https://doi.org/10.24199/j.mmv.1980.41.04 13 October 1980

THE IDENTITY OF TWO TUBULARIAN HYDROIDS FROM AUSTRALIA WITH A DESCRIPTION AND OBSERVATIONS ON THE REPRODUCTION OF *RALPHARIA MAGNIFICA* gen. et sp. nov.

By Jeanette E. Watson

Honorary Associate, Invertebrate Zoology, National Museum of Victoria.

Abstract

The identity of two common Australian tubularian hydroids is established. *Tubularia ralphi* Bale is an estuarine species and an important component of the summer fouling communities in Australian ports. *T. ralphi* has been recorded under various synonyms from southern Australia.

Ralpharia magnifica gen. *et* sp. nov. is described. It is a widely, although sparsely distributed species on shallow oceanic and sheltered water reefs in southern Australia. It has formerly been confused with *T. ralphi* Bale.

Ralpharia releases a free-swimming, short-lived medusa with 4 tentacle knobs and 4 radial canals. Nematocyst tracks are absent. The amoeboid egg, growth of the actinula and late development of the oral tentacles of the young hydranth indicate a close relationship with the primitive Atheeata.

Introduction

The literature on Australian tubularian hydroids is confused, some species having been poorly described in the past from inadequate material, leading to misidentifications by later workers, while the literature as a whole is in need of revision (Watson, 1979).

The identity of the two most abundant and widely distributed Australian species of *Tubularia* is discussed in this paper.

Ralph (1966) recorded two species of *Tubularia* collected from four localities (Point Cook, Mud Islands, off Sandringham and near Port Phillip Heads) in the Port Phillip Survey, 1957-1963. The taller species with stems 10 cms high, collected from the two latter localities, she assigned to *Tubularia ralphi* Bale, 1884, remarking that this "tall stemmed tubularian possesses characters similar to that described by Bale (1884) for specimens from Port Phillip, and by other workers (Broch, 1948) for *T. ralphi* Bale". She tentatively assigned the smaller hydroid with clustered stems up to 4 cm high to *Tubularia larynx* Ellis & Solander, 1786, as the first record of the species from Australia. The colonies of both hydroids were moribund at the time of collection.

Bale (1884) gave a very brief description of "*T. ralphii* Halley m.s." after a description of the species read before the Microscopical Society of Victoria by Halley in 1879. Halley's description was not subsequently published, nor was any record of the paper kept in the Society's archives. Search of the hydroid collections of the National Museum, Melbourne, and the Australian Museum, Sydney failed to reveal any specimens. In his description of *T. ralphi*, Bale makes particular reference to the habitat of this hydroid in Hobsons Bay, remarking that it is "common on piles, ships, etc."

During ecological studies extending over several years in Hobsons Bay, the author observed colonies of a tubularian hydroid seasonally very abundant on wharves and port beacons near the mouth of the Yarra River where it enters Hobsons Bay. Colonies of this hydroid so closely resemble Bale's description of the "stems clustered, three or four inches in height, slender, . . . smooth or obscurely wrinkled transversely, simple or rarely branched; polypites about one-third of an inch across the tentacles . . . Gonophores in clusters on branched peduncles; ovate, with four small tubercles at the summit, and a small aperture" that there is no doubt that this hydroid is *T. ralphi*. Careful search among the epibiota of Hobsons Bay has failed to find evidence of any other tubularian hydroid which answers this description. Examination of a large range of fresh material of this hydroid shows that the four small tubercles on the gonophores, mentioned by Bale, are apical crests, fugutive structures which occur on only a few of the male gonophores. Later authors have assumed that these were perradial tentacle knobs, present on the gonophores of both sexes of some tubularian species.

Lendenfeld (1885) described *Tubularia gracilis* from the "Laminarian Zone" at Port Jackson, New South Wales. Thornely (1904), recognised material from Ceylon as *T. gracilis*. Fenchel (1905) considered *T. gracilis* to be synonymous with *T. larynx*. Stechow (1925) recorded *T. gracilis* from the mouth of the Swan River, Western Australia, renaming it *T. australis* because of pre-occupation of the name *T. gracilis* Harvey, 1836.

I have examined Lendenfeld's specimens of *T. gracilis* in the collection of the Australian Museum. The spirit preserved specimens labelled "G10801 Type"are too poorly preserved for detailed examination but another specimen labelled "G10800 Port Jackson, New South Wales" is well preserved. This material is conspecific with *T. ralphi* from Hobsons Bay.

Hickson & Gravely (1907) assigned a group of dead perisarcal tubes 60-120 mm high and a single hydranth "not well preserved, as well as a few immature specimens" from McMurdo Bay, Antarctica, to *T. ralphi*. Their material had "long slender hydrocauli arising from a contorted hydrorhizal plexus". Following Hickson & Gravely, Broch (1948) assigned a moderately tall stemmed hydroid from Peter I Island, Antarctica, to *T. ralphi,* remarking that his two specimens were solitary but with some evidence of there having been a hydrorhiza. The hydrocauli were feebly striated throughout their length and the hydranths had about 25 aboral and 30-40 oral tentacles. It is virtually impossible to assign tubularian hydroids to species in the absence of fertile parts, and from their description it is very doubtful that the material of these authors was indeed *T. ralphi*.

More recently, Ewer (1953) described a new species, *Tubularia warreni* from the coast of Natal, South Africa. His detailed description, particularly of the cnidome, leaves no doubt that *T. warreni* is synonymous with *T. ralphi*.

Pennycuik (1959) doubtfully assigned an immature hydroid from Moreton Bay, Queensland, to *Tubularia crocea* (Agassiz, 1862), as the first record of this species from Australian waters. *T. crocea* is known from the Atlantic and Pacific coasts of the U.S.A. (Agassiz, 1862: Torrey, 1902; Fraser, 1944; Calder, 1970), and from Christmas Island in the Indian Ocean (Ritchie, 1910). Specimens of *T. ralphi* collected from ports and estuaries along the Australian coastline from Gladstone, Queensland, to Fremantle in Western Australian very closely resemble specimens of *T. crocea* from Chesapeake Bay, U.S.A., provided by Dr. D. Calder. The cnidome of *T. crocea* has atrichous isorhizas (Weill, 1934) while *T. ralphi* has abundant heterotrichous anisorhizas. Only examination of the nematocysts of fresh material of each will determine whether the two are indeed conspecific. In the meanwhile, the species are considered separate.

Since there is no existing type material of *T. ralphi* it it necessary to erect a neotype. A typical colony from Bale's original locality at the mouth of the Yarra River in Hobsons Bay is nominated as the neotype. A description of *T. ralphi* from the neotype colony is given later in this paper.

Referral of the specimens identified by Ralph (1966) as *T. larynx* to *T. ralphi* leaves the tall stemmed tubularian from Port Phillip Bay without identity. This hydroid is common on sheltered ocean reefs and in clear water embayments along the southern and south-eastern coastline, and because of its large size and graceful hydranths it is often photographed by divers. The distribution, ecology and reproduction of this hydroid has been investigated by the author. Certain features of the structure and release of the medusae and early larval development are unique among the Tubulariidae, warranting the erection of a new genus.

Type material on which the following descriptions are based is lodged in the National Museum of Victoria, Melbourne (NMV).

Ralpharia gen. nov.*

Diagnosis: Hydranths colonial, hydrocaulus with firm perisarc, gonophores released as free swimming medusae. Medusae radially symmetrical with four radial canals and four rudimentary marginal tentacles. Nematocyst tracks absent.

Ralpharia magnifica sp. nov.

Type Material: Holotype, NMV G3224; paratypes G 3225, G 3226.

---

* Named for Dr. P. M. Ralph who first recorded this hydroid and who has contributed much to understanding of the Trans-Tasman hydroid fauna.

Material preserved in 5% formalin. Coll: J. E. Watson, 3/1/79 from reef at Tortoise Head, Western Port, 2 m deep, on the alcyonacean *Parerythropodium membranaceum* Kükenthal, 1906. Description from holotype and paratypes: Colonies sparse, comprising a few to 20 erect stems arising from a tubular hydrorhiza embedded in the sheet-like mass of the alcyonacean. Diameter of hydrorhiza up to 1 mm. Stems to 150 mm high and 2-2.5 mm diameter at widest part immediately below hydranth. Perisarc of stems thick and smooth, very thick on the hydrorhiza, thinning distally, the perisarc of the distal region 4-5 mm below hydranth reduced to a transparent transversely wrinkled sheath. (In preserved material the coenosarc of this region of the stem is contracted to a narrow cylinder which expands distally into a thin collar supporting the hydranth; in life, the coenosarc in this part of the stem is inflated, filling the entire upper stem cavity). In transverse section, stems comprise a thin, transparent outer pellicle overlying the thick perisarcal layer; internally, the walls are lined with a ring of numerous, small, subcircular canals, one of which is always 3-4 times the diameter of the others (Fig. 2). These longitudinal canals are clearly visible through the distal stem wall where the perisarc is thin. In the lower stem region and hydrorhiza, the canal system fills much of the stem cavity, but distally the canals lie close to the wall, the core of the stem being occupied by a mass of parenchymous cells.

Hydranths large, in life up to 50 mm across the extended tentacles. Aboral tentacles 27-40 in number, up to 30 mm long, arranged in a single verticil and up to 150 oral tentacles 1-5 mm long, bunched in a dense tuft 5-6 rows deep around the mouth; a few very short tentacles less than 1 mm long usually present around the basal row of oral tentacles. Body of hydranth 4-5 mm in diameter and 3-4 mm in length between the basal row of oral tentacles and the blastostyles (preserved material), and finely, but conspicuously striated. Internally, the endoderm of the gastral cavity comprises an upper, deeply lobed layer, and a lower, dark coloured band of digestive glands.

Blastostyles numerous, 50-60 arising in a circlet 2-3 deep proximal to the oral tentacles, mature blastostyles up to 5 mm long, much branched, bearing up to 8 mature or nearly mature gonophores and many immature gonophores in various stages of development. When fully fertile, the proximal blastostyles tend to droop in clusters between the tentacles. Gonophores of both sexes identical in shape and size but borne on different hydranths, attached to blastostyle by a short wrinkled pedicel.

Medusa at liberation about 2.5 mm long and 0.8-1 mm wide with 4 radial canals and 4 poorly developed inter-radial ribs and 4 rudimentary tentacle knobs. Jelly moderately thick with a well developed shelf-like velum and a simple, circular opening surrounded by a raised internal collar. Nematocysts rare on exumbrella but concentrations of large anisorhizas present on tentacle knobs. Spadix simple, about half to two-thirds length of the medusa, varying in shape from oval to conical, without mouth or stomach. At release, the gonads completely surround the spadix, occupying most of the internal cavity, the female medusa containing 12-18 eggs.

Nematocysts of four kinds present:

Hydranth —(i) moderately abundant stenoteles with round capsule, 10 × 10-14 × 14μ (Fig. 4).
—(ii) very abundant stenoteles with elongate capsule, 7 × 5-9 × 7μ (Fig. 5).
—(iii) very rare ? isorhizas, undischarged, capsule 15 × 16-17 × 17μ (Fig. 6).

Gonophores—
—(i) very abundant? isorhizas, capsule 8 × 3 μ (Fig. 7).
—(ii) abundant stenoteles, capsule 7 × 7-7 × 9μ, similar to those in hydranth.
—(iii) abundant very large heterotrichous anisorhizas, capsule 12 × 16-15 × 14μ, with long threads, concentrated in proximal parts of radial canals and tentacle knobs (Fig. 8).

Colour in life: stems greenish brown with dark brown perisarc on lower stem and hydrorhiza, coenosarc flesh pink. Tentacles translucent white, body of hydranth mushroom pink, blastostyles white, maturing gonophores orange brown. At release, jelly of medusae transparent, radial canals and tentacle knobs white with a shade of purple, reproductive products orange. Spadix of spent gonophore dark orange brown.

Remarks on the hydroid generation: Ralpharia magnifica possesses the largest solitary hydranth known from Australian waters and rivals in size *T. regalis* Boeck, 1860 from the northern hemisphere. This similarity is of interest, since *T. regalis* is also reported to be associated with a coralline substrate, *Lophophelia* sp., in shallow water (Broch, 1916). *R. magnifica* is a widely, although sparsely distributed species, recorded by the author from near Sydney, New South Wales, to the eastern Great Australian Bight. It invariably occurs in association with *P. membranaceum* in cool temperate waters, but may, however, be associated with other species of alcyonaria elsewhere. Because of the obligate nature of its association with *P. membranaceum, R. magnifica* is restricted, in Victoria, to shallow coastal reefs where the alcyonacean is abundant.

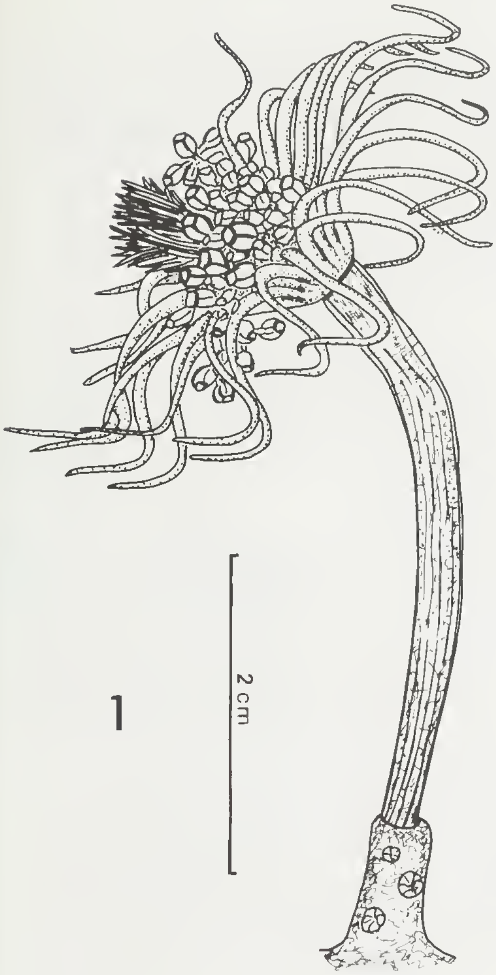
Although not truly solitary, since they are interconnected by the hydrorhiza, the stems are always well separated to allow full expansion and movement of the large hydranths. Individual hydranths are capable of considerable axial movement around the stem and are also capable of orientation in various directions independent of the current flow. This flexibility is permitted by the thinning of the perisarc in the distal stem region. Most of the colonies appear to be quite old and the majority of stems show evidence of repeated breakage, possibly due to fish grazing, followed by regeneration of the hydranths. The hydranths are evidently voracious predators, since the stomach contents often contain small crustacea; on one occasion, a small fish about 1 cm long was observed being swallowed.

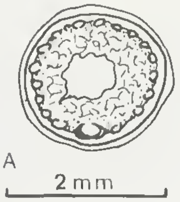
Reproduction and Development: The following account of the reproduction and development of *R. magnifica* is from observations made in the field and from specimens reared and kept under observation in the laboratory in aerated Western Port sea water at ambient field temperature. The preserved specimens are included in the type series.

Blastostyles appear in early November and reproduction commences in early January when water temperature rises to a maximum of 20-21°C. (Western Port). Near maturity, the gonophores pulse spasmodically while still attached to the blastostyle. At this stage, both male and female reproductive products completely surround the spadices and fill the cavity of the gonophore. The 12-18 eggs are large, about 0.3 mm long, irregularly and deeply lobed, and each is enclosed in a thin transparent pellicle which attaches it to the spadix. (Fig. 14).

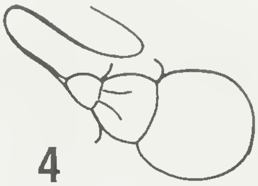
Medusae are synchronously liberated in large numbers at night and swim with strong jerking movements for several hours. During this time the sperm is shed rapidly from the male and the eggs are expelled one by one from the female. Although the point was not positively established, it is likely that fertilisation occurs in the water. During their expulsion from the medusa the eggs change from their original deeply lobed form and assume a lumpy amoeboid shape (Figs 11, 15). Such a high degree of plasticity would be advantageous to allow escape of the egg undamaged through the narrow orifice in the velum.

Figures. 1-16. *Ralpharia magnifica* g. *et* sp. *nov.* Fig. 1. Fertile hydranth, holotype colony, drawn from underwater photograph. Fig. 2A. Transverse section through mid-stem region showing longitudinal circumferential canals. Fig. 2B. Canals, enlarged. Fig. 3. Blastostyle with gonophores in various stages of development, drawn from underwater photograph. Figs 4-8. Nematocysts (all drawn to same scale). Figs 4-5. Stenoteles from hydranth: Fig. 6. Isorhiza from hydranth: Fig. 7. ? Isorhiza from gonophore. Fig. 8. Anisorhiza from gonophore. Figs. 9-13. Stages in development of the female gonophore (all drawings to same scale from living material): Fig. 9. Immature gonophore. Fig. 10. Nearly mature gonophore with segmented ova: Fig. 11. Free medusa liberating ova. Fig. 12. Later stage, showing nearly spent medusa with few remaining ova. Fig. 13. Empty medusa showing spadix. Fig. 14. Mature ova dissected out from gonophore, showing thin pellicle covering ova (preserved material). Figs. 15-16. metamorphosis of the egg: Fig. 16. Larva 1-2 hours after expulsion, showing beginning of development of tentacles.


1


2A

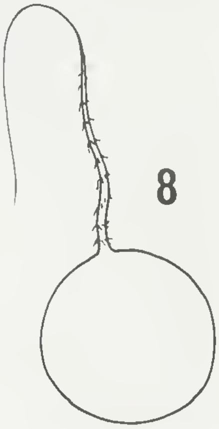

2B

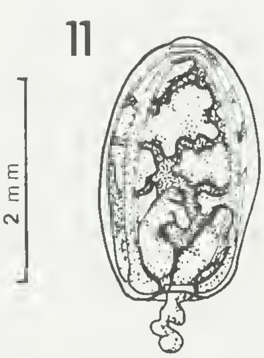

4

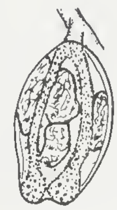

5

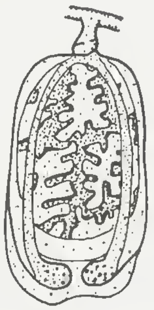

6

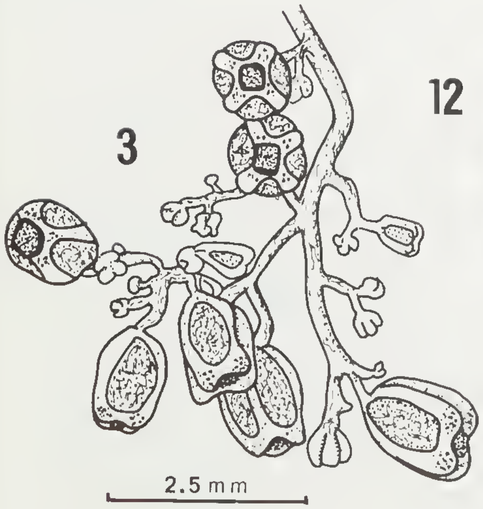

7

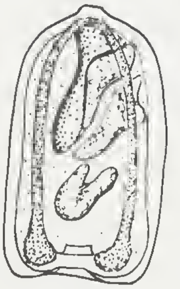

8

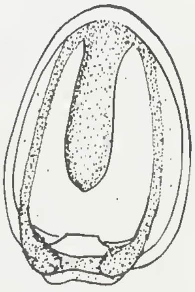

11

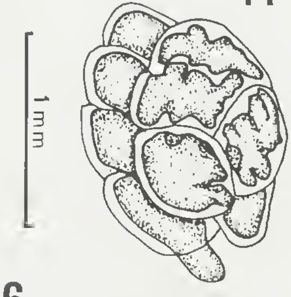

9

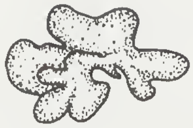

10

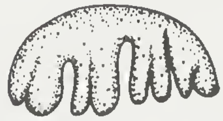

3


12


13


14


15


16

During the first one or two hours after expulsion, the fertilised egg contracts and arches a little in the centre; at the same time the rather shapeless amoeboid lobes become re-organised into a number of elongate processes fringing the central convexity (Fig. 16). About 20 hours after fertilisation, the central part of the larva is now a more or less circular disk and the processes have become re-arranged into 2 circlets of stubby, rudimentary tentacles (Fig. 17). At 24 hours after fertilisation, the body is top-shaped and the tentacles are more elongated (Fig. 18). After 48 hours, the larvae have 6-12 tentacles which now react to stimuli. Between 2 and 4 days after fertilisation, the tentacles reach maximum length and are now long and slender, radiating stiffly alternately upward and downward from the body (Fig. 19). The aboral pole is dome-shaped, with a conspicuous central pale pink ring.

Although the tentacles react sharply to stimuli, extended observation of 30 actinulae failed to reveal any evidence of crawling movements, it therefore seems likely that the stiffly extended tentacles may provide a passive but effective means of wide dispersal by "cartwheeling" along with water currents.

Laboratory reared actinulae from 3-5 days old settled rapidly when placed in contact with pieces of *P. membranaceum*. Immediately on contact with the alcyonacean the actinulae orients itself in a squatting position, strongly contracting the tentacles to bring the aboral pole into contact with the substrate (Fig. 20). Within 12 hours of settlement, a short pedicel has penetrated the alcyonacean and the tentacles have resumed their normal position (Fig. 21). During the next 2 days, the tentacles contract to mere stumps while the pedicel and the hydrorhiza grow rapidly (Fig. 22). (In laboratory specimens, the maximum length attained by the pedicel and hydrorhiza was 3.5 mm). The manner by which the hydrorhiza penetrates the hard mass of the alcyonacean was not investigated, but an aureole of dead tissue at the site of penetration of the pedicel suggests that some chemical reaction takes place.

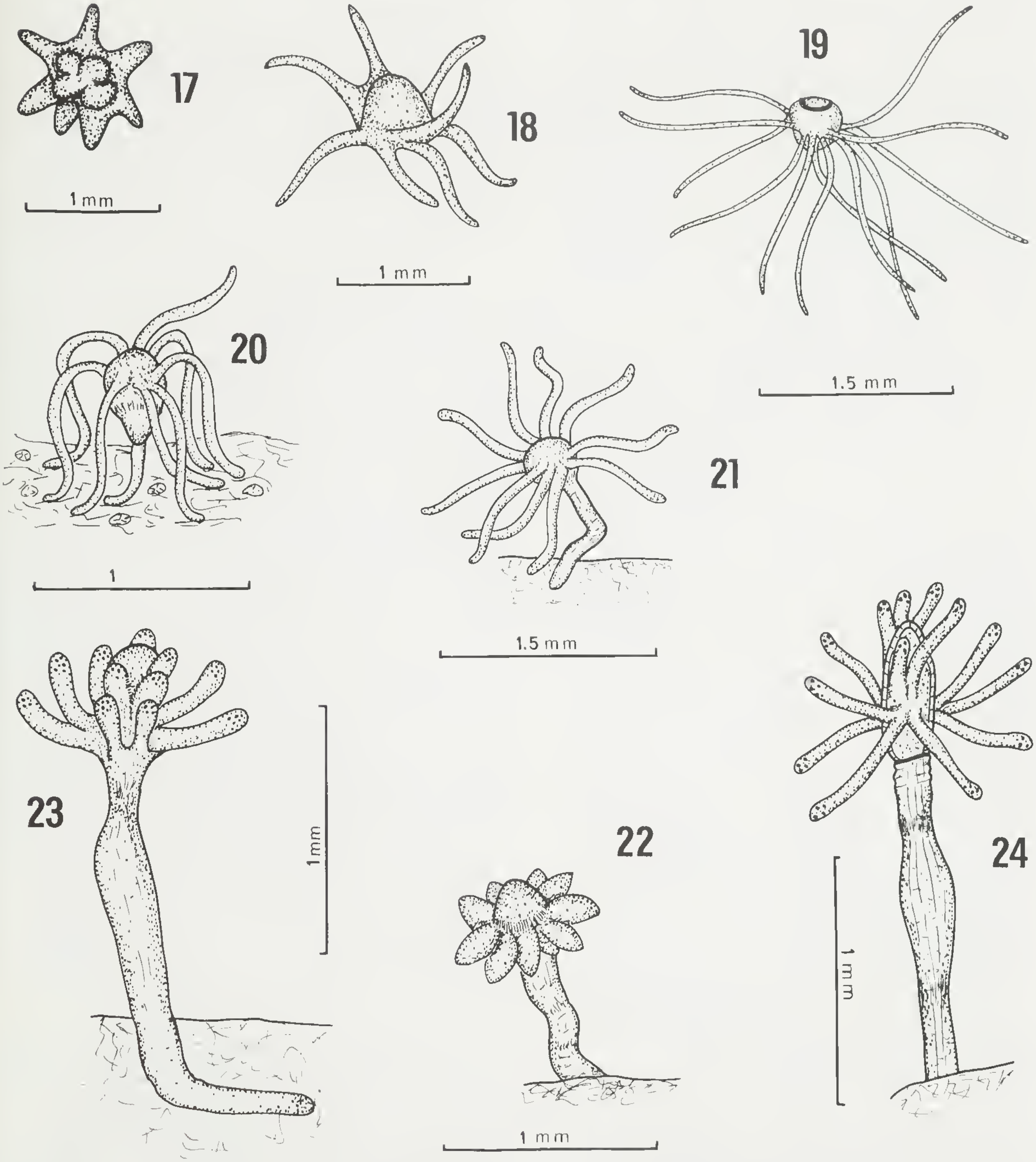
From 2-3 days after settlement, the oral pole commences to evaginate while the aboral tentacles of the young hydranth begin to lengthen once more. The tentacles are now thick, with blunt tips set with large nematocysts. At 4 days after settlement the oral pole has elongated to form the hydranth body. At this stage 4 oral tentacles begin to differentiate by outward and upward growth from the oral evagination. (Fig. 23). After 5 days, the body of the hydranth is clearly separated from the pedicel by a constriction identical to that seen in the mature hydranth, and during the next several days (up to 8 days after settlement) the 4 oral tentacles continue to grow. Both oral and oboral tentacles are blunt-tipped with nematocysts along most of their length, with the greatest concentrations at the tips.

At this stage the developing gastral cavity is clearly visible through the body wall and the site of the hypostome becomes visible as an apical thinning of the endoderm. (Fig. 24). A brisk internal circulation is visible in the distal region of the pedicel and in the lower gastral cavity. At this stage longitudinal striae, comprising rows of orange coloured cells, begin to form in the endoderm of the pedicel.

Because of the advancing decay of the alcyonacean substrate, the observations were terminated at this stage before the actual development of the mouth was observed and it is possible that the later stages of development of the hydranths may have become more protracted than would occur under natural conditions.

Remarks on the genus Ralpharia: There are no structures of the sterile hydranth which distinguish *Ralpharia* from other genera of the Tubulariidae. Both *Ectopleura* Agassiz, 1862, and *Hybocodon* Agassiz, 1862, have firm perisarc covered stems and liberate medusae. The medusa of *Ectopleura* has eight nematocyst tracks on the exumbrella, and may have rudimentary tentacles, while the medusa of *Hybocodon* is asymmetrical, has one long tentacle and five nematocyst tracks. Both medusae have mouths. The medusa of *Ralpharia*, because of its brief free-swimming existence, has no mouth.

Some of the features observed in the development of *Ralpharia* from ovum to young hydranth, are, according to Rees (1957),



Figures 17-24. Stages in development of the actinula and young hydranth of *Ralpharia magnifica* g. *et* sp. nov. Fig. 17. Actinula with rudimentary tentacles, 20 hours after release from medusa. Fig. 18. Commencement of elongation of tentacles, 24 hours after release. Fig. 19. Actinula 2-4 days old, with fully developed tentacles. Fig. 20. Actinulae settling on to alcyonacean substrate. Figs. 21-24. Development of young hydranth. Fig. 21. Hydranth 12 hours after settlement, section of alcyonacean cut away to show penetration of hydrorhiza. Fig. 22. Contraction of tentacles, further development of pedicel and hydrorhiza 2 days after settlement. Fig. 23. Evagination of oral pole and commencement of differentiation of oral tentacles 4 days after settlement. Cut away section showing further development of hydrorhiza. Fig. 24. Young hydranth with growing oral tentacles and developing gastral cavity.

characteristic of the more primitive Athecata. Rees considers that the Corymorphidae are ancestral to the Tubulariidae because of the presence of an elastic pellicle surrounding the fertilized amoeboid egg in *Corymorpha nutans* Sars, 1835, and in *C. palma* Torrey, 1907 (Rees, 1937). Torrey (1907) notes that the larva of *C. palma* is mobile before settling. The eggs of *Hybocodon prolifer* Agassiz, 1862, are also amoeboid in shape and are brooded in the medusa until development of the actinula (Russell, 1953). There is little information on the development of the egg of *Ectopleura*. The expulsion of the egg of *R. magnifica* while still in the amoeboid stage and covered by a protective pellicle is evidence of a close relationship with the Corymorphidae and provides an evolutionary link between the Corymorphines and the more advanced Tubulariidae. Rees (1957) also noted that the pellicle surrounding the egg of *Corymorpha nutans* was pushed out into pseudopodia-like processes and then atrophied to form the anchoring filaments of the young hydranth. He also remarked that Manton's (1940) observations of the shrinkage of the larval tentacles of *Myriothela phrygia* (Fabricius), exposing the central disk, is evidence of the primitive relationship between the Corymorphidae and the Myriotheliidae. The slow development of the pseudopodia-like lobes of the larva of *R. magnifica* into the tentacles of the actinula, and later, partial resorption of the tentacles in the post-settling phase thus provides evidence for the relationship of *R. magnifica* with the more primitive members of the Capitata.

The lengthy actinula stage and the late development of the oral tentacles and mouth of the young hydranth are without parallel in the literature of the Tubulariidae. *T. larynx* and its congeners, which have received most study, are essentially estuarine species. Adaptation to the restricted but rigorous estuarine environment would demand brooding of the larva to an advanced stage followed by rapid settling and metamorphosis. In contrast, a relatively long planktonic actinula stage would favour dispersal of oceanic species, particularly substrate specific forms such as *R. magnifica*, and no adaptive advantage would be gained by a mobile actinula. The delayed development of the oral tentacles and mouth until after the young hydranth is rooted and the pedicel is long enough to hold the hydranth clear of the substratum again lies in environmental demands since rapid establishment of a secure hydrorhiza would be imperative in a regime of strong water movement.

Tubularia ralphi Bale, 1884

Tubularia ralphii Bale, 1884, p. 42; Hickson & Gravely, 1907, p. 13; Broch, 1948, p. 6.
Tubularia gracilis Von Lendenfeld, 1885, p. 597.
Tubularia australis Stechow, 1924, p. 5; 1925, p. 196.
Tubularia warreni Ewer, 1953; Millard 1975, p. 35.
Tubularia larynx Ellis & Solander, 1786; Fenchel, 1905; Ralph, 1966, p. 158.
?*Tubularia crocea* (Agassiz, 1862); Pennycuik, 1959, p. 157.
Tubularia marina Torrey, 1902; Russ & Wake, 1975, p. 9.

Material: The following description is from the neotype, NMV G3227. Colony preserved in 5% formalin. Coll: Yarra River Entrance Beacon, Port Phillip, Victoria, 3/4/77, 1-2 m deep, on mussels, *Mytilus edulis* Lamarck, and on the ascidian *Styela clava* Herdman.

Other records: Inkerman Creek, Queensland, J. E. Watson 20/5/77; Port Kembla Harbour, New South Wales, J. E. Watson, 6/2/77; Popes Eye Reef, Port Phillip, J. E. Watson, 14/6/79.

Description: Colonies growing in hand-sized tufts to 12 cm high, comprising up to several hundred individual stems. Hydrorhiza a matted reticulum of tubes of the same diameter as stems. Individual stems range up to 12 cm but averaging 6-8 cm long, simple, tubular, 0.3-0.5 mm diameter, occasionally branched, each bearing a terminal hydranth. Perisarc of stems smooth with groups of 3-8 annulations at intervals, becoming thinner distally. Coenosarc of stem divided into 2 longitudinal canals which terminate in indistinct striae below the hydranth. (Fig. 26).

Mature hydranth variable in size, ranging up to 15 mm in diameter across the extended aboral tentacles in living specimens. Aboral tentacles in 1 verticil, 4-5 mm long, tapering, the number varying from 16-27 according to age of the hydranth. Oral tentacles 2-3 mm long, usually 15-25 in a single verticil, but always less then the number of aboral tentacles, with blunt tips.

Blastostyles arising just above aboral tentacles, usually a maximum of 12 with 6-8 in a more advanced state of development than the others. Mature blastostyles branched, longer than the oral tentacles, pendulous, bearing clusters of up to 46 gonophores in various stages of maturity. Male and female gonophores borne on short pedicels on different hydranths, mature gonophores oval to spherical, about 0.3 mm in diameter. Female gonophore containing 6-8 ova (in lower latitudes there are 2-4 ova) 2-3 of which develop into actinulae. Spadix of immature female gonophore large, tapering distally, later displaced to one side by growing actinulae. Gonophore surmounted by 8 transparent radial crests and a long, central protrusion of the spadix. At maturity the crests may be resorbed to mere knobs and the spadix is replaced by a tentacle of the most advanced actinula. Immature male gonophore elongate oval, becoming spherical near maturity. Mature gonophore with central spadix and usually without apical processes. (Fig. 28). There is, however, considerable variability throughout the colony, and even on the one hydranth. Variations include a bun-shaped apical process, often associated with an almost spherical gonophore (Fig. 29), a short protrusion of the spadix which may be accompanied by 4 incipient apical crests, or 4 raised knob-like processes. (Fig. 30).

At liberation the actinula has 8 aboral tentacles with swollen tips and 5-8 rudimentary oral tentacles. It performs sluggish swimming and crawling movements prior to settling. Settling occurs within 24 hours by attachment of the aboral pole, followed by rapid elongation to form a stem and development of the capitate oral tentacles. After 36 hours the young hydranth has a well developed hypostome and a short, annulated stem.

Nematocysts of four kinds present:

Heterotrichous anisorhizas—capsule spherical, 7-9 μ diameter, thread very long, abundant on male gonophores, rare on hydranth and female gonophores. (Fig. 33).

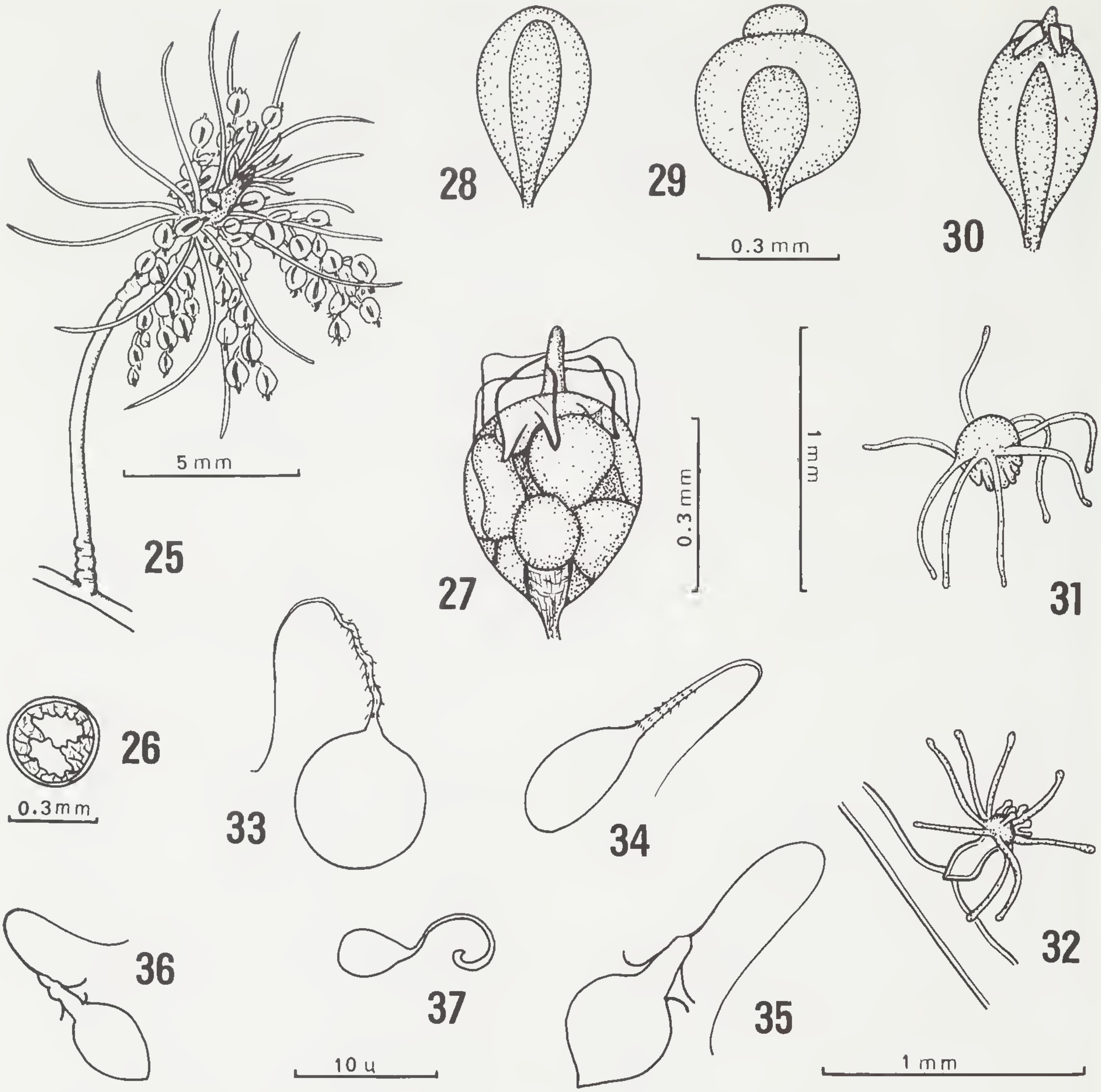
Basitrichous isorhizas—$7 \times 4 - 9 \times 4$ μ, very abundant on hydranth and female gonophores. (Fig. 34).

Stenoteles— (i) Large, almost spherical, 6-8 μ diameter, very abundant on male gonophore. (Fig. 35). (ii) Smaller, oval, $5 \times 4 - 6 \times 5$ μ, butt 3 μ long, very abundant on hydranth, rare on gonophores. (Fig. 36).

Desmonemes—small, $4 \times 3 - 6 \times 4$ μ, with 4 coils, abundant on hydranth. (Fig. 37).

Colour: Stems pale straw colour, body of hydranth and spadix usually orange red and tentacles transparent white. Variations are common, including golden, brown, or pale green hydranths and gonophores. The ova are always creamy white.

Remarks: Branching among the colonies is due to the settling of actinulae on adjacent stems of the parent colony, the annulated stem of the young hydranth forming the base of the new branch. There is a tendency for all hydranths on the one colony to be the same sex; however, both male and female may occur on the one colony. Both the hydranth and blastostyles are very active, the pendulous blastostyles performing rhythmic lashing movements at intervals. Although it's preferred substrate is mussels, *T. ralphi* grows on solitary ascidians, on other animal substrate and on ropes, metal and wooden structures. The most luxuriant colonies occur in the upper water column in estuarine situations such as Hobsons Bay where salinity may vary from 9‰—35‰. *T. ralphi* also occurs in fully marine waters, but the colonies tend to luxuriant growth only in good current flow and in reduced light. *T. ralphi* is an important member of the summer fouling community of Hobsons Bay where it grows rapidly and reproduces after the summer temperature peak of 21°C.



Figures 25-37. *Tubularia ralphi.*
Fig. 25. Mature female hydranth with gonophores, drawn from underwater photograph. Fig. 26. Transverse section through mid-stem region showing 2 longitudinal canals. Fig. 27. Nearly mature female gonophore with transparent apical crests and protuding spadix. Figs 28-30. Morphological variations of nearly mature male gonophore (all drawn to same scale). Fig. 28. Most commonly occurring gonophore without apical processes. Fig. 29. Gonophore with bun-shaped apical process. Fig. 30. Gonophore with incipient lateral crests. Fig. 31. Newly liberated actinula. Fig. 32. Young hydranth 24-36 hours after settlement. Figs 33-37. Nematocysts (all drawn to same scale). Fig. 33. Heterotrichous anisorhiza from male gonophore. Fig. 34. Basitrichous isorhiza from female gonophore. Fig. 35. Stenotele from male gonophore. Fig. 36. Stenotele from hydranth. Fig. 37. Desmoneme from hydranth.

Acknowledgements

I am grateful to Dr. J. Verseveldt of Zwolle, Netherlands, for identification of the alcyonacean coral; to Dr. D. R. Calder of the South Carolina Wildlife and Marine Resources Department for provision of comparison material from North America, and to the Trustees of the C.S.I.R.O. Science and Industry Endowment Fund for provision of laboratory equipment.

References

Agassiz, L., 1862. *Contributions to the Natural History of the United States of America* 4 (4): Hydroidae. Boston: Little, Brown.

Bale, W. M., 1884. *Catalogue of the Australian hydroid zoophytes.* Sydney: Australian Museum.

Boeck, H., 1860. Beskrivelse over en Tubularie fra Belsund paa Spitsbergen, *Tubularia regalis. Forh. Vidensk. Selsk. i. Krist.* 1859: 114-117.

Broch, H. J., 1916. Hydrioda I—*Dan. Ingolf-Exped.* 5 (1).

Broch, H. J., 1948. Antarctic hydroids. *Det. Norske Videnskaps Akademi*: I. Oslo. Res. Norwegian Antarctic Exped. 1927-28.

Calder, D. R., 1970. Hydroids and Hydromedusae of southern Chesapeake Bay. *Occas. pap. Va. Inst. Mar. Sci. 1.*

Ciamician J., 1879. Zur frage über die entstehung der geschlechtsstoffe bei den Hydroiden. *Zeitschr. wiss zool.* 30: 323-347.

Ellis J. & Solander D., 1786. *The natural history of many curious and uncommon zoophytes, collected from various parts of the globe* London: White.

Ewer, D. W., 1953. On a new tubularian hydroid from Natal. *Ann. Natal. Mus.* 12: 351-357.

Fenchel A., 1905. Über *Tubularia larynx* Ellis. *Rev Suisse Zool,* 13: 507-580.

Fraser, C. McL., 1944. *Hydroids of the Atlantic west of North America* Toronto: University of Toronto Press.

Harvey, J. B., 1836. Letter referring to a collection of marine productions including a specimen of *Capros aper* Lacep and a new species of *Tubularia* (*T. gracilis* Harv.) collected on the south coast of Devonshire and presented by the writer to the Society. Proc. Zool. Soc. Lond. 41: 54.

Hickson, S. J. & Gravely, F. H., 1907. Hydroid Zoophytes. National Antarctic Exped. 1901-1904. *Nat. Hist. 3 Zool. and Bot.*

Kükenthal, W., 1906. Alcyonacea Wiss. *Ergebn. deutsch. Tiefsee Exped. "Valdivia" 1898-1899,* 13: 1-111.

Lendenfeld R., 1885. The Australian Hydromedusae (v). *Proc. Linn. Soc. N.S.W.* 9 (3): 581-612.

Manton, S. M., 1940. On two new species of the hydroid *Myriothela. Brit. Grahamland Exped.*, 1934-37, *Sci. Rept* (4): 255-294.

Millard, N. A. H., 1975. Monograph on the hydroida of southern Africa. *Ann. S. Afr. Mus.* 68: 1-513.

Pennycuick, P. R., 1959. Faunistic records from Queensland. Part V. Marine and brackish water hydroids. *Pap. Dep. Zool. Univ.* Qd 1 (6): 141-210.

Ralph, P. M., 1966. Port Phillip Survey 1957-1963: Hydroida. *Mem. natn. Mus. Vict.* 27: 157-166.

Rees, W. J., 1937. The development of the hydroid *Corymorpha nutans* M. Sars from the egg. *J. Mar. biol. Assoc. U.K.* 21: 743-746.

Rees W. J., 1957. Evolutionary trends in the classification of capitate hydroids and medusae. *Bull. Br. Mus. nat. Hist. (Zool)* 4: 455-534.

Ritchie, J., 1910. Hydroids from Christmas Island, Indian Ocean, collected by C. W. Andrews D. Sc., F.R.S., F.Z.S., in 1908. *Proc. zool. Soc. Lond.* 1910: 826-836.

Russ, G. R. & Wake, L. V., 1975. *A Manual of the Principal Australian Marine Fouling Organisms.* Melbourne: Department of Defence.

Russell, F. S., 1953. *The medusae of the British Isles.* Cambridge: University Press.

Stechow, E., 1924. Diagnosen neuer hydroiden aus Australien. *Zool. Anz.* 59: 57-69.

Stechow, E., 1925. Hydroiden von west-und sudwest-australien nach den Sammlungen von. Prof. Dr. Michaelsen und Prof. Dr. Hartmeyer. *Zool. Jahrb. Abt. F. Syst.* 50: 191-269.

Thornely, L. R., 1904. Report on the Hydroida collected by Professor Herdman at Ceylon in 1902. *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf Manaar.* Suppl. Rep. 8: 107-126.

Torrey, H. B., 1902. The Hydroida of the Pacific coast of North America with special reference to the species in the collection of the University of California. *Univ. Calif. Pub. Zool.* 1: 1-104.

Torrey, H. B., 1907. Biological studies on *Corymorpha* II. The development of *C. palma* from the egg. *Univ. Calif. Publ. Zool.* 3 (12): 253-298.

Watson, Jeanette E., 1973. Pearson Island Expedition 1969. Hydroids. *Trans. R. Soc. S. Aust.* 97: 153-200.

Watson, Jeanette E., 1979. New species and new records of Australian Athecate hydroids. *Proc. R. Soc. Vic.* 90 (2): 301-314.