ISSN 0168-6259

Distributed in USA & Canada by: A.A.Balkema Publishers, P.O.Box 230, Accord, MA 02018

Printed in the Netherlands

South-west Pacific cidarid echinoids (Echinodermata), including two new species

A.K.Hoggett* & F.W.E.Rowe

The Australian Museum, College Street, Sydney, New South Wales 2000, Australia

ABSTRACT: The cidarid echinoid fauna of the south-west Pacific Ocean (including the Solomon Islands, New Caledonia, Vanuatu, Fiji and Samoa), is now known to comprise eight species. A new species of *Histocidaris* from 420 m off New Caledonia, and a new species of *Prionocidaris* from 55-275 m off New Caledonia and Vanuatu, are described. *Goniocidaris peltata* Mortensen, 1927, is newly recorded from 420 m off New Caledonia. New records from Australia for some of the species are included.

1. INTRODUCTION

Only five cidarid species have been reliably recorded from the south-west Pacific islands (Mortensen 1928, Clark & Rowe 1971, Rowe & Hoggett. 1986). They are *Eucidaris metularia* (Lamarck, 1816), *Prionocidaris verticillata* (Lamarck, 1816), *Phyllacanthus imperialis* (Lamarck, 1816), *Chondrocidaris brevispina* H.L.Clark, 1925, and *Prionocidaris callista* Rowe & Hoggett, 1986. The first three species are widespread throughout the Indo-west Pacific.

Michelin (1861) has also recorded *Cidaris Thouarsii* Valenciennes, [*Eucidaris thouarsii* (Agassiz & Desor, 1846)] from New Caledonia. *E. thouarsii* is otherwise known only from the west coast of America, from California to Panama, and the Galapagos Islands (Mortensen 1928). It seems likely that Michelin's record is based on a misidentification or incorrect locality data.

Six species of cidarid are represented in the Australian Museum collection from that area of the south-west Pacific Ocean which includes the Solomon Islands, New Caledonia, Vanuatu, Fiji and Samoa. This includes two new species, and one species newly recorded from this area. New Australian records for some species of south-west Pacific cidarids are also given. In all, eight species of cidarid echinoids are now known to occur in the south-west Pacific islands.

All material listed is in the collection of the Australian Museum. Abbreviations used in the text are as follows: h.d. = horizontal test diameter; W.A. = Western Australia; Qld. = Queensland, Australia; N.S.W. = New South Wales, Australia.

*New address, Northern Territory Museum, GPO Box 4646, Darwin, N.T. 5794, Australia.

2. SYSTEMATIC ACCOUNT

Genus Histocidaris Mortensen

Histocidaris longicollis sp.nov. (Pls 1A-C)

Material. Holotype, J19173, south of New Caledonia (23°S 167°17'E), 420 m, 'Coreolus', 6.4.71.

Diagnosis. Well-developed tridentate pedicellariae are the only form of pedicellaria present; primary tubercles are strongly crenulate; marginal ambulacral tubercles are well-spaced, in a regular series; collars of primary spines are long, up to 9 mm on ambital spines; shafts of primary spines are ornamented with longitudinal rows of fine, distally-directed spinules, which are more well developed on the adapical side of the spine than on the lower side.

Distribution. Known only from the type locality.

Description. Some measurements of the holotype are listed below:

Horizontal diameter (mm)	19
Vertical diameter (mm)	12
Apical system diameter (mm)	7
Apical system diameter: h.d. (%)	37
Peristome diameter (mm)	8
Peristome diameter: h.d. (%)	42
No. interambulacrals	5-6
No. ambulacrals/interambulacral	7-8
Width interambulacrum (mm)	10
Width ambulacrum (mm)	2
Longest spine (mm)	50+
Longest collar (mm)	9

The ambulacra are only very slightly sinuate. The interpore zone is about twice the width of a pore zone, and slightly raised. The midline is not sunken. The marginal ambulacral tubercles are in a regular series, widely spaced from each other, and are slightly smaller than the scrobicular tubercles. There is a single inner tubercle on each ambulacral plate. The pores of a pair are close together, oriented obliquely. They are separated by a distinct wall.

The interambulacra have five or six coronal plates in each series. The areoles are large, occupying most of the plate. The areoles above the ambitus are separated only by the scrobicular tubercles. Below the ambitus, the upper and lower scrobicular tubercles become progressively reduced, so the proximal 2-3 areoles are confluent. The median area is very narrow, less than one third the width of an areole. There are very few miliary tubercles owing to the small median area. The median sutures are slightly sunken and are bordered by a narrow bare area.

The apical system has all the oculars widely exsert. The genital pores are not developed, indicating that this specimen is a juvenile. Each of the periproctal

plates bears at least one comparatively large spine, forming a tuft around the anus, but the rest of the apical system is rather bare. Tubercles are present on the inner edge and on the outer median part of the genital plates, and are sparsely situated all over the ocular plates. Each of the ocular plates bears one very large (2.5 mm) tridentate pedicellaria, among other smaller tridentate pedicellaria.

The primary spines are long, slender, and gently tapering. Length of the ambital spines is at least 2 × h.d. The shaft has about 12 very low, longitudinal ridges, which are set with fine, distally-directed spinules, especially on the adapical side of the spine (Pl. 1C). The lower surface of the shaft is distinctly smoother. The collar is relatively long, 8-9 mm on ambital spines. There is a short neck (1 mm) between the collar and the shaft. The 1-2 uppermost primary spines have not developed the shaft ornamentation, and are markedly shorter than the apical spines. The oral primary spines are short, flattened and curved inwards, with strongly serrate margins.

The scrobicular spines vary slightly in shape. They are about 2.5 mm long and flattened, but some taper from a broad base to a point, while others are more spatulate, with a broad, round tip. The outer surface of the latter may be excavate. The miliary spines are long (up to 1.5 mm) and erect, cylindrical or slightly flattened basally. The marginal ambulacral spines are flattened, but are not as broad, and slightly shorter than the scrobicular spines.

Tridentate pedicellariae are the only type of pedicellaria present, and these vary widely in size, to a maximum valve length of 2.5 mm. The valves are long and slender, usually terminating in a hook (Pl. 1B). The terminal hook is usually more well-developed in one of the three valves. The largest pedicellariae are found on the apical system and in the interambulacra above the ambitus; they become smaller below the ambitus. Small tridentate pedicellariae are found on the apical system, amongst the scrobicular spines, and in the ambulacra.

The naked test and secondary spines of the dried specimen are white in colour. The collars of the primary spines are white or yellowish-white, and the shafts change from white near the collar to a delicate, deep pink by midway along the shaft.

Remarks. H.longicollis is a very distinctive species, despite the fact that only a single, juvenile specimen is known. It is placed in *Histocidaris* without hesitation, as we have directly compared the holotype of *longicollis* with similarly-sized specimens of *H.elegans* (Agassiz, 1879), the type species of the genus. A specimen of *elegans* wih h.d. of 7 mm (J15833) has no genital pores, while another of 21 mm h.d. (J15810) has pores in only three of the five genital plates. All genital plates have developed pores by the time h.d. of 25 mm has been reached in *elegans* (e.g. J15809). Characters accorded generic importance by Mortensen (1928) which are shared by the holotype of *longicollis* and juvenile specimens of *elegans* include: possession of only tridentate pedicellariae of various sizes; non-conjugate pores; sparse tuberculation of the apical system; form of the primary spines, including the serrate, curved, oral primaries; and erect secondary spines.

H.longicollis differs most markedly from all other *Histocidaris* species by the extreme length of the collars of the primary spines. At up to 9 mm long, the collars of *longicollis* are more than twice as long as any recorded by Mortensen (1928) for any *Histocidaris* species.

Poriocidaris Mortensen is the only genus linked with *Histocidaris* in the group Histocidarina, according to Mortensen (1928). *Poriocidaris* is distinguished from *Histocidaris* by its very long primary spine collar, and by its two-valved pedicellariae. It is represented by a single species, *P.purpurata* (Thomson, 1872) which is known mainly from the north east Atlantic, although a single specimen has been reported from the Indian Ocean by Döderlein (1906). Mortensen (1928) considered an error in the locality data of the latter specimen may have occurred.

H.longicollis is similar to *P.purpurata* in the length of the primary spine collar. The presence of only three-valved pedicellariae in *longicollis*, however, precludes its referral to *Poriocidaris.* Comparison of a specimen of *P.purpurata* (J5162) from the north-east Atlantic with the holotype of *longicollis* also shows major differences in the primary spines between the species. The collars of *P.purpurata* are pigmented deep brown/purple, while those of *longicollis* are white, and the shafts of *P.purpurata* lack the fine spinules present in *H.longicollis*, being either smooth or with a few scattered thorns.

Two Indo-Pacific species of *Histocidaris* (*variabilis* Agassiz & Clark, 1907; *denticulata* Koehler, 1927) are known to have two-valved pedicellariae occasionally. As a species of *Histocidaris* with a long collar has now been found to occur in the Pacific Ocean, the distinctness of *Poriocidaris* must be questioned. The two nominal genera are widely separated geographically, and there is apparently little variability in the two-valved pedicellariae of *P.purpurata* according to Mortensen (1928), so the two may perhaps be maintained. They are very closely related, however, and Mortensen (1928) suggested that it may be better to regard *Poriocidaris* as a subgenus of *Histocidaris.*

The species most closely related to *H.longicollis* appears to be *H.elegans*, which occurs from Japan, through the Philippines and Indonesia, to north-west Australia and south to Bass Strait, Australia (Rowe & Hoggett, 1986). The two species share similar primary spine shaft ornamentation, general pedicellaria shape, and test features. Mortensen (1928) has not described a terminal hook on the pedicellariae valves of any species of *Histocidaris*, although it is illustrated (1928: Pl. 71, Fig. 1) for *H.variabilis.* Examination of specimens of *elegans* from N.S.W. waters shows this hook to be present occasionally, but it is not as well-formed as in *longicollis. H.longicollis* differs from *elegans* in its considerably longer collars, in having the shaft ornamentation more pronounced on the adapical side than on the adoral side, and in having a distinct hook on the tip of the valves of the larger pedicellariae. The pink colouration of the primary spines of *longicollis* has not been observed in *elegans*, or reported for any other species of *Histocidaris* by Mortensen (1928).

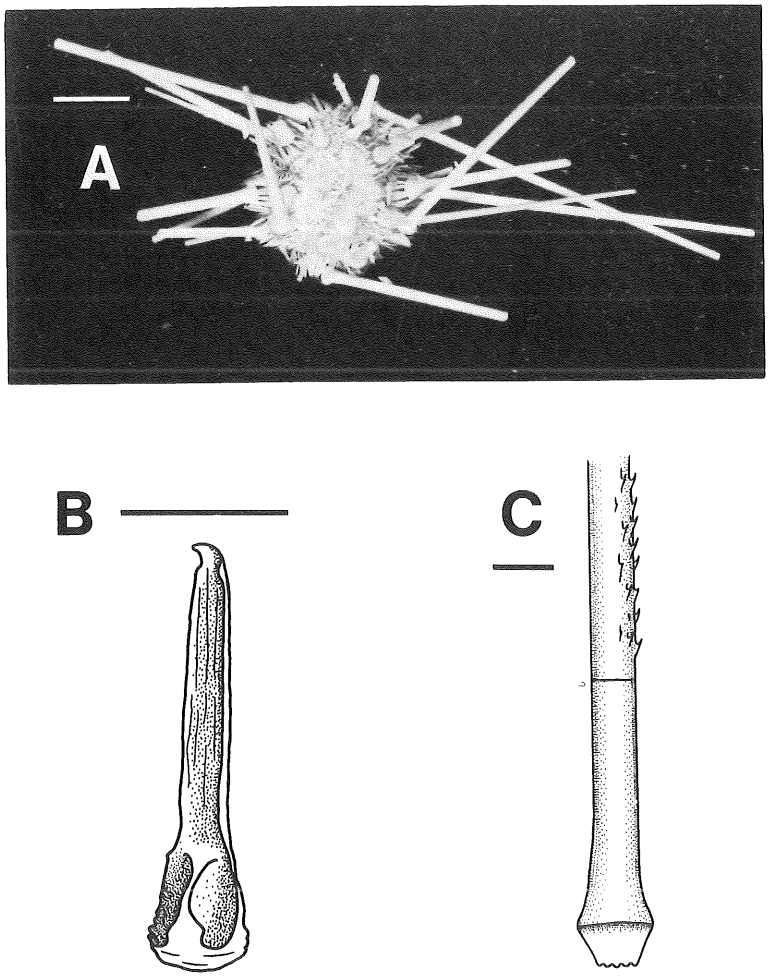

Plate 1. *Histocidaris longicollis*, holotype, J19173. A. Whole specimen, scale = 10 mm; B. Valve of tridentate pedicellaria, scale = 1 mm; C. Proximal portion of primary spine, adapical side on right, scale = 2 mm.

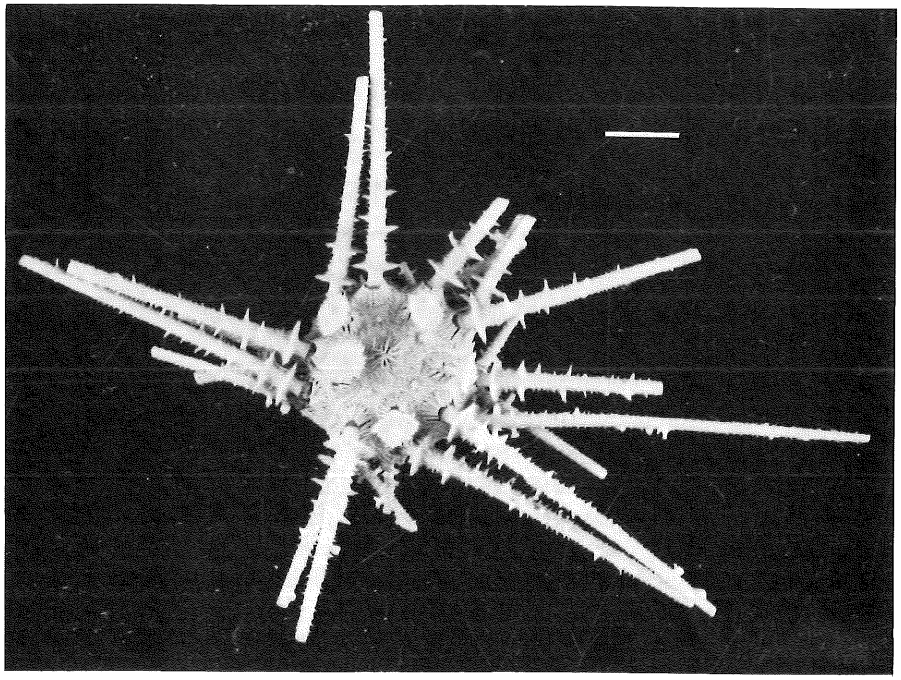

Plate 2. *Goniocidaris peltata*, J19172, scale = 10 mm.

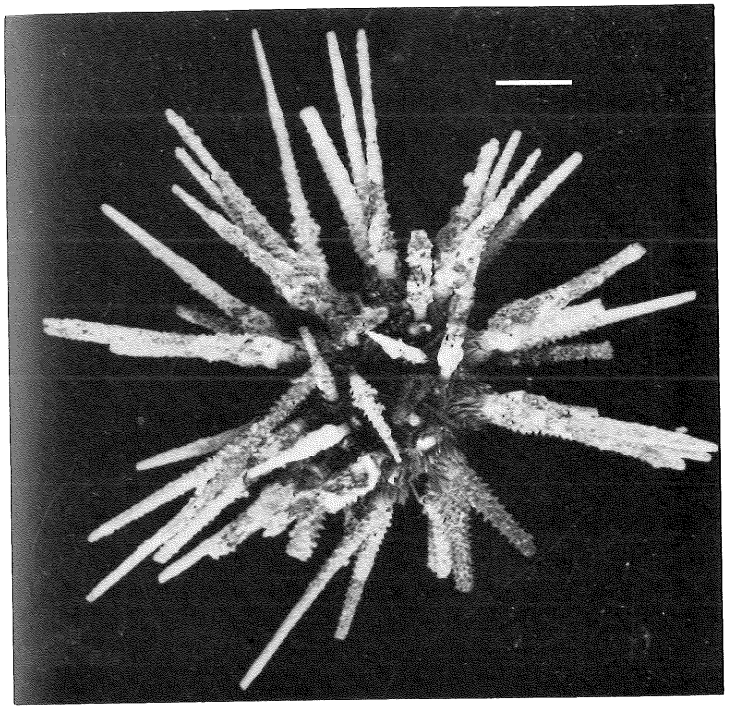

Plate 3. *Prionocidaris callista*, J8191, scale = 20 mm.

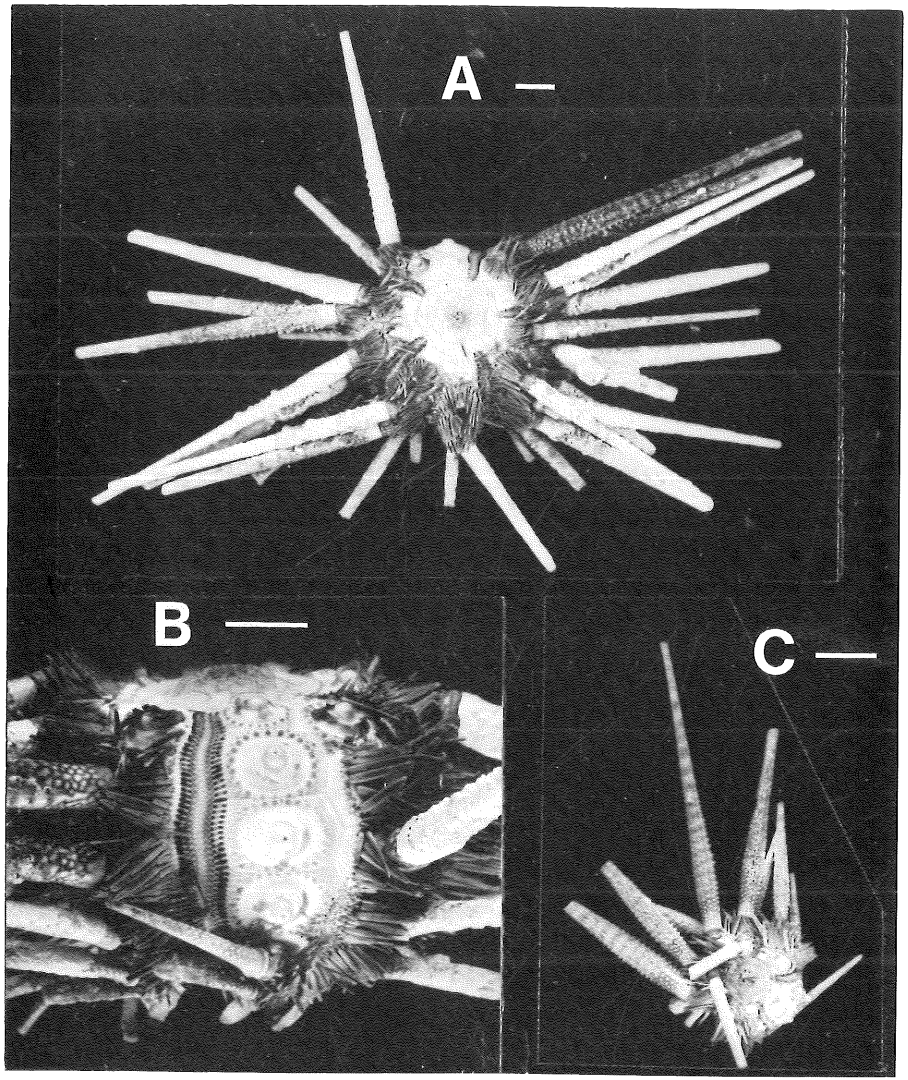

Plate 4. *Prionocidaris popeae*, scale = 10 mm. A. Holotype, J19206, whole specimen; B. Holotype, lateral view; C. Paratype, J19210, whole specimen.

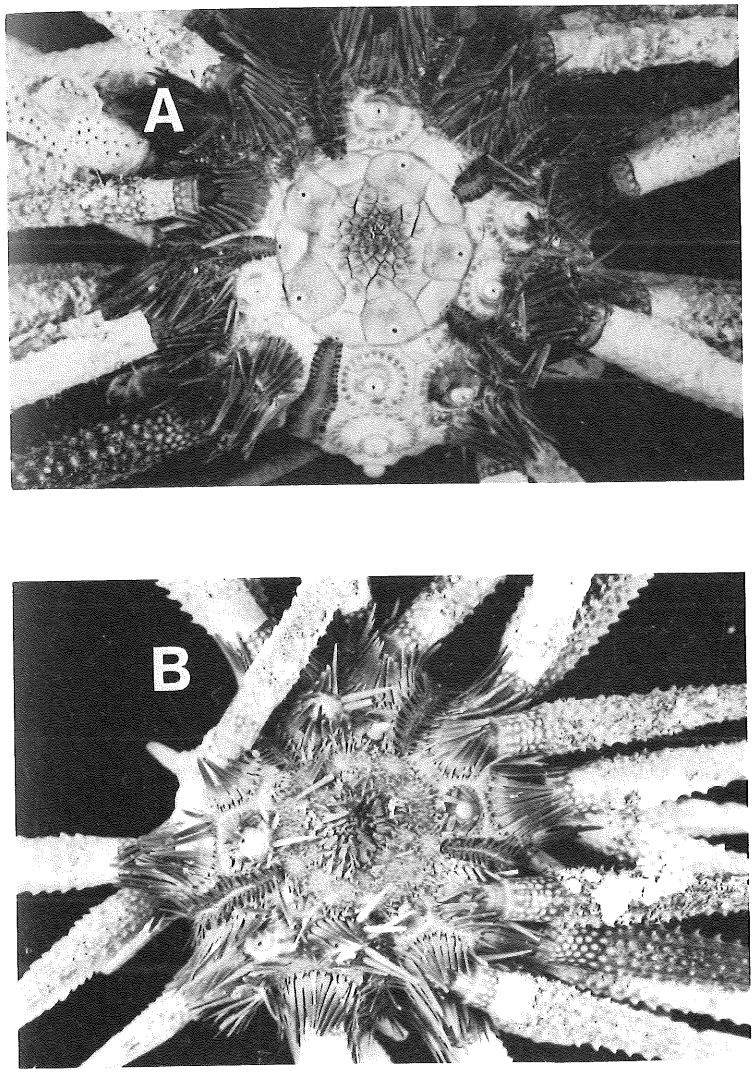

Plate 5. *Prionocidaris popeae*, apical system. A. Holotype J19206; B. Paratype, J19207.

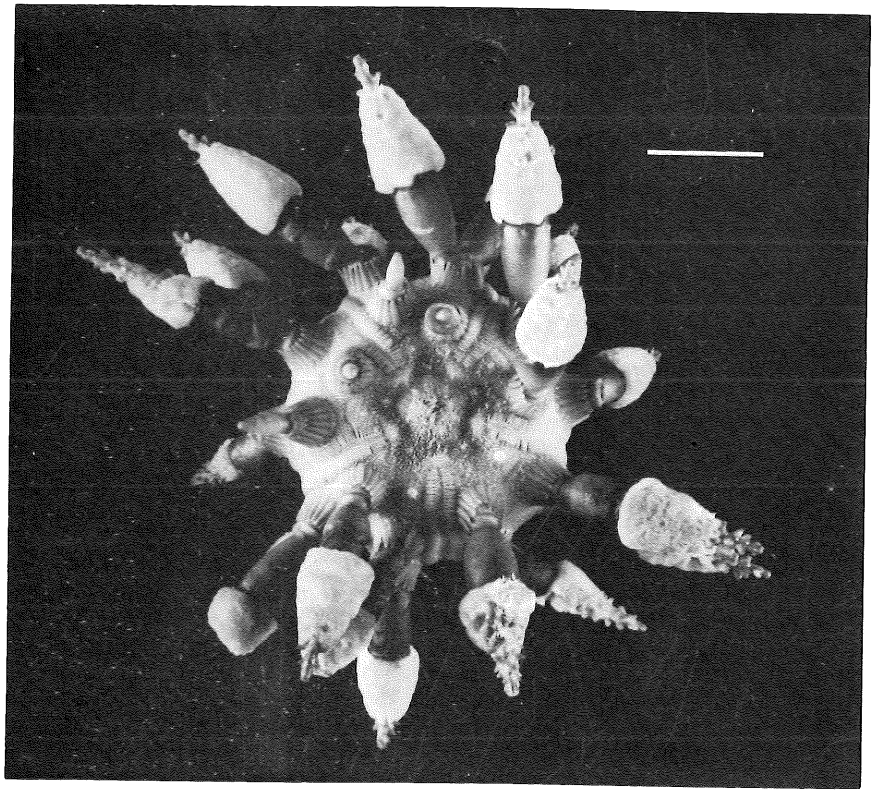

Plate 6. *Chondrocidaris brevispina*, J18916, scale = 20 mm.

Genus Goniocidaris Agassiz & Desor

Goniocidaris peltata Mortensen (Pl. 2)
Goniocidaris (Petalocidaris) peltata Mortensen, 1927:261, Pl. 55-56, 74.4-5, 78.9-12.
Goniocidaris (Discocidaris) peltata: Mortensen, 1928:183, Pl. 15.17-18.

Material. 1 specimen, J19172, south of New Caledonia (23°00'S 167°17'E), 420 m, 'Coreolus' 6.4.71.

Diagnosis. Globiferous pedicelariae are of two forms, and tridentate pedicellariae are apparently not present; apical primary spines are very short, with a well-developed, eccentric, terminal disc, the internal side being the larger; basal discs on other primary spines are well-developed; partial discs or coarse thorns also occur on the proximal half of these spines; primary spines with numerous, non-anastomosing hairs, especially near the basal discs; scrobicular spines are flattened, with a square-cut tip; miliary spines are more or less cylindrical, very short and slender.

Distribution. Indonesia; New Caledonia. 235-420 m.

Remarks. The specimen from New Caledonia is only the third one known of *Goniocidaris peltata.* Some measurements are listed below for comparison with those given by Mortensen (1928) for the other two specimens:

Horizontal diameter (mm)	23
Vertical diameter (mm)	17
Apical system diameter (mm)	9.5
Apical system diameter: h.d. (%)	41
Peristome diameter (mm)	10.5
Peristome diameter: h.d. (%)	46
No. interambulacrals	7-8
No. ambulacrals/interambulacral	11
Longest spine (mm)	55+

The holotype, from off Ternate, Indonesia, measures 25 mm h.d., and the second known specimen, from the Kei Islands, is 19 mm h.d. (Mortensen 1928). The latter specimen differs from the holotype in lacking apical discs, in having the median ambulacral and interambulacral areas more naked, and in having more slender secondary spines (Mortensen 1928). Mortensen considered the first two differences to be developmental, the Kei Islands specimen being a juvenile. The last difference was regarded as intraspecific variation.

The New Caledonia specimen is similar to the holotype in having well-developed apical discs. However, it has more or less bare median ambulacral and inter-ambulacral areas, which is unlike the description of the holotype, but similar to that of the smaller specimen. The hair coat of the primary spines is dense only near the base on the New Caledonian specimen. Mortensen (1928) described the hair coat of the other two specimens as being dense over the whole shaft

surface. In all other respects, the New Caledonian specimen agrees with the descriptions of *G.peltata* given by Mortensen in 1927 and 1928.

The known geographical range of the species is thus extended eastwards, from Indonesia to New Caledonia.

Genus Prionocidaris Agassiz

Prionocidaris verticillata (Lamarck)
Cidarites verticillata Lamarck, 1816:56.
Plococidaris verticillata: Mortensen, 1928:428 (synonymy), Pls 51.3-7, 74.5, 83.19-21.
Prionocidaris verticillata: H.L.Clark, 1946:287; Clark & Rowe, 1971:140, 151.

Material. 1 specimen, G215, Mauritius; 9 specimens, J5728, J5741-4, J7854, J13877, various localities near Port Moresby, New Guinea; 1 specimen, J17492, North Point, Lizard Island, Qld., 6 m, L.Vail, 18.2.83.

Diagnosis. Tridentate and globiferous pedicellariae are present; pores are distinctly conjugate; primary spines are not much longer than the horizontal test diameter; spines have a complete whorl of thorns repeated several times along the shaft; the collars are short, not spotted.

Distribution. Widespread throughout the tropical Indo-Pacific.

Remarks. Previous records of *P.verticillata* in Australia include Torres Strait (Agassiz 1881) and Low Isles, Qld. (H.L.Clark 1946), and the present material does not extend the known Australian distribution. The species does appear to be quite rare, as suggested by H.L.Clark (1946).

Prionocidaris callista Rowe & Hoggett (Pl. 3)
Prionocidaris callista Rowe & Hoggett, 1986: 252, Figs 12a, b, Fig. 13b.

Material. 2 specimens, J8191, off Ile des Pins, New Caledonia (22°50'S 167°34'E), 275 m, 'Kimbla', 8.5.71; holotype, J15715, Bottle and Glass Rocks, Port Jackson, N.S.W., 2-4 m; 5 paratypes, J18919-18923, South Solitary Island, N.S.W., 28 m; 116 other specimens in the Australian Museum collection (57 from N.S.W. coastal waters, 57 from Lord Howe Island area, 3 from Queensland waters; see Rowe & Hoggett, 1986).

Diagnosis. Tridentate and globiferous pedicellariae are present; pores are distinctly conjugate; primary spines are always less than 2.5 x h.d., and specimens larger than 35 mm h.d. have spines much less than 2 x h.d.; coarse thorns on the primary spines are not arranged in whorls; the collars have distinct white spots on brown/marroon background; areoles of coronal plates above the ambitus are markedly oval (height 71-79% of width in specimens greater than 16 mm h.d.); apical system is quite spinous, not appearing bare; scrobicular spines are red in colour.

Distribution. Bushy Id., Queensland (20°57'S 150°05'E) to Montague Is., New South Wales, Australia; Lord Howe Island; New Caledonia; ?Norfolk Island. 2-275 m.

Remarks. Some measurements of the New Caledonian specimens are listed below:

	Specimen 1	Specimen 2
Horizontal diameter (mm)	47	45
Vertical diameter (mm)	29	27
Apical system diameter (mm)	21	20
Apical system diameter: h.d. (%)	45	44
Peristome diameter (mm)	25	23
Peristome diameter: h.d. (%)	53	51
Interambulacrum width (mm)	26	23
Ambulacrum width (mm)	6.0	4.5
No. interambulacrals	8	8
Areole width (mm)	8.1	7.2
Areole height (mm)	6.0	5.4
Height/width areole (%)	74	75
Maximum spine length (mm)	70	72

These specimens do not differ significantly from the type series and other material from eastern Australia, which have been described by Rowe & Hoggett (1986). It is interesting, however, that the peristome of each of the two New Caledonian specimens is slightly larger than the respective apical system. Specimens from other localities have the peristome, at most, equal in diameter to the apical system.

The New Caledonian specimens provide the greatest known depth record for the species, 275 m. The next greatest depth record is for a specimen from off Port Stephens, N.S.W., Australia (J6984) at 198 m.

Rowe & Hoggett (1986) considered *P.hawaiiensis* (Agassiz & Clark, 1907) to be the species most closely related to *P.callista*, because of similarity in test morphology.

Prionocidaris popeae sp.nov. (Pls 4A-C, 5A-B)

Material. Holotype, J19206, off Ile des Pins, New Caledonia (22°50'S 167°34'E), 275 m, 'Kimbla', 8.5.71; 6 paratypes, J8192, J13887, J19207-J19210, same data as holotype; 1 specimen, J18969, 1.5 miles south of Aneityum Island, Vanuatu (20°17'S 169°48'E), 55-75 m, 'Kimbla' 12.5.71; 1 specimen, J18970, south of New Caledonia (22°48'S 167°36.5'E), 85-100 m, 'Kimbla', 8.5.71.

Diagnosis. Tridentate and globiferous pedicellariae are present; pores are distinctly conjugate; primary spines are at least 2.5 × h.d. in specimens less than 30 mm h.d., and the spines of larger specimens are rarely less than 2 × h.d.; primary spines are coarsely thorny in the proximal half, and the thorns are not arranged in whorls; the collars are spotted white or pale green on a red brown background; areoles of coronal plates above the ambitus are only slightly flattened (height 80-88% of width); apical system appears rather bare, due to the small size of the spines in the centre of the genital and ocular plates; scrobicular spines are deep purple basally, with a sharp transition to bright green distally.

Distribution. New Caledonia; Vanuatu. 55-275 m.

Etymology. The species is named for Miss Elizabeth Pope, formerly of the Australian Museum.

Description of holotype. Measurements of the holotype are included in Table 1.

The ambulacra are slightly sinuate, and the pore zones are slightly sunken relative to the interpore zone and the interambulacra. The pores are widely separated, conjugate. The interpore zone is about 1.5 times the width of a pore zone at the ambitus. The marginal ambulacral tubercles are in a regular series, more or less contiguous, and slightly smaller than the scrobicular tubercles. One or two very small tubercles occur inside the marginals, usually also in regular longitudinal series. The interpore zone appears quite bare due to the small size and low density of inner tubercles. The denuded ambulacrum is creamy-white with longitudinal stripes of deep purple on each series of marginal tubercles.

The interambulacra have 7 or 8 coronal plates in each series. The areoles are wider than high. The single row of scrobicular tubercles on the upper and lower side of each areole are slightly smaller than the lateral scrobicular tubercles, which are arranged in an uneven double row. Small miliary tubercles cover the lateral surfaces of the interambulacral plates. The median area is about half the width of an areole. The denuded interambulacrum is creamy white and the scrobicular tubercles have a distinct pinkish cast.

The apical system has all the ocular plates rather widely insert, and the genital plates are sunk below the level of the occulars and periproctal plates. The genital pores are about 0.5 mm in diameter, and are each situated on a distinct elevation of the genital plate. The ocular and genital plates are more or less evenly tuberculated, with slightly larger tubercles occurring on the inner and outer edges of the plates. One tubercle on each of the large, outer periproctal plates is distinctly larger than the other tubercles on the plate. This tubercle is pigmented deep pink, in contrast to the otherwise creamy-white plate.

Primary spines at the ambitus are up to 85 mm long, almost 2 × h.d. In dorsal view, they widen to about 6 mm diameter just distal to the neck, then taper quite sharply to about half the spine length, and then continue to taper more gradually to the tip. In cross-section, the proximal half of the spine is more or less flat adorally and steeply rounded adapically. The spine becomes more or less circular in cross-section in the distal half.

Most of the primary spines are almost totally covered by encrusting organisms, but two ambital primaries are sufficiently bare to describe. The collar is about 3 mm long, arising from an inconspicuous milled ring. It has diffuse whitish/greenish spots on a red/brown background. This pattern continues and becomes more distinct on the shining neck, which is about the same length as the collar. The adoral surface of the shaft has low, spaced thorns irregularly arranged in the proximal half. These become arranged into longitudinal series in the distal half, and are fused together, so as to form low, longitudinal ridges. The spaces

between the ridges, and between the thorns, are filled with a coat of anastomosing hairs. The lateral edges of the shaft are coarsely serrate in the proximal half, being lined with a row of larger, distally-directed spines. The rounded adapical surface is set with distally-directed thorns, which are arranged in longitudinal series, and an indistinct carinal row is discernable. The thorns become smaller and more closely spaced towards the spine tip. The proximal thorns are white, apparently continuing the pattern of white spots on the collar and neck. By about half way out of the spine, the thorns are deep red in colour. Both upper and lower spine surfaces are banded dark brown/purple on paler red.

The scrobicular spines are long (about 7 mm), flattened, and gently tapering to a rounded tip. They are deep purple on the basal third, with an abrupt transition to bright grass green on the remainder of the spine. The marginal ambulacral spines are flattened basally, becoming round in cross-section near the tip. They are deep purple in colour. The miliary spines are very short and scale-like, adpressed to the test. They are green or pale brownish in colour.

The tridentate pedicellariae have long, narrow valves, similar to those described by Mortensen (1928) for *P.australis* (Ramsay 1885). Only one form of globiferous pedicellaria was found. This has a distinct end tooth and slender valves, again resembling the 'small' globiferous pedicellariae of *P.australis* as described by Mortensen (1928).

Remarks. Table 1 lists some measurements of the type specimens. Spine length

Table 1. Measurements of type specimens of *Prionocidaris popeae.*

	J19206	J8192	J13887	J19207	J19208	J19209	J19210
Horizontal dia. (mm)	46	42	38	36	34	22	17
Vertical dia. (mm)	28	26	25	21	21	13	10
Apical system dia. (mm)	21	18	17	17	16	10	8
Apical system dia.: h.d. (%)	46	43	45	47	47	45	47
Peristome dia. (mm)	22	20	18	15	15	11	8
Peristome dia.: h.d. (%)	48	48	47	42	44	50	47
Interambulacrum width (mm)	28	22	19	17	16	10	10
Ambulacrum width (mm)	5.0	4.8	4.7	4.2	4.1	2.5	2.6
No. interambulacrals	7-8	7	7	6-7	6-7	6	5
Areole width (mm)	8.4	8.0	7.6	7.0	6.9	4.0	3.7
Areole height (mm)	6.8	6.5	6.1	5.8	5.9	3.5	3.1
Height/width areole (%)	81	81	80	83	86	88	84
Maximum spine length (mm)	85	80	84	77	81	68	50

is less than 2 × h.d. only in the two largest specimens, indicating that spine growth slows relative to test growth. Similarly, elevations on the genital plates occupied by the genital pores also occur only in these two specimens. Genital pores are present in all specimens larger than 22 mm h.d. In all other respects, the material examined does not differ from the holotype. The distinctive purple and green colour pattern described for the holotype is constant throughout the wide size range of known specimens.

The apical system of the holotype has been denuded, so the apical system spines of the paratypes are described. Two distinct sizes of spines occur. The larger spines (up to 5 mm) are situated on the inner and outer edges of the genital and ocular plates, and one large spine is present on each of the periproctal plates. The remainder of the apical system is sparsely covered with much smaller miliary spines. The apical system thus appears to be relatively bare (Pl. 5B). The large spines are deep purple and may have bright green tips, and the small spines are greenish.

P.popeae occurs sympatrically with *P.callista* near New Caledonia. The two are readily distinguished by their colours, which appear to be retained in preserved specimens. Other characters separating *popeae* from *callista* include the less 'flattened' shape of the ambital areoles, the less spinous apical system, and the longer primary spines of the former species.

P.hawaiiensis (Agassiz & Clark, 1907) is similar to *P.popeae* in the shape of the areoles and in having relatively long spines. The spinulation of the apical system of *P.hawaiiensis* is not known. Examination of a specimen of *hawaiiensis* (G6098) and Agassiz & Clark's photographs of the type (1907: Pl. 24-25), show that the species may be separated by the shape of the primary spines. The proximal area is noticeably broadened in *popeae*, while the primaries of *hawaiiensis* taper continuously. The pigmentation of the denuded tests also differs: the ambulacra of *hawaiiensis* are orange, and those of *popeae* are purple.

P.popeae is also closely related to *P.australis*. *P.glandulosa* (De Meijere 1904) is synonymous with *australis* according to Rowe & Hoggett (1986), so the distribution of *australis* includes the Philippines, Indonesia and the east Australian coast. Examination of the large collection of *australis* in the Australian Museum shows that it has a similar areole shape to *popeae*. The species are distinguished by the longer primary spines and the more sparsely spined apical system of *P.popeae*.

P.popeae also differs from *callista, australis* and *hawaiiensis* by the slightly greater length of the neck of the primary spines, and by the abrupt transition to finer thorns on the distal half of the adapical surface of the primary spines.

Genus Eucidaris Döderlein

Eucidaris metularia (Lamarck)
Cidarites metularia Lamarck, 1816:56.
Eucidaris metularia: Mortensen, 1928:386 (synonymy), Pls. 41.1-8, 73.6, 86.11-14; Clark & Rowe, 1971:140, 150; Marsh & Marshall, 1983:678 (table); Rowe & Hoggett, 1986: 246.

Material. 6 specimens, G7396, J178-82, Mauritius; 1 specimen, J14089, N. of Montebello Islands, W.A. (20°12'S 115°19'E), 65 m, 'Soela', 26.5.80; 3 specimens, J5722, J8575, various localities in New Guinea; 8 specimens, J7388, J8912, J17314, J17317, J18840, J19198, various localities on the Great Barrier Reef, from Carter Reef to Lady Elliot Island, Qld., 9-72 m; 2 specimens, J18838, J18845, Wreck Reef, Coral Sea (22°13'S 155°15'E), 1-2 m, I. Loch, 29.10.83; 3 specimens, J16798, J19199, Lord Howe Island and Middleton Reef, 10-72 m; 1 specimen, J12510, Point Cruz, Honiara, Guadalcanal, Solomon Islands, P.H.Coleman; 2 specimens, J10845, J10847, lagoon, Noumea, New Caledonia, E. Pope; 1 specimen, J17640, Mele Reef, Vila, Vanuatu, N.Coleman, July 1982; 1 specimen, J13899, Main Reef, near Suva Fiji, L.Marsh, 1966.

Diagnosis. Tridentate and globiferous pedicellariae are present; madreporite may be slightly, but not conspicuously, enlarged; apical system is virtually bare of spines except for a single series on the outer edges of the ocular and genital plates; pore pairs are not conjugate; primary spines are thick and robust, cylindrical or slightly fusiform; shafts of the primary spines are set with numerous low tubercles arranged in longitudinal series.

Distribution. Widespread in the Indo-Pacific. Surface — 570 m.

Remarks. The distribution records in the present material from eastern Australia were reported as new by Rowe & Hoggett (1986). The species has apparently not been previously recorded from the Solomon Islands, New Caledonia or Vanuatu, but its occurrence in these localities was to be expected.

Genus Phyllacanthus Brandt

Phyllacanthus imperialis (Lamarck)
Cidarites imperialis Lamarck, 1816:54.
Phyllacanthus imperialis: Mortensen, 1928:504 (synonymy), Pls. 54.4, 57.3, 74.6, 88.4-10; H.L.Clark, 1946:282; A.H.Clark, 1954:249; Clark & Rowe, 1971:140, 151; Rowe & Hoggett, 1986: 256.

Material. 1 specimen, J199, Mauritius; 4 specimens, J5749-51, Port Moresby, New Guinea; 11 specimens, J5119, J6017, J7119, J10477, J14785, J17572, J18826-7, various localities on the Great Barrier Reef, from Torres Strait to the Whitsunday Islands, Qld., 1-10 m; 1 specimen, J12070, lagoon, New Caledonia, J.Marshall, Nov., 1978; 1 specimen, J10854, Main reef, near Namuka, Fiji.

Diagnosis. Tridentate and globiferous pedicellariae are present; madreporite is much enlarged; pores are conjugate and occur in a double series on the peristome; primary spines are thick and robust, cylindrical or slightly fusiform; shafts of

the primary spines have a finely striated appearance, formed from numerous, microscopic, rounded projections, arranged in many longitudinal series.

Distribution. Widespread in the tropical Indo-west Pacific. Surface — 73 m.

Remarks. The specimens of *P.imperialis* listed here extend the known range of the species in Queensland from Torres Strait to the Whitsunday Islands, as reported by Rowe & Hoggett (1986). *P.imperialis* was recorded from New Caledonia by A.H.Clark (1954), but it has not previously been recorded from Fiji.

Genus Chondrocidaris H.L.Clark

Chondrocidaris brevispina H.L.Clark (Pl. 6)
Chondrocidaris brevispina H.L.Clark, 1925:11, Pl. I, 1-2; Mortensen, 1928:497 (synonymy), Pls 54.1-3, 74.2, 87.13-19; Clark & Rowe, 1971:140, 151.

Material. 1 specimen, J18916, N. side of Palm Passage, near Hinchinbrook Island, Qld., 3 m, on dead staghorn coral, R.Murphy, 10.1.85.

Diagnosis. Tridentate and globiferous pedicellariae have been reported (Mortensen 1928), but may be lacking; madreporite is not much enlarged; pores are conjugate and occur in a single series on the peristome; primary spines are thick, fusiform, with coarse, randomly-arranged thorns and a dense hair coat on the shaft; collar is strongly-developed, long and widened.

Distribution. Indonesia; northern Queensland, Australia; Loyalty Islands; Samoa. Shallow water.

Remarks. Some measurements of the Australian specimen are listed below:

Horizontal diameter (mm)	49
Vertical diameter (mm)	28
Apical system diameter (mm)	20
Apical system diameter: h.d. (%)	41
Peristome diameter (mm)	22
Peristome diameter: h.d. (%)	45
No. interambulacrals	6
Maximum spine length (mm)	40

No tridentate pedicellariae were found on this specimen, but many globiferous pedicellariae are present. Colour of the test and secondary spines is bright olive green; the collars are dark reddish/brown, and the primary spine shafts, including the hair coat, are mottled pale and bright orange/pink.

This is only the fourth specimen of *C.brevispina* to be reported. The species is newly recorded from Australia.

REFERENCES

Agassiz, A. 1881. Echinoidea. *Rep. scient. Results Voy. 'Challenger'*, Zool. 3:1-321, Pls. 1-45.

Agassiz, A. & H.L.Clark 1907. Hawaiian and other Pacific Echini. The Cidaridae. *Mem. Mus. comp. Zool.* 34(1):1-42, Pls 1-44.

Agassiz, L. & E.Desor 1846. Catalogue raisonné des familles, des genres et des espèces de la classe des Echinodermes. *Annls. Sci. nat.* (3)6:325-374.

Clark, A.H. 1954. Records of Indo-Pacific echinoderms. *Pac. Sci.* 8:243-263.

Clark, A.M. & F.W.E.Rowe 1971. *Monograph of shallow-water Indo-west Pacific Echinoderms*, 238 pp., 31 pls, 100 figs. British Museum (Natural History), London.

Clark, H.L. 1925. *A catalogue of the recent sea-urchins (Echinoidea) in the collection of the British Museum (Natural History)*, 250 pp., 11 pls. Oxford University Press, London.

Clark, H.L. 1946. The echinoderm fauna of Australia, its composition and origin. *Carnegie Inst., Wash. Publ.* 566:1-567.

Döderlein, L. 1906. Die Echinoiden der deutschen Tiefsee-Expedition. *Wiss. ergeb. Deutschen Tiefsee-Exp.* 5(2):1-290, 46 figs, 42 pls.

Koehler, R. 1927. An account of the Echinoidea. Echinoidea III. *Echinodermata of the Indian Museum* 10:1-148, 27 pls.

Lamarck, J.B.P.A.de 1816. *Histoire naturelle des Animaux sans Vertèbres.* Paris. Ed. 1, 3:1-59 (Echinides).

Marsh, L.M. & J.I.Marshall 1983. Some aspects of the zoogeography of northwestern Australian echinoderms (other than holothurians). *Bull. Mar. Sci.* 33(3):671-687.

Meijere, J.C.H.de 1904. Die Echinoidea der 'Siboga'-Expedition. *Siboga-Expeditie*, 1-251, 23 pls.

Michelin, H.M. 1861. Notice sur quelques espèces d'Echinides provenant de la Nouvelle Caledonie. *Rev. Mag. zool.* 2(13):325-329, Pl. 9.

Mortensen, T. 1927. Report on the echinoidea collected by the United States fisheries steamer 'Albatross' during the Philippine expedition, 1907-1910. Part 1. The Cidaridae. *U.S. Nat. Mus. Bull. 100*, 6(4):243-307, 22 figs, 32 pls.

Mortensen, T. 1928. *A Monograph of the Echinoidea. I. Cidaroidea*, 551 pp., 88 pls. Reitzel, Copenhagen.

Ramsay, E.P. 1885. *Catalogue of the Echinodermata in the Australian Museum. I. Echini Demosticha and Petalosticha,* 54 pp., 2 pls. Australian Museum, Sydney.

Rowe, F.W.E. & A.K.Hoggett, 1986. The cidarid echinoids (Echinodermata) of New South Wales. *Proc. Linn. Soc., N.S.W.* 108(4):226-261, Figs. 1-15.

Thomson, W. 1872. On the Echinoidea of the 'Porcupine' deep-sea dredging expeditions. *Phil. Trans. Roy. Soc., Lond.* 164(2):719-756, Pls. 59-71.