928. *Silicularia bilabiata* (Coughtrey). Trebilcock, p. 3.
—— *Silicularia campanularia* (von Lendenfeld). Trebilcock, p. 4.
1950. *Silicularia campanularia* (von Lendenfeld). Hodgson, p. 6, Figs. 12, 13.

LOCALITY: Long Beach, Russell, intertidal rock pool (P.M.R.), 27/11/50, 29; Muriwai Beach, drift (P.M.R.), 8/2/53, 323; Bethell's Beach, Auckland (D. Kulka), 1/1/51, 466; Napier waterfront, drift (P.M.R.), 19/11/50, 1; Wellington Harbour, intertidal rock pool (P.M.R.), —/2/44, 467; Lion Island, New Plymouth (P.M.R.), —/1/56, 469; Lyttelton Harbour (C. Chilton), 17/11/06, Canterbury Museum Slide No. 3; Portobello Marine Biological Station Reef (E. Batham), 16/3/51, 175.

forma **intermedia**

LOCALITY: Island Bay, Wellington (R. Zander), —/8/55, 468; Sumner (C. Chilton), —/9/03, Canterbury Museum Slide No. 2.

forma **subantarctica**

1875. *Campanularia bilabiata* Coughtrey, p. 291, Pl. XX, Figs. 46–49.
1876. *Campanularia bilabiata* Idem, p. 299.
1876a. *Campanularia bilabiata* Idem, p. 25.
1876. *Hypanthea repens* Allman, p. 115.
1888. *Hypanthea aggregata* Allman, p. 26, Pl. 14, Figs. 1, 1a.
1889. *Hypanthea georgiana* Pfeffer, p. 54.
1896. *Campanularia bilabiata* Coughtrey. Farquhar, p. 460.
1898. *Hypanthea bilabiata* (Coughtrey). Hilgendorf, p. 213, Pl. XX, Fig. 5.
1903. *Hypanthea repens* Allman. Jaderholm, p. 271.
1905. *Silicularia georgiana* (Pfeffer). Hartlaub, p. 573, Fig. U_1, V_1, W_1.
1914. *Hypanthea bilabiata* (Coughtrey). Bale, p. 89.
1924. *Silicularia bilabiata* (Coughtrey). Bale, p. 233, Fig. 4.
1929. *Silicularia georgiana* (Pfeffer). Broch, pp. 3–28, Pl. I, Text-figs. 1–12.

LOCALITY: Timaru, drift (E. W. Bennett), 12/6/27, 49; Dunedin (Hilgendorf, 1898); Macquarie Island, 17/5/49, A.N.A.R.E. Slide No. 3; Kerguelen Island, —/2/50, A.N.A.R.E. Slide No. 4.

forma **indet.**

LOCALITY: Island Bay, drift (Trebilcock, 1928); Dunedin and Bluff (Trebilcock, 1928).

Genus TULPA Stechow, 1921.

Campanularians with very deep and particularly large hydrothecae, these with flared (everted) margins and narrowing under the border of the margin. (After Stechow.) Hydrothecae usually longitudinally ridged or lined: reproductive structures producing sporosacs that remain within the gonotheca while the planulae develop.

The genotype is *Campanularia tulipifera* Allman, 1888. Stechow also assigned to g. *Tulpa, Campanularia magnifica* Fraser, and *Campanularia speciosa* Clark. Fraser (1937 and 1944) retains them in the g. *Campanularia.* The characters of the hydrothecae of *Tulpa diverticulata,* the only known New Zealand species, described as new from off Three Kings by Totton in 1930, and those of the species recognised by Stechow as belonging to the genus, have very deep hydrothecae with the length 3 or 4 times the depth, and they are very large, up to 4·0 mm in length. Such hydrothecal characters contrast sharply with those described for the majority of the species of the g. *Campanularia* in which the length is rarely greater than 2–½ times the depth, and the hydrothecal length rarely greater than 1·5 mm. Accordingly Stechow's genus is retained here.

In general other New Zealand material of *T. diverticulata* from Bligh Sound (West Coast Fiord) and Menzies Bay, Christchurch is of smaller size than that recorded by Totton. Regeneration of the hydrothecal rim and pedicel was observed in

a few specimens. Only the specimens from Bligh Sound, taken in May, had gonothecae, but no indication of the reproductive zooid can be given as just a remnant of the coenosarc remained. This is the first description of the gonotheca of *T. diverticulata.*

T. diverticulata differs from *T. tulipifera* mainly in the habit of the erect stem. *T. tulipifera* is sparingly branched with hydrothecae supported on pedicels which arise from the sides of the branches usually " with a pinnate and alternate disposition ". There is also a distinct joint on the pedicels. *T. diverticulata* is not known to branch, is stolonal in habit, and has no true joint in the pedicels, although some stems show points of regeneration. The hydranth of *T. diverticulata* is of similar shape and has the same number of tentacles as *T. tulipifera.* Since a change in habit of the erect stem and its size may occur in species that range from subantarctic to subtropical waters, it seems possible that further collections will show that *T. diverticulata* is a form of *T. tulipifera* which is known from off Heard Island, in 150 fathoms.

The North American species *T. magnifica* and *T. speciosa* are both stolonal in habit. The characters of *T. speciosa* (annulated stolon, annulated pedicel and gonotheca shaped like an inverted cone with length and breadth nearly equal) clearly separate it from *T. magnifica* and from *T. diverticulata.* These latter species have very similar gonothecae borne on a short pedicel, oval with the distal end drawn out into a long bottle-neck. The proximal region may be corrugated. The gonotheca of *T. magnifica,* however, lacks the fine striations on the neck and the everted rim about the aperture characteristic of *T. diverticulata,* and the hydrothecal pedicel is annulated not smooth in *T. magnifica.*

Tulpa diverticulata Totton, 1930. Text-fig. 7, 1-n.

1930. *Tulpa diverticulata* Totton, p. 145. Text-fig. 5.

Colony stolonal, hydrorhiza 0·31 to 0·50 mm in diameter and perisarc 0·031 to 0·062 mm thick; hydrothecal pedicels straight, 1·0 mm to 9 0 mm in length, 0·17 to 0·23 mm in width; usually 3 evenly spaced undulations below the hydrotheca on pedicels over 5·0 mm in length, otherwise irregular in this region; hydrotheca large, slightly curved, 2·0 to 4 0 mm in length, 1·00 to 1·125 mm at the aperture; narrows immediately below the aperture; walls with 9 to 11 longitudinal ridges, with concave facets between; margin entire, but everted and the ends of the fluted facets appear as bosses; " diaphragm " a thickened ring 0·125 to 0·21 mm from the base of the hydrotheca; hydranth with about 20 tentacles and a distinct trumpet-shaped proboscis: gonotheca 3·0 to 4·0 mm in length, borne on the stolon by a short straight pedicel 0 31 to 0 50 mm in length; long narrow neck region (1 25 to 1 50 mm) with about 25 fairly prominent but fine closely spaced annulations; terminal aperture, circular, with everted margin (0 25 to 0 40 mm in diameter); proximal region usually smooth but small irregular corrugations may be present and a few barely visible annuli.

LOCALITY: Type locality, off Three Kings Islands, 300 fathoms. Bligh Sound, South Island on *Antipathes aperta,* 30 fathoms (W. H. Dawbin), 10/5/50, 33; Menzies Bay, intertidal rock pool creeping over other hydroid stems (G. Knox), 26/8/49, 240.

DISTRIBUTION: New Zealand.

Family CAMPANULINIDAE Hincks, 1868

Colonies branched or unbranched; hydrothecae ovato-conic or tubular, stalked or sessile; always operculate and the operculum often shaped like a pyramid or composed of several converging segments forming a cone when closed; hydranth with conical hypostome: reproductive zooid producing sporosac or free medusa.

The following campanulinid species were previously recorded from New Zealand: *Thyroscyphus simplex* (Lamouroux, 1816), ? *Operculariella humilis* (Bale, 1924),

Stegolaria irregularis Totton, 1930, *Stegopoma fastigiatum* (Alder, 1860), *Campanulina repens* Allman, 1864.

Kramp (1932) reviews the standing of genera included in the F. Campanulinidae. The g. *Thyroscyphus* is considered by Kramp to show characters "transitional" between the F. Campanulinidae and the F. Sertulariidae. Kramp includes *Thyroscyphus* within the F. Campanulinidae. Following Stechow (1923, pp. 153–158) and others, the g. *Thyroscyphus* is here recognised as belonging to the F. Sertulariidae and its status within that family is to be discussed in a later paper. Following Rees (1939), *Campanulina repens*, and on my own finding, *Eucope annulata* von Lendenfeld, 1885 (transferred from F. Campanulariidae) are synonyms of *Phialella quadrata* (Forbes, 1848).

Phialella quadrata is the most widely distributed campanulinid in New Zealand. One of the specimens in the present collection was growing on the pleon of an Isopod ectoparasitic on "Groper". Such a habitat, taken in association with the fact that the reproductive zooid produces free medusae, suggests an effective means of dispersal for the species, but its "somewhat peculiar distribution" (Russell, 1953, p. 315), namely from the British Isles, Belgium and New Zealand, is not surprising since it occurs on wharf piles, or an oyster bed association, and the distribution resembles that of the barnacle *Elminius modestus*. Of the other New Zealand campanulinids, ? *Opercularella humilis* and *Stegolaria irregularis* are known only from New Zealand. *Stegopoma fastigiatum* is essentially cosmopolitan.

KEY TO THE GENERA AND SPECIES OF F. CAMPANULINIDAE IN NEW ZEALAND

1	(4)	Operculum of hydrotheca formed by about 8 converging segments.	
2	(3)	Reproductive zooid producing a fixed sporosac Erect stem may be unbranched and hydrothecal pedicels arise directly from the stolons, or show sympodial branching; stem and branches annulated throughout; hydranth tentacles webbed at the base: gonotheca unknown	OPERCULARELLA Hincks, 1868 ? *O. humilis* (Bale, 1924).
3	(2)	Reproductive zooid producing free medusae Erect stem as for ? *O. humilis* but hydranth tentacles free to the base, not webbed: gonotheca more or less cylindrical, with annulated short pedicel; 2 or 3 medusae buds developed	PHIALELLA Browne, 1902 *P. quadrata* (Forbes, 1848).
4	(1)	Operculum of hydrothecae formed by 2 membranes folded lengthwise which come together roof-like, with their long edges.	
5	(6)	Erect stem polysiphonic; hydrotheca tubular: gonotheca adnate to stem for almost whole of adcauline length, aperture circular	STEGOLARIA Stechow, 1913 (probably a synonym of *Stegopoma* Levinsen, 1893).
		Main stem and branches in the proximal region polysiphonic, distal region only monosiphonic; stem up to 9.0 cm in height, branching irregular; hydrothecae from all sides in the proximal region, alternate in distal region: gonotheca unknown	*S. irregularis* Totton, 1930
6	(5)	Erect stem polysiphonic, or hydrothecal pedicels arising directly from the stolons; hydrotheca tubular: gonothecae usually adnate to stem or branch in polysiphonic forms and may be incorporated into stem or branch by overgrowth of accessory tubes; aperture of gonotheca in polysiphonic colonies often circular, in stolon colonies gonotheca free, pedicellate and from the stolon with operculum similar to that of the hydrotheca	STEGOPOMA Levinsen, 1893

Hydrothecal pedicels directly from stolons; hydrothecal pedicel and cup may be very variable in length; hydrotheca tubular, from 1·0 mm to 1·30 mm in length; gonotheca usually with short pedicel, tubular, when operculum closed distal end obliquely truncate, aperture more or less circular when operculum fully open . .... *Stegopoma fastigiatum* (Alder, 1860)

Genus Opercularella Hincks, 1868

"Stem simple or branched, rooted by a filiform stolon; hydrothecae ovato-conic with a cleft or folded margin, the segments of which converge to an operculum; hydranths cylindrical with a single whorl of filiform tentacles around a conical proboscis: reproduction by means of fixed gonophores giving rise to planulae." (Rees, 1939.)

The genus is known from New Zealand by only one species recorded originally from the hull of the "Terra Nova" by Bale in 1924 as a new species *Campanulina humilis*. In 1939 Rees reviewed the g. *Campanulina* van Beneden, 1847, and provisionally placed *C. humilis*, a species in which the reproductive zooid was unknown, in the g. *Opercularella* as ? *O. humilis* (Bale). No specimens of ? *O. humilis* have come to hand in the present collection and the species is known to me only from the literature (Trebilcock, 1928) and from the colony of 20 stems mounted as the type material. This has been re-examined but nothing significant can be added from this to the original account.

? **Opercularella humilis** (Bale, 1924). Text-fig. 8, a-f.

1924. *Campanulina humilis* Bale, p. 235. Fig. 5.
1928. *Campanulina humilis* Bale. Trebilcock, p. 8, Pl. IV, Fig. 3 a-b.
1939. ?*Opercularella humilis* (Bale). Rees, pp. 438 and 444. (Synonymy.)

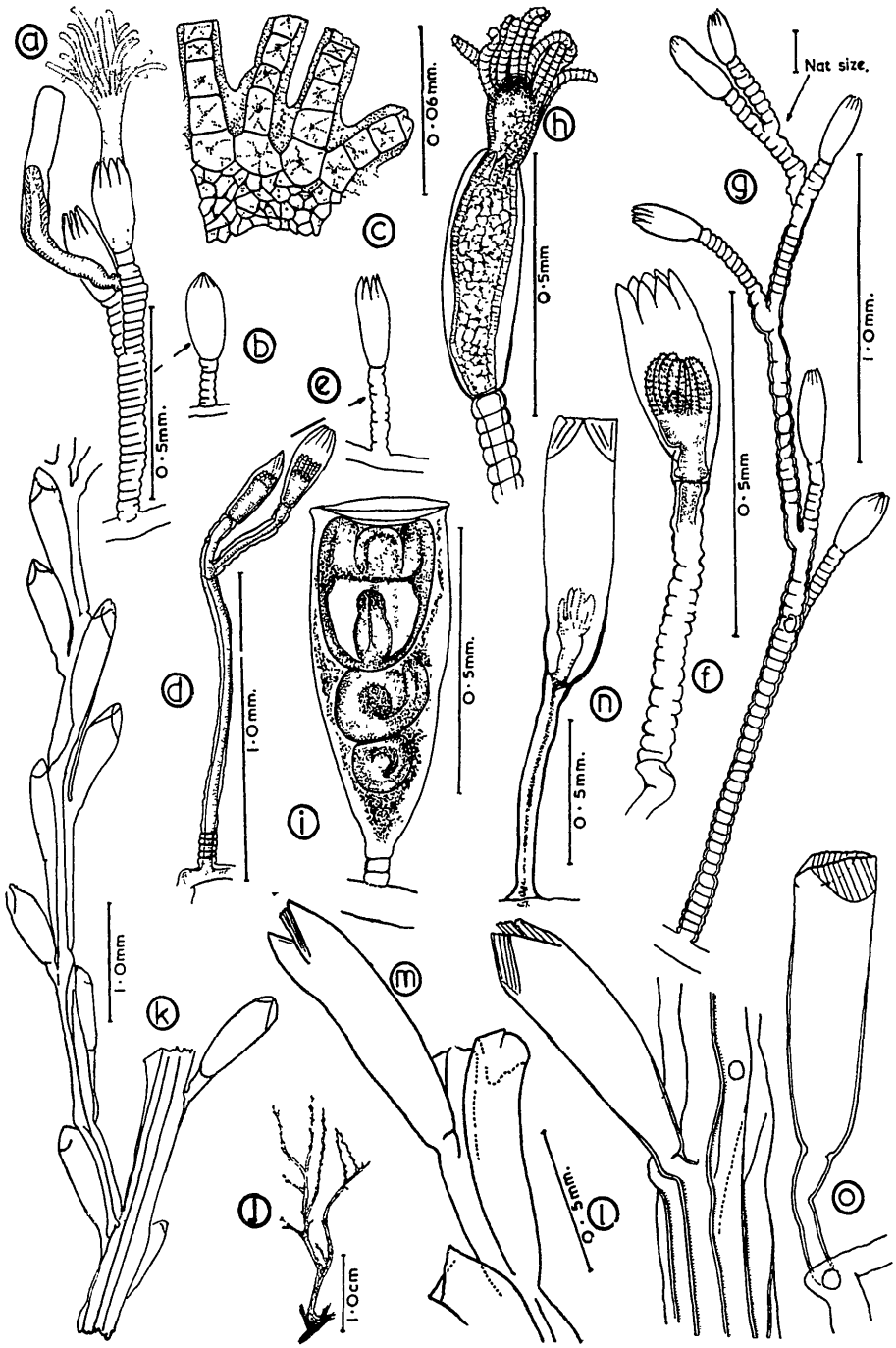
Hydrorhiza filiform 0 062 mm in diameter giving rise either to solitary undulated pedicels about 0 187 mm in length and 0·062 mm in diameter or to small, sparingly branched erect stem up to 1 35 mm in height, branches and main stem annulated throughout; hydrothecal pedicel expanding gradually to base of hydrotheca; hydrotheca ovato-conic with delicate perisarc from 0·27 mm to 0·35 mm in length, with about 8 converging segments (approximately ⅓ the length of the hydrotheca) forming an operculum; a distinct but very thin diaphragm is present; hydranth with about 16 tentacles with small web at their base: gonotheca, unknown.

Locality: Type locality, hull of "Terra Nova" (presumably—collected while vessel was in Lyttelton Harbour as specimens were part of Professor Chilton's Canterbury University College hydroid collection). Type, Canterbury Museum Slide No. 4; Campbell Is. (Jaderholm, 1926); St. Clair, Dunedin (Trebilcock, 1928).

Genus Phialella Browne, 1902.

Stem simple or branched, arising from a creeping stolon; hydrothecae conical or ovato-conic, with an operculum formed of distinct converging segments; hydranths tubular and extensile, with a whorl of filiform tentacles (without a web at the base) around a conical proboscis: gonothecae large, oval or cylindrical, borne on stems and stolons; medusae of F. Eucopidae with 8 adradial marginal sensory vesicles, each with two or more otoliths and situated on the margin of the umbrella between two tentacles, many marginal tentacles, no marginal cirri; a gonad on each of the four radial canals; stomach not on a peduncle. (Rees, 1939.)

This genus is known for New Zealand by only one species recorded originally by Ralph & Hurley (1952) from wharf piles in Wellington Harbour as *Campanulina repens* Allman and now recognised, following Rees (1939), as *Phialella quadrata* (Forbes). Recently through the courtesy of Dr. J. W. Evans of the Australian Museum, Sydney, I examined von Lendenfeld's type microslide of the young medusa



TEXT-FIG. 8.—a–f, ? *Operculariella humilis* (Bale). a–c, (after Trebilcock, 1928, Pl. 5, Fig. 3); d–f, stem from Bale's type material. g–i, *Phialella quadrata* (Forbes). j–m, *Stegolaria irregularis* Totton. m, hydrotheca, of Totton's type material. n–o, *Stegopoma fastigiatum* (Alder).

of *Eucope annulata.* Von Lendenfeld's medusa is similar to that described by Russell (1953, p. 315, Text-fig. 196) as *Phialella quadrata* (Forbes), and *Eucope annulata* von Lendenfeld is here placed in synonymy with *P. quadrata* (Forbes). The characters of the erect stem and branches, the gonotheca, and those of the young free medusa of *Europe annulata* are similar to those described for *P. quadrata.* Von Lendenfeld, however, figures the margin of the hydrotheca as entire, and makes no mention of the operculum of 8 converging segments characteristic of the cup of *P. quadrata.* Small opercula segments such as those of *P. quadrata* are sometimes difficult to see when the hydranth is fully expanded and the operculum wide open. Von Lendenfeld's Pl. 28, Fig. 57 shows well expanded hydranths, and this may explain why he shows the margin as entire. Fig. 57 also shows 16 to 20 hydranth tentacles, a number similar to that known for *P. quadrata,* but in the text (p. 603) von Lendenfeld gives 30 to 35 as the number of hydranth tentacles. Despite the difference noted above between the margin of the hydrotheca figured in *E. annulata* and *P. quadrata,* the combined evidence of the characters of the erect stem, the gonotheca and the young medusa determine *E. annulata* a synonym of *P. quadrata.* Furthermore, some of my material of *P. quadrata* comes from Lyttelton Harbour, the type locality of *E. annulata. E. annulata* is known only from the type locality and has not been recognised by any worker since von Lendenfeld's original observation.

Phialella quadrata (Forbes, 1848). Text-fig 8, g-i.

1848. **Thaumantias quadrata* Forbes p. 43, Pl. IX, Fig. 2.
1848. * *Thaumantias aeronautica* Forbes, p. 44, Pl. IX, Fig 3.
1848. * *Thaumantias aeronautica* Forbes, p. 44, Pl. VIII, Fig. 4.
1848. * *Thaumantias maculata* Forbes, p. 45, Pl. IX, Fig. 4.
1848. * *Thaumantias globosa* Forbes, p. 46, Pl X, Fig. 4.
1864a. *Campanulina repens* Allman, p. 61.
1868. *Campanulina repens* Allman. Hincks, p. 189, Pl. 38, Fig. 1.
1885. *Eucope annulata* von Lendenfeld, p 602, Pl. 28, Figs. 53–57.
1896. * *Phialidium cymbaloideum* Browne, p 491, Pl XVII, Figs. 1, 2.
1902. * *Phialella cymbaloidea* Browne, p. 282.
1910. *Eucope globosa* (Forbes), Mayer, p. 235.
1933. *Eucope quadrata* (Forbes). Kramp, p 576, Figs 40, 41.
1939 *Phialella quadrata* (Forbes). Rees, p. 440 and 442. (Synonymy.)
1952. *Campanulina repens* (Allman). Ralph & Hurley, p. 8
1953. **Phialella quadrata* (Forbes) Russell, p. 315, Pl. XVI, Figs. 4–6; Pl. XVII, fig. 5, Text-figs 196–200 (for full synonymy of medusa generation).

Colony usually branched up to 10.0 mm in height but solitary hydranths arising from a creeping stolon are known; hydrorhiza about 0·093 mm in diameter; branching irregular and most active in the distal region of the colony; pedicels of solitary hydranths and hydrocaulus and branches of larger colonies usually closely annulated throughout; hydrothecae ovato-conic with an operculum of about 8 distinct converging segments, and these in length approximately ⅓ the total length of the hydrotheca; hydrothecae from 0 187 to 0 34 mm in length, about 0 140 mm in diameter at widest point, walls very thin and delicate; hydranth tubular and very extensile, with a whorl of about 16 filiform tentacles around a conical proboscis: gonotheca large, 0·50 mm to 0·68 mm in length and 0·25 mm in width; borne on both the stolons and the erect stem; more or less cylindrical but narrows gradually at the proximal end into a distinct and annulated pedicel about 0 062 mm in length; (distal end rather truncated); two, and frequently three medusae buds produced by the reproductive zooid.

Locality: Type locality, Firth of Forth. St. Helier's Bay, Auckland (D. Kulka), —/—/51, 518; Te Mata, Coromandel Peninsula (P.M.R), 25/11/50, 25; on crab's back from ship-bottom fauna, New Plymouth Harbour dredge (" Paritutu "), (J. H. Sorensen), 5/5/54, 453; wharf piles, Wellington Harbour (P.M.R.), 30/7/49, 472;

* = record of medusa generation.

on pleon of isopod *Neroula,* parasitic on " Groper," Lyttelton Harbour (B. Pilgrim), —/12/53, 452; Gladstone Pier, Lyttelton Harbour (G. Knox) 25/6/53, 411; laminarian zone, Lyttelton Harbour (fide *Eucope annulata* von Lendenfeld); Otago Harbour, as the medusa (Russell, 1953); on shell of *Ostrea sinuata,* Foveaux Strait (J. Yaldwyn), 3/10/51, 206.

DISTRIBUTION: England; Belgium; New Zealand.

Genus STEGOLARIA Stechow, 1913.

Erect stem polysiphonic; hydrotheca tubular, with an operculum formed of 2 membranes folded lengthwise, and which come together roof-like, with their long edges; each of them is separated from the remainder of the hydrotheca by a curved line; at each side the hydrothecal wall forms a triangular gable-like structure between the two opercular membranes: reproductive zooid produces a sporosac; gonotheca flask-shaped where known, single, not aggregated, irregularly arranged on the stem, adnate to the stem on the adcauline side for almost the whole of its length.

This genus is known from New Zealand by only one species recorded originally from east of North Cape by Totton in 1930, as a new species, *Stegolaria irregularis.* Totton's material lacked gonothecae, but the erect stem was very similar other than in size to that of *S. geniculata* (Allman) the genotype, the type locality of which is off Matuku, Fiji. *S. geniculata* has hydrothecae about twice the length of those known for *S. irregularis.* Other New Zealand material also lacking gonothecae from 400 miles N.W. of Wellington and from the Chatham Is., has characters as described for *S. irregularis,* and is here assigned to that species.

Stegolaria irregularis Totton, 1930. Text-fig. 8, j-m.

1930 *Stegolaria irregularis* Totton, p. 154

Colonies polysiphonic and fascicled regions of stem and branches may enclose polychaete worm " runs "; colony up to 9 0 cm in height; branching irregular, but mostly in one plane; number of tubes in fascicled regions from 3 upwards; only extreme distal region of stem and branches monosiphonic and in this region erect stem thin, about 0 125 mm in diameter, and ascending the last formed hydrotheca; hydrothecae alternate in distal region, from all sides of the stem in the proximal region and arising from the subsidiary tubules; hydrothecae in distal region with distinct pedicels which may have slight undulations, about 0·25 mm in length, but pedicels much shorter, less obvious in the proximal region, and hydrotheca may be almost sessile; hydrothecae 0 87 mm to 0 94 mm long, rather tubular in shape, flattened " dorso-ventrally " at mouth to form two lateral teeth (i.e., " gable ") with folded opercular flap in " embayment " both above and below, slightly curved at first, becoming longer and more curved with re-duplication; hydrothecae 1 25 mm apart in strongly fascicled region, about 0 35 mm in diameter at widest point and 0·21 mm in diameter at base; hydranth with from 10 to 12 simple tentacles and with annular attachment to hydrotheca near base: gonotheca, unknown.

LOCALITY: Type locality, 7 miles east of North Cape, New Zealand, 70 fathoms 400 miles N.W. of Wellington from submarine cable 600 fathoms (C.S.S. " Recorder," W. Forster), 1932, 154; Stn. 7, Chatham Rise, 200–300 fathoms, " Chathams Expedition, 1954," Chatham Expedition Slide No 5

DISTRIBUTION: New Zealand.

Genus STEGOPOMA Levinsen, 1893.

Hydrotheca with an operculum formed of 2 membranes folded lengthwise, and which come together roof-like, with their long edges; each of them is separated from the remainder of the hydrotheca by a curved line; at each side the hydrothecal wall forms a triangular, gable-like structure between the two opercular membranes (Fraser): reproductive zooids producing sporosacs, gonotheca with operculum similar to that of hydrotheca.

This genus is represented in New Zealand only by the cosmopolitan *S. fastigiatum* and this species was first recorded from this country by Totton in 1930

Stegopoma fastigiatum (Alder, 1860). Text-fig. 8, n-o.

1860. *Campanularia fastigiata* Alder, p. 73, Pl. V, Fig. 1.
1868. *Calycella fastigiata* (Alder). Hincks, p. 208, Pl. XXXLX, Fig. 3.
1914. *Stegopoma fastigiatum* (Alder). Stechow, p. 135, Fig. 9.
1930. *Stegopoma fastigiatum* (Alder). Totton, p. 155, Fig. 11.
1944. *Stegopoma fastigiata* (Alder). Fraser, p. 178, Pl. 32, Fig. 153.

Colonies stolonal, pedicellate hydrothecae arise at irregular intervals from the smooth slender hydrorhiza about 0·125 mm in diameter; pedicels 0·68 to 0·75 mm in length, but known to be very variable in this character; hydrothecae usually almost tubular in shape, but tapering towards the proximal end, 1·0 mm to 1·30 mm in length, about 0·25 mm in width at distal opercular region; about 0·125 mm at level of hydranth base, but hydrotheca known to be very variable in length; " operculum of the usual two membranes meeting along a ridge, with the walls of the hydrotheca produced to form a gable to support the operculum "; hydranth with about 12 tentacles: gonotheca arises from the stolon usually by a short pedicel, but some gonothecae almost sessile, rather tubular in shape; aperture covered by an operculum similar to that of the hydrotheca, but distal end when operculum closed often obliquely truncate; aperture when operculum in the " open " position is circular.

Locality: Type locality, Shetland Island. Off Three Kings Islands, N.Z., 300 fathoms (Totton, 1930); Cook Strait Stn. GUJ (55), 40–100 fathoms, (Zoo. Dept. V.U.C.), 23/2/56, 529. Stn. 34, E. of Forty Fours, 130 fathoms, Chatham Expedition, 1/2/54, Chatham Expedition Slide No. 6.

Distribution: Principally in the North Atlantic; also Japan, East India; New Zealand.

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