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## Budding in *Acrozoanthus* Saville-Kent, 1893 (Anthozoa: Zoanthidea)

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Abstract: The zoanthid *Acrozoanthus*, monotypic for *A. australiae* Saville-Kent, has been rediscovered on the Queensland coast after a lapse of 100 years. It lives on the parchment-like tubes of the worm *Eunice* cf. *tibiana* (Pourtalès), projecting from low intertidal mud. Although the polyps contain a double mesogloal sphincter muscle, hitherto regarded as characterizing only *Zoanthus*, with which *Acrozoanthus* was accordingly merged, the mode of budding appears to be unique. Small buds arise as mesogloal cavities, or extensions of the coelenteron, between neighbouring pairs of macrosepta, in a ring near the base of the column. As buds grow, the shared pedal region delaminates, so that large buds acquire direct attachment to the substratum. It is inferred that, since the clone on the worm tube consists of regularly spaced incipient colonies, each comprising a single fullgrown polyp and its developing buds, buds separate and move away from their parent. The taxonomic status of the genus *Zoanthus* is discussed and, on the basis of the budding method, *Acrozoanthus* provisionally restored to use.

### Introduction

The genus *Acrozoanthus* was created by Saville-Kent (1893: 154) for the single species *A. australiae* from the Great Barrier Reef of Australia. The new genus was based on the interpretation that the erect colonies were supported by an axial skeleton of their own secretion, as was known in the distantly related genus *Gerardia* Lacaze-Duthiers, 1864. However, Haddon (1895), to whom Saville-Kent had sent a specimen, pointed out that the supporting structure was actually a polychaete tube of the type described by Ehlers (1887) as being constructed by *Eunice tibiana* (Pourtalès, 1867). Haddon then proposed "to abolish the genus *Acrozoanthus*, and place Mr. Saville-Kent's form under the genus *Zoanthus*", with which *A. australiae* agreed in [unspecified] morphology. There appear to have been no further reports of this zoanthid in the succeeding century and it was, therefore, exciting to rediscover *A. australiae* on the Queensland coast in March 1995. The find has made possible a reexamination of the species and an evaluation of the status of *Acrozoanthus*. Saville-Kent (1893) described the species well enough for instant recognition but gave neither histological information nor any account of the budding process, which appears to be unique in the order Zoanthidea.

### Locality, methods, and depository of material

The specimen was found on 17 March 1995 at Cape Hillsborough, near Mackay, Queensland, at low water of a spring tide (0.5 m) in a rocky causeway, exposed only on low spring tides, at Wedge Island. The locality has rocky shores, with scattered

corals and other zoanthids, and comprises part of reef 20-275 in the Mackay/Capricorn section of the Great Barrier Reef Marine Park (Great Barrier Reef Marine Park Authority, 1988). The site is very sheltered from the prevailing southeasterly winds by a protective arc of headland, island and islet, and mud had accumulated between the boulders. The tube of the worm, *Eunice* cf. *tibiana*, projected some 20-25 cm from the mud. The apical portion of about 10 cm, with part of the zoanthid clone on it, was removed, photographed, and then preserved on site in 95% ethanol (the visit was part of extended fieldwork to collect zoanthids for DNA extraction: no histological fixative was available).

On return to Swansea the preserved and retracted specimens were further photographed (fig. 1) and a few polyps with buds were removed for sectioning. Specimens were wax embedded, sectioned in longitudinal and transverse planes at 7  $\mu$ m, and stained with Mallory's trichrome though, owing to preservation in ethanol, neither the sections nor the staining were of exceptional quality.

The colony, in which the nematocysts are being studied, and histological preparations are retained in my collection at Swansea, registered number JSR 543.

#### Description of *Acrozoanthus australiae* Saville-Kent, 1893

The zoanthid clone comprised a series of discrete polyps on an erect worm tube of approximately 25 cm free length (which may extend up to 45 cm according to Saville-Kent or even more (J.C. den Hartog, personal communication)); clustered near the apex of the tube, well separated lower down (fig. 1). Well grown polyps 11  $\times$  8 mm, obovoid or hot air balloon shaped in contraction, with the basal disk slenderer than the middle column. Each large polyp supports a developmental series of (up to six) buds, in a circle, near the base of the column (figs 1, 2A); the largest bud on some polyps, nearly as large as the parent, having made independent contact with the surface of the worm tube. The tube being slightly but distinctly zigzag, with openings at the angles, the discrete polyps, with their buds, are positioned at the angles (fig. 1A-C). Outer surface of polyps smooth, soft, not encrusted with sand.

Large polyps have 24-26 macrosepta and about 50 tentacles. Septa with a large canal (fig. 2E) near their base. Sphincter muscle mesogloea, in two annuli separated by a cleft; the inner annulus much the shorter and thicker (fig. 2F). Mesogloea of column thick, with numerous canals (fig. 2E). Endoderm of tentacles deep, packed with zooxanthellae. Ectoderm with moderately abundant spirocysts. Buds arising above the pedal disk (fig. 2A), first as a pocket of the coelenteron into the mesogloea, between two macrosepta (fig. 2E); then bulging from the surface and lengthening (fig. 2B-D). No gonads are present.

Colour: oral disk and tentacles grey brown; column light fawn grey, paler toward its base, with flecks of brown and a vivid emerald green ring at about the position of the sphincter (agreeing closely with chromo plate 3 in Saville-Kent, 1893).

The worm tube belongs to *Eunice* cf. *tibiana* (P.A. Hutchings, personal communication). Its substance is parchment like and the outer surface heavily colonized by small algae, bryozoans and hydroids.

Saville-Kent referred to the occurrence of *Acrozoanthus australiae* in the Great Barrier Reef from the vicinity of Mackay to Torres Strait, and also from Darwin (where it is still found, P. Alderslade, personal communication), noting its restriction to "some-



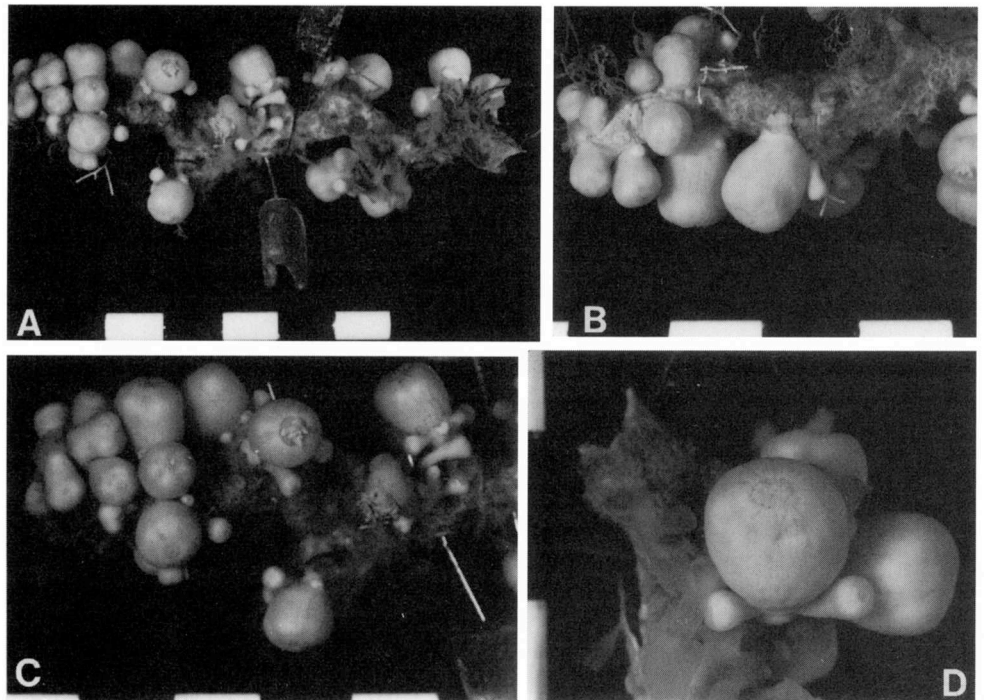


Fig. 1A-D. *Acrozoanthus australiae*. Photographs of preserved clone on part of tube of *Eunice cf. tibiana*, Cape Hillsborough, Queensland. Scale bar in cm.

what muddy shores". The association with muddy shores may explain the lack of recent records: reef researchers currently pay little attention to such sites. Outside Australia, *A. australiae* is known from Indonesia, with specimens in the Nationaal Natuurhistorisch Museum, Leiden, from Ambon in the Moluccas, collected by the Rumphius Biohistorical Expedition 1990 (RMNH 23405-7), and from the Spermonde Archipelago in southwest Sulawesi, collected in 1990 and 1994 (RMNH 23408-11).

#### Discussion

*Acrozoanthus australiae* is readily recognizable both for its unusual habitat and the striking coloration, well depicted by Saville-Kent (1893, chromo pl. 3). The generic placement, however, is open to debate. Certain morphological characters, such as the particle free mesogloea in combination with the double, mesogloea sphincter, are diagnostic for *Zoanthus* Lamarck, 1801, as currently used. The type species of *Zoanthus* is *Actinia sociata* Ellis & Solander, 1786 (which see, p. 5, pl. 1) from the Caribbean. A closely similar species from the Great Barrier Reef and Fiji is *Z. coppingeri* Haddon & Shackleton, 1891 (now recognized as an older name for the species described as *Z. mantoni* Carlgren, 1937, by Ryland & Muirhead (1993)). These two species form colonies of polyps united by flat stolons or thin spreading coenenchyme; buds, and hence polyps, arise at intervals from the coenenchyme, not from the column of polyps.

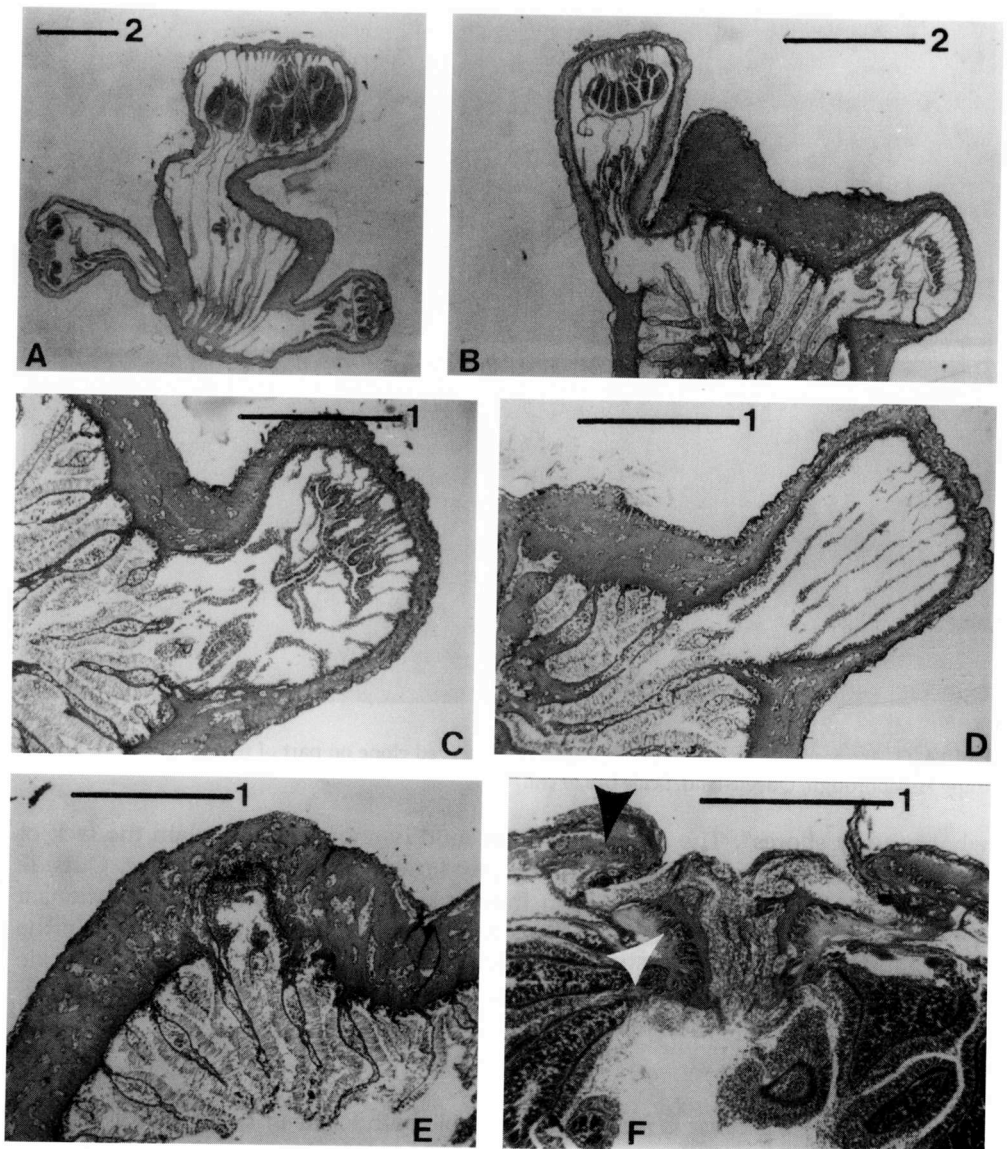


Fig. 2A-F. Sections through *Acrozoanthus australiae*. A, Nearly median longitudinal section through polyp with two buds; B, Transverse section through part of polyp with two buds; C, Section through developing bud (transverse section with reference to parent polyp); D, Transverse section through polyp wall showing incipient bud; E, Transverse section through part of column showing all septa with a large basal canal, the mesogloea, and an incipient bud between two macrosepta as an evagination of coelenteron into the mesogloea; F, Median longitudinal section to show the sphincter muscle, the two parts indicated with black and white arrowheads. Scale bar 1 = 1 mm; 2 = 2 mm.



A different kind of colony occurs in *Zoanthus vietnamensis* Pax & Müller (1957), also redescribed by Ryland & Muirhead (1993), in which polyps are essentially immersed in thick continuous coenenchyme (this also being the principal character of *Palythoa* Lamouroux, 1816, sensu stricto used by those authors, most recently Ryland & Muirhead (1993), who separate *Protopalythoa* Verrill, 1900, from *Palythoa*). Since recent work (Burnett et al., 1997) has shown that the genetic distance between *Z. coppingeri* and *Z. vietnamensis* well exceeds what is usual in congeners, the broad concept of *Zoanthus* as including all soft bodied zoanthids with a double sphincter muscle seems untenable.

The method of budding from the column, giving rise to a clone of virtually separate polyps made miniature colonies only by the developing buds, provides such a strong contrast to the budding method and colony form of *Zoanthus sociatus* and *Z. coppingeri*, that it seems to justify acceptance of Saville-Kent's (1893) genus, albeit with changed diagnosis.

Cnidom characters have not been considered, though included in taxonomic papers in the past. Muirhead & Ryland (1985) found them unhelpful when revising the related genus *Isaurus* Gray, 1828, and their traditional method of use, as practised by the measurement of a small sample of capsules, appears of questionable value and a contributory factor in the past creation of several spurious species of both *Zoanthus* and *Palythoa* (Burnett et al., 1997). Nevertheless, differences in cnidom do occur between zoanthid taxa, and a comparative study based on the rigorous statistical analysis of large populations of nematocysts is in progress. The cnidom of *Acrozoanthus australiae* will be compared with those of *Z. coppingeri* and *Z. vietnamensis*.

Genetic evidence of the relationship of *Acrozoanthus australiae* with *Zoanthus coppingeri* and *Z. vietnamensis* will also be sought. The genus *Acrozoanthus* (Akros, Gr., high or tall) is meanwhile provisionally retained, contrary to the view of Haddon (1895) only recently repeated by Ryland & Muirhead (1993), none of these authors having had information on the method of budding.

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