

A new Species in the echinasterid Genus *Echinaster* Müller and Troschel, 1840 (Echinodermata: Asteroidea) from southeastern Australia and Norfolk Island

FRANCIS W. E. ROWE and E. LYNNE ALBERTSON

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A new species of *Echinaster*, *E. colemani*, is described from the southeastern coast of Australia between Moreton Bay, Queensland and Ulladulla, N.S.W. possibly as far south as Bass Strait, and from Norfolk Island. The relationships of *E. colemani* with the southern Australian endemic species *E. arcystatus* H. L. Clark and *E. glomeratus* H. L. Clark are discussed. The new species most likely evolved from *E. arcystatus* as a result of isolation on the east coast due to the emergence of Bass Strait during glacial periods. The most recent emergence of Bass Strait occurred 18-20,000 years ago. Distribution of *E. colemani* to Norfolk Island can only be explained by trans-Tasman larval transportation.

F. W. E. Rowe and E. L. Albertson, Division of Invertebrate Zoology (Echinoderms), Australian Museum, Sydney, Australia 2000; manuscript received 19 November 1986, accepted for publication 18 February 1987.

INTRODUCTION

During an investigation of the echinoderm fauna of New South Wales, Lord Howe Island and Norfolk Island, a number of *Echinaster* specimens in the Australian Museum (AM) collections were examined. These specimens were without species epithet, or provisionally identified as either *E. glomeratus* H. L. Clark or *E. arcystatus* H. L. Clark. More specimens of *Echinaster* have been collected from New South Wales waters as a result of this project, which has been substantially funded by the Marine Sciences and Technologies Grant Scheme (MST). In addition, specimens from Tasman locations collected by the New Zealand Oceanographic Institution (NZOI) were examined by the senior author whilst visiting the National Museum of New Zealand, Wellington. Reappraisal of these specimens showed the occurrence of a new *Echinaster* species on the southeastern coast of Australia and at Norfolk Island. This is the first report of *Echinaster* from Norfolk Island. Table 1 lists all known species of *Echinaster* occurring in Australian waters with their distributions. A key is also provided for the species.

SYSTEMATIC ACCOUNT

Family Echinasteridae

Genus *Echinaster* Müller & Troschel, 1840

Key to Australian species of *Echinaster*

1. Abactinal spinelets large, conspicuous, up to 4-5mm long, well spaced, single, on the primary plates only, arms cylindrical.
E. callosus
- 1'. Abactinal spinelets smaller, <2mm long, numerous, single or in groups on primary plates, sometimes spinelets occur also on secondary abactinal plates, arms cylindrical or widened at base.

2.

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2. Abactinal spinelets single, on primary plates, skeletal reticulum with relatively small papular areas, arms cylindrical or widened at the base. 3.
- 2'. Abactinal spinelets in small (2-4) to large (5-60) groups on primary plates, sometimes spinelets occur on secondary plates, relatively large papular areas, arms cylindrical. 6.
3. Arms cylindrical, disc small. 4.
- 3'. Arms widened at base, disc relatively large. *E. stereosomus*
4. 5-7 arms, autotomus, usually more than one madreporite, subambulacral spines well developed. *E. luzonicus*
- 4'. 5 arms, not autotomus, single madreporite, subambulacral spines not well developed. 5.
5. Abactinal and actinal spinelets include stout, chisel-shaped or club-shaped forms. *E. superbus*
- 5'. Abactinal and actinal spinelets uniform in size and shape, bluntly rounded at tips or truncate, some may be pitted at tip. *E. varicolor*
6. Abactinal spinelets in large discrete groups on primary plates (5-60). Papulae extend to inferomarginal line. *E. glomeratus*
- 6'. Abactinal spinelets in small groups on primary plates (2-4). also singly on secondary plates, papulae restricted to abactinal surface above the superomarginal line. 7.
7. Papulae 11-40 (up to about 60) per area, papular areas up to about 15.00mm diameter. *E. arcystatus*
- 7'. Papulae 6-8 (up to about 14) per area, papular areas up to about 6.5mm diameter. *E. colemani*

Echinaster colemani n.sp.

Figs 1a-b, 2

Diagnosis: A species of *Echinaster* with a well developed reticular abactinal skeleton; spinelets occur in groups of 2-4 on primary plates at reticular junctions and singly on secondary plates between junctions; papular areas of skeletal reticulum up to 6.5mm diameter, containing 3-14, usually 6-8 papulae; papulae occur abactinally as far as the superomarginal line.

Material examined: Holotype, AM J13076, R/r=110mm/13mm, Bate Bay, off Cronulla, N.S.W., 24.4m, rocky bottom; (14 paratypes), 1 paratype, J10862, R/r=40/8, off Moreton Bay, Qld, 76.8m; 1 paratype, J15258, R/r=85/13.5, Julian Rocks, Byron Bay, N.S.W., 24.4m; 1 paratype, J15259, R/r=43/8.4, South Solitary Islands, off Coffs Harbour, N.S.W., 27.4mm; 2 paratypes, J16541, R/r=71/10, J16534, R/r=100/13, Broughton Island, near Port Stephens, N.S.W., 18m, reef; 1 paratype, J13000, R/r=65/10.5, Broughton Island, near Port Stephens, N.S.W., 25m, on rocks; 1 paratype, J13077, R/r=92/15, off Boat Harbour, north of Cronulla, N.S.W., 39.7m; 1 paratype, J13084, R/r=75.5/13, off Cronulla, N.S.W., 30.5m; 1 paratype, J10835, R/r=80/13, Jibbon Point, Bundeena, N.S.W., 25m, sand and rubble; 1 paratype, J590, R/r=106/14.5, Newcastle Bight, N.S.W.; 1 paratype, J9182, R/r=56/12.5, Bass Point, N.S.W., 17m, bottom cover of sponge and coral; 2 paratypes J14137,

2. Abactinal spinelets single, on primary plates, skeletal reticulum with relatively small papular areas, arms cylindrical or widened at the base. 3.
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5. Abactinal and actinal spinelets include stout, chisel-shaped or club-shaped forms. *E. superbus*
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7. Papulae 11-40 (up to about 60) per area, papular areas up to about 15.00mm diameter. *E. arcystatus*
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Echinaster colemani n.sp.

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TABLE 1

Species of the genus Echinaster occurring in Australian waters
(H. L. Clark, 1946; L. M. Marsh, 1976; Rowe (unpublished))

Species/Author	Distribution
<i>E. arcystatus</i> H. L. Clark	Shark Bay, W.A. south to Waterloo Bay, Wilsons Promontory, Vict. (Endemic).
* <i>E. callosus</i> von Marenzeller	Lizard Island, Qld. (Indo-west Pacific; Clark and Rowe, 1971).
<i>E. glomeratus</i> H. L. Clark	Abrolhos Islands, W.A., Dongarra, W.A., south to Kangaroo Island, S.A. (Endemic).
<i>E. luzonicus</i> (Gray)	Exmouth Gulf, W.A. north and east along the coast to Double Island Point, Qld, south to Solitary Islands, N.S.W.; offshore reefs, Rowley Shoals and Ashmore, W.A. along the Great Barrier Reef from Murray Islands south to Bunker Group, Qld. (East Indian region to islands of the south-west Pacific; Clark and Rowe, 1971).
<i>E. stereosomus</i> Fisher (syn. <i>E. acanthodes</i> H. L. Clark; Jangoux, 1978)	Murchison, W.A. north and east to Fraser Island, Qld, south to Brunswick Heads, N.S.W. (Philippines south to Australia; Jangoux, 1978).
<i>E. superbus</i> H. L. Clark	Broome south west to Dampier Archipelago (N.W. Cape). W.A. (Endemic).
<i>E. varicolor</i> H. L. Clark	Broome south to Esperance, W.A. (Endemic).
<i>E. colemani</i> n.sp.	Moreton Bay, Qld, south to Ulladulla, N.S.W., possibly to Bass Strait; Norfolk Island.

* New record based on 2 specimens held in the Australian Museum collections (AM J9674; 13096).

R/r=137.5/18.5, 115/16.2, Ulladulla, N.S.W., 24.4m, rocky bottom; 1 paratype, ? Bass Strait, trawled (? 91-110m); 1 specimen NZOI, R/r=137/18.5, Norfolk Island, 5-15m.

Distribution: Moreton Bay, Qld, south to Ulladulla, N.S.W., (? Bass Strait), Norfolk Island (N.E. Tasman Sea), in depths ranging from 17-40m (? possibly to 91-110m).

Description: R=40-137mm, r=8-18.5mm, R/r=4.48-8.4 (av. 6.4). Arms 5, rounded in cross-section, tapering evenly to a blunt tip, though slightly constricted at the base (Figs 1a-b). The body is covered by a thick skin. The disc is relatively small with the madreporite, which bears small spinelets, close to the interradial angle. The abactinal skeleton forms an open reticulum, the papular areas of which are more or less pentagonal and range from 3-6.5mm diameter in the specimens examined (Fig. 2). The papular areas contain 3-14 papulae, but more often 6-8 papulae. The papulae extend to the superomarginal line. Below the superomarginals groups of papula-like patches of skin occur, but these do not extend to the coelom due to a dense, fibrous tissue occluding the spaces between the plates. The primary abactinal plates at each of the 5 junctions of the pentagonal papular areas, bear groups of 2-4 small, bluntly pointed spinelets. One to four spinelets occur singly, spaced, on secondary plates delimiting the circumference of the papular areas.

Superomarginal plates are irregularly quadrilobed and bear 2-3 spinelets (1 distally on the arms). Inferomarginal plates are similarly quadrilobed, but larger than the superomarginals. They similarly bear 2-3 spinelets (1 distally). An irregular series of intermarginal plates extends to 1/5-1/4R. A number of these plates each bear a single spinelet.

Adambulacral plates are rectangular, broader than long. They bear a single, small furrow spine on the vertical surface. Across the actinal surface of the plate are 3, sometimes only 2, prominent subambulacral spines. The innermost and outermost are usually stout and cylindrical, but the middle spine may be flattened chisel-shaped towards the tip, or widened and scoop-shaped at the tip, the flattening or scooping being parallel to the furrow.

A row of actinal plates extends for about 1/5-1/4R, each plate bearing a single spinelet.

Oral plates bear 1 or 2 small furrow spinelets (where 2 are present they stand adjacent

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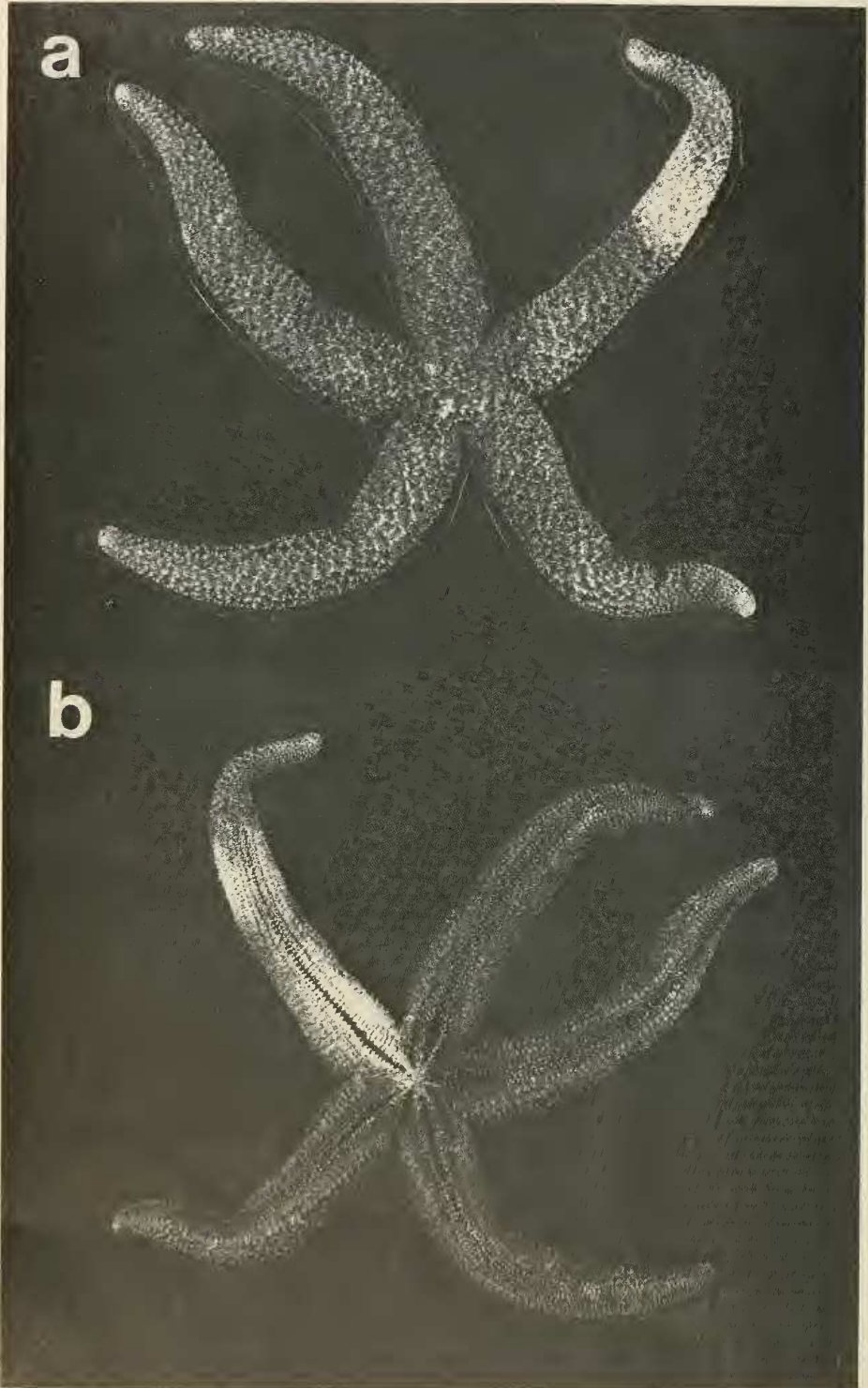


Fig. 1. Echinaster colemani sp. nov. (holotype; AMJ13076). a. abactinal surface; b. actinal surface (R=110mm).

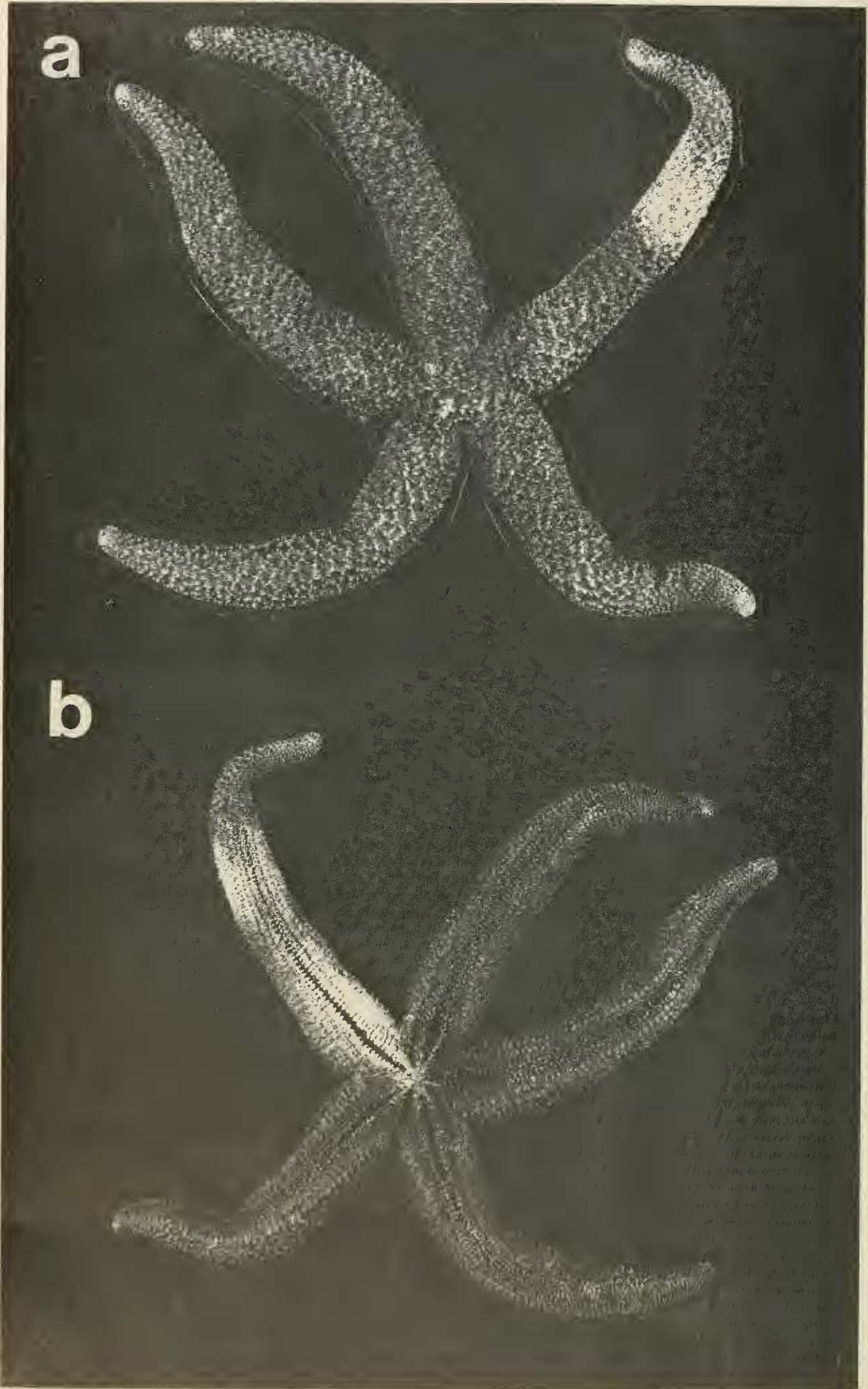


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Fig. 2. *Echinaster colemani* sp. nov. (holotype) abactinal surface showing fine reticulation and papulae.

to one another) and 4-6 subambulacral spines. The subambulacral spines form a single or irregularly double series behind the first spine at the apex of each oral plate.

Colour: In life this species is velvet brown with purple papulae (Coleman, *pers. comm.*).

Etymology: Named for Mr Neville Coleman, who has contributed many specimens to the Australian Museum collections, including specimens of this species.

Remarks: *E. colemani* is most closely related to *E. arcystatus* H. L. Clark, 1914, (Fig. 3a, b) and *E. glomeratus* H. L. Clark, 1916, (Fig. 4). These latter species are endemic to Australia and occur sympatrically along most of the west and south coasts. All three species bear clusters of spinelets on primary abactinal skeletal plates at the reticular junctions between the papular areas. However, *E. glomeratus* is immediately distinguished from *E. colemani* and *E. arcystatus* by: its stouter abactinal skeletal spinelets, which are restricted to discrete groups of 10-20 or more (up to 60) on the primary plates (Fig. 4); the extension of papulae to the inferomarginal line; and the arrangement of its subambulacral spines. *E. colemani* and *E. arcystatus* share the restriction of papulae to the abactinal surface above the superomarginal line of plates, the occlusion of spaces between the plates below the superomarginal line, the distribution of abactinal spinelets and arrangement of subambulacral spines. *E. colemani* (Figs 1a-b, 2) differs from *E. arcystatus* (Figs 3a-b) principally in the consistently smaller size of the abactinal papular areas (up to about 6.5mm, *colemani*, up to about 15mm, *arcystatus*) and fewer papulae per area (up to 14, usually 6-8, *colemani*; up to 60, usually 11-40, *arcystatus*). The largest specimen of *colemani* known measures R=137mm; *arcystatus*



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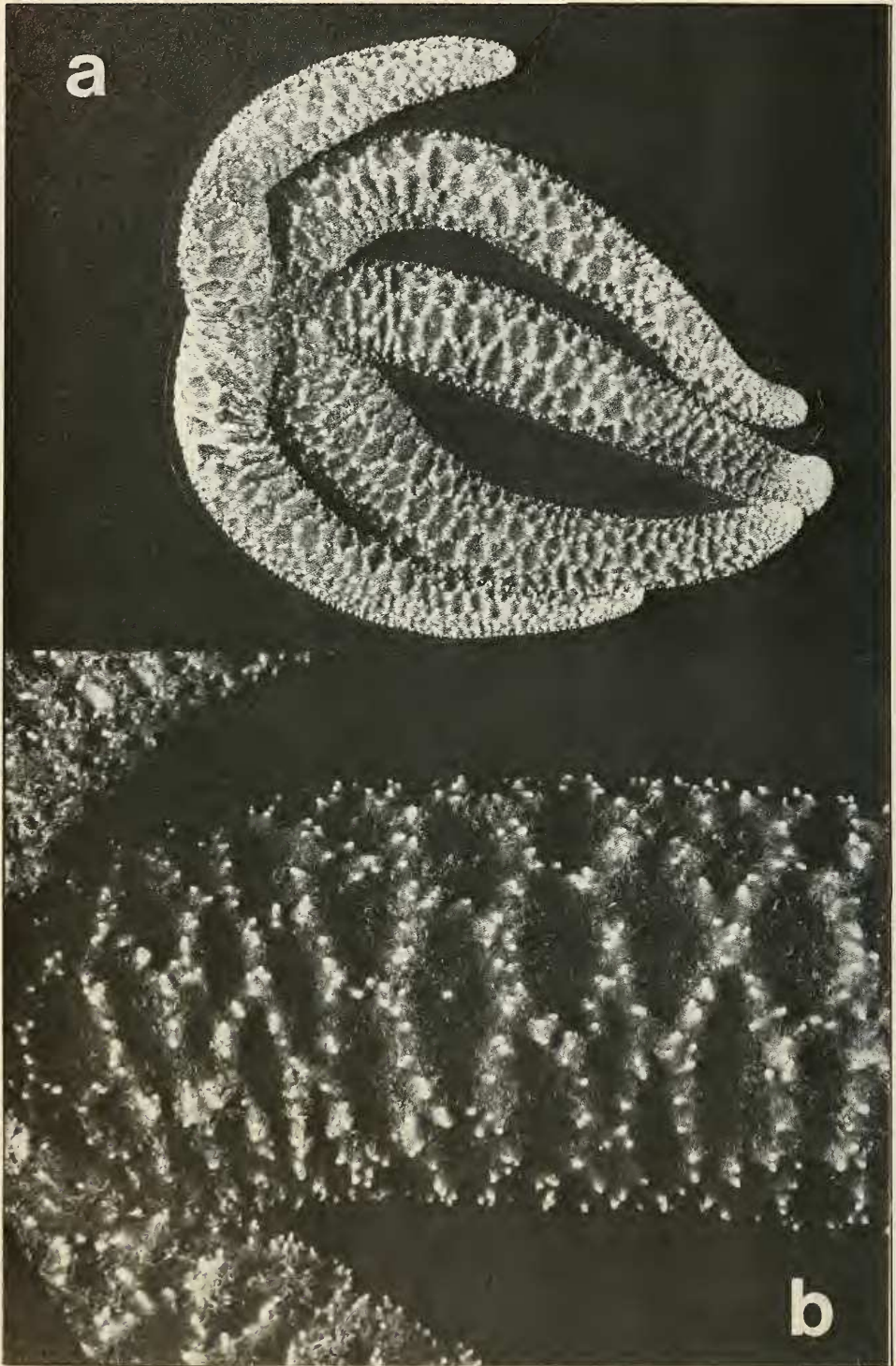


Fig. 3. *Echinaster arcystatus* (AM J11873) a. abactinal surface (R=189mm); b. detail of reticulation, abactinal surface of arm.

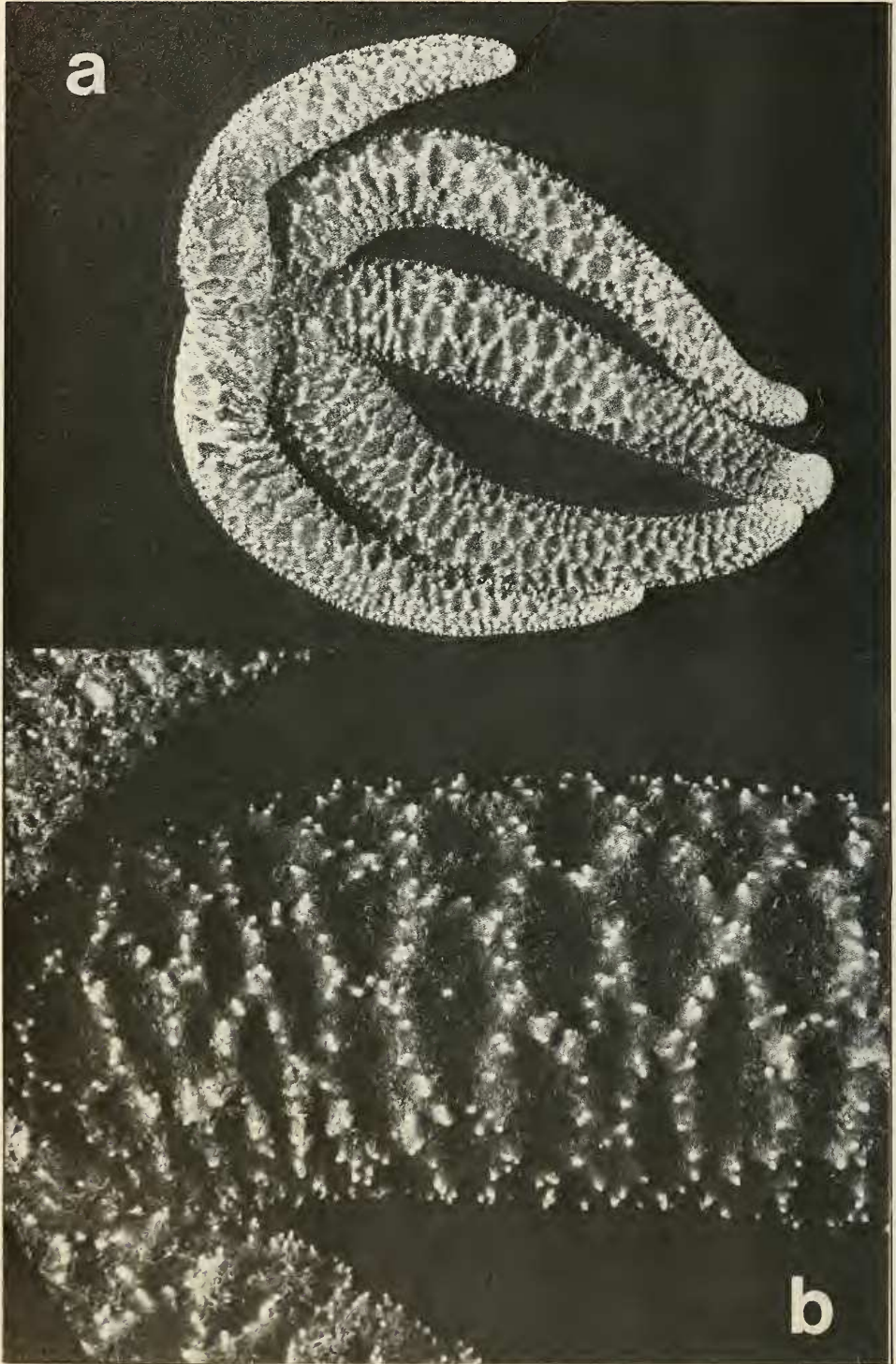


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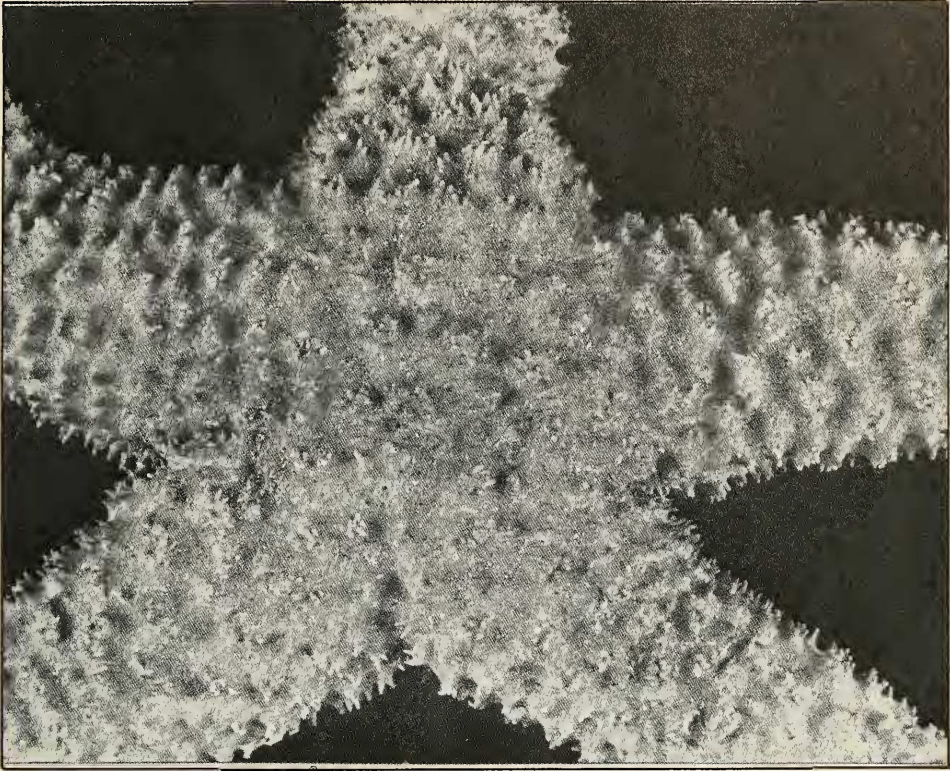


Fig. 4. *Echinaster glomeratus* (holotype; AM J1624) abactinal surface (R=135mm).

R=186mm. The velvet brown colour of *colemani* contrasts with the yellow/pink background colour and bright purple papulae of *arcystatus* (Coleman, *pers. comm.*).

It seems likely that *E. colemani* has evolved from *E. arcystatus*, or their common precursor, through isolation in the Tasman region, possibly as recently as 18-20,000 years ago when Bass Strait was last emergent during a glacial period. *E. arcystatus* is known to occur as far east along the south coast as Wilsons Promontory, Victoria (AM J11873).

The distribution of *E. colemani* south of Ulladulla on the New South Wales coast, however, requires confirmation. We believe there is an element of doubt regarding the Bass Strait locality attributed to the specimen (AM J8652) we identify as *E. colemani* reputedly collected during the Endeavour (1909-1914) Expedition. Since the specimen was not seen or reported by H. L. Clark (1916), it is possible that the label attached to the specimen may have been associated with it by error.

The occurrence of *E. colemani* at Norfolk Island is interesting. The reproductive strategy of *colemani* has not been determined, although its occurrence at Norfolk Island suggests a strategy involving a planktotrophic larval stage. This would facilitate dispersal across the Tasman from the coast of New South Wales in the known west to east current tracts (Rowe, 1985). The apparent absence of this shallow-water species from Lord Howe Island or other locations on the Lord Howe Ridge is perplexing. Considering the few specimens found so far, absence from such intermediate locations may be due to lack of collecting, rather than to any other agency.

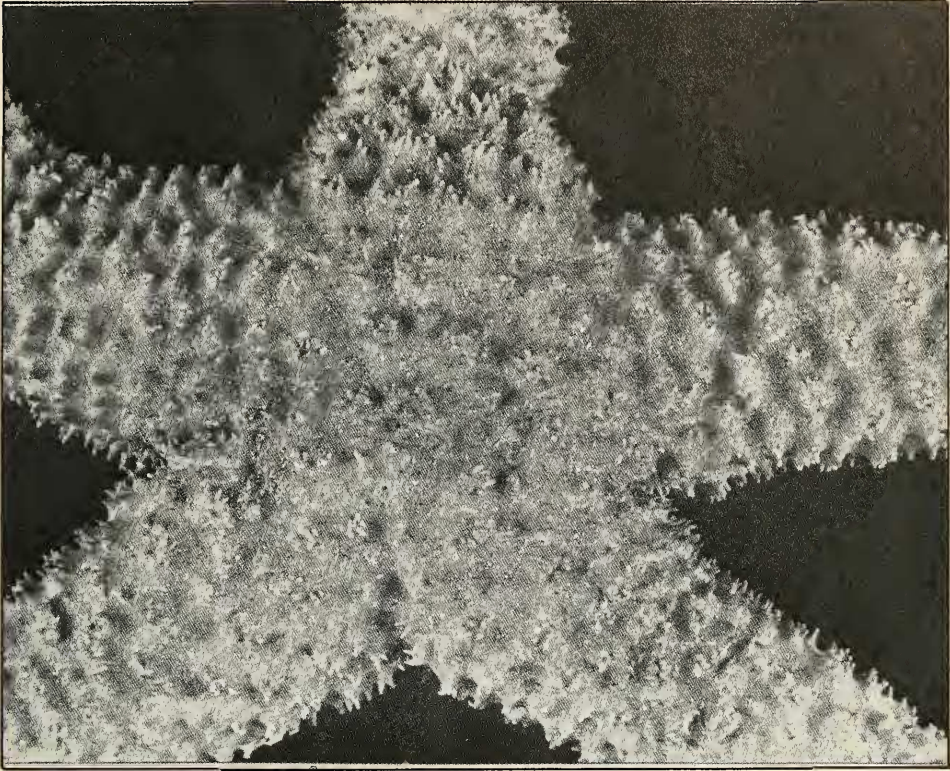


Fig. 4. *Echinaster glomeratus* (holotype; AM J1624) abactinal surface (R=135mm).

R=186mm. The velvet brown colour of *colemani* contrasts with the yellow/pink background colour and bright purple papulae of *arcystatus* (Coleman, *pers. comm.*).

It seems likely that *E. colemani* has evolved from *E. arcystatus*, or their common precursor, through isolation in the Tasman region, possibly as recently as 18-20,000 years ago when Bass Strait was last emergent during a glacial period. *E. arcystatus* is known to occur as far east along the south coast as Wilsons Promontory, Victoria (AM J11873).

The distribution of *E. colemani* south of Ulladulla on the New South Wales coast, however, requires confirmation. We believe there is an element of doubt regarding the Bass Strait locality attributed to the specimen (AM J8652) we identify as *E. colemani* reputedly collected during the Endeavour (1909-1914) Expedition. Since the specimen was not seen or reported by H. L. Clark (1916), it is possible that the label attached to the specimen may have been associated with it by error.

The occurrence of *E. colemani* at Norfolk Island is interesting. The reproductive strategy of *colemani* has not been determined, although its occurrence at Norfolk Island suggests a strategy involving a planktotrophic larval stage. This would facilitate dispersal across the Tasman from the coast of New South Wales in the known west to east current tracts (Rowe, 1985). The apparent absence of this shallow-water species from Lord Howe Island or other locations on the Lord Howe Ridge is perplexing. Considering the few specimens found so far, absence from such intermediate locations may be due to lack of collecting, rather than to any other agency.

In a preliminary analysis of the distributions of some 440 species which we identify as occurring on the coast of New South Wales, no fewer than 54 species (12.3%) occur either at Norfolk Island and/or Kermadec Islands and New Zealand, but not on the Lord Howe Ridge. Of these only 8 occur in shallow water (< 30m), 13 occur across the continental shelf (31-200m) and the remaining 33 occur on the slope and deeper (201+ m). Shallow-water species which share with *E. colemani* a distribution along the New South Wales coast and at Norfolk Island are the southern Australian asteroid species *Austrofromia polypora* and crinoid species *Antedon incommoda*. The echinoid species *Phyllacanthus parvispinus* is distributed along the New South Wales coast and occurs at the Kermadec Islands, whilst the southern Australian asteroid species *Allostichaster polyplax*, the ophiuroid species *Ophiopeza cylindrica* and holothurian species *Chiridota gigas* are known also from the coast of New South Wales and in New Zealand waters.

In discussing the distributions of species of *Asterodiscides*, Rowe (1985) suggested that populations of the southern and southeast Australian species *A. truncatus* (Coleman), which also occurs only at the Kermadec Islands and New Zealand region, might be self-sustaining and relatively phenotypically stable in their northeastern Tasman locations. He considered it is difficult to determine whether larval input was maintaining gene flow across the Tasman, despite the occurrence of appropriate current tracts. Only further sampling along the Lord Howe Ridge and in deeper waters of the Tasman Sea, together with detailed studies of reproductive strategies of these echinoderms, will help to elucidate these apparently disjunct distributions.

ACKNOWLEDGEMENTS

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