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THE ASTERINID SEA STARS OF TASMANIA

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(With one plate and one table)

SUMMARY

The ten species of sea stars of the family Asterinidae occurring in Tasmania are considered. Synonymies, locality lists and distributional data are given. *Patiriella gunnii* (Gray) is redescribed and lectotypes designated. Some account of characters distinguishing *P. gunnii* and *Patiriella brevispina* H. L. Clark is provided. A key to the species is presented and some account of the zoogeography of the Tasmanian species given, attention being drawn to the existence of pairs of sibling species in the group.

INTRODUCTION

Ten species of three genera of the sea star family Asterinidae are known from the littoral and shallow waters around Tasmania. In this paper abbreviated synonymies are given as necessary and details of localities, habitat and distribution provided. In one case (viz. *Patiriella gunnii* (Gray)) it has been found necessary to redescribe the species. A key to the Asterinidae has been constructed and is presented here. Finally the zoogeography of the Tasmanian asterinids is considered.

Family ASTERINIDAE

Genus **ASTERINA** Nardo, 1834

Asterina atyphoida H. L. Clark, 1916

H. L. Clark, 1916. *Endeavour Rept*, p. 57; pl. 17, figs 1, 2.

Material examined: A total of three specimens.

Localities: Greens Beach, near the mouth of the estuary of the River Tamar.

Habitat: Under rocks and in crevices. Low water to 40 metres, perhaps found at greater depths (Shepherd, 1968).

Distribution: The north coast of Tasmania, Victoria and South Australia.

Asterina inopinata Livingstone, 1933

A. A. Livingstone, 1933. *Rec. Austr. Mus.* vol. 19, no. 1, p. 3, pl. 5, figs 1-8. 14.

Habitat: Very shallow water (H. L. Clark, 1946).

Distribution: S.E. Australia from New South Wales to Northern Tasmania.

Remarks: No recent material of the species from Tasmania has been seen by this author.

Asterina scobinata Livingstone, 1933

A. A. Livingstone, 1933. *Rec. Austr. Mus.* vol. 19, no. 1, p. 1, pl. 5, figs 9-12. 15.

Material examined: A total of twenty-four specimens.

Localities: Boat Harbour; Greens Beach; Cape Portland; Maria Island; Dunalley; Eaglehawk Neck; Carlton; Blackmans Bay, Kingston; Variety Bay, Bruny Island; Bond Bay, Port Davey.

Habitat: Under rocks and crevices in the lower littoral zone.

Distribution: Tasmania and Victoria. Extension of the known range to Victoria has been reported in another place (Dartnall, in press).

Genus **PATIRIELLA** Verrill, 1913

'regularis' group

Patiriella regularis (Verrill, 1867)

Restricted synonymy

Asterina regularis Verrill, 1867. *Trans. Conn. Acad.*, vol. 1, p. 250.

Patiriella regularis Verrill, 1913. *Amer. Jour. Sci.*, ser. 4, vol. 35, p. 480.

Patiriella mimica Livingstone, 1933. *Rec. Austr. Mus.* Sydney vol. 19.

Asterina regularis Fell, 1959. *Tuatara*, vol. 7, (3), p. 127-142.

Patiriella regularis Dartnall, 1969. *Proc. Roy. Soc. Tasm.* vol. 103, p. 54.

Material examined: A total of 420 specimens.

Localities: Oyster Cove, Kettering; Coningham; Margate; Blackmans Bay, Kingston; Tinderbox; Taroona; Sandy Bay, Hobart; Wrest Point, Hobart; Hobart wharves; Ralphs Bay; Roches Beach; Midway Point; Slopen Main; Variety Bay, Bruny Island.

Habitat: From the mid-littoral to 15 metres on rock, sand and mud.

Distribution: New Zealand and S.E. Tasmania (Dartnall, 1969).

Remarks: Evidence demonstrating that this species may have been imported into Tasmania

with cargoes of commercial oysters was presented in a previous paper (Dartnall, 1969). In the same paper it was suggested that *Patiriella mimica* (Livingstone) is a synonym of *Patiriella regularis*.

Patiriella calcar (Lamarck, 1816)

Restricted synonymy

Asterias calcar Lamarck, 1816. *Anim. sans Vert.*, vol. 2, p. 557.

Asterina calcar Gray, 1840. *Ann. Mag. Nat. Hist.*, vol. 6, p. 290.

Patiriella calcar Verrill, 1913. *Amer. Jour. Sci.*, ser. 4, vol. 35, p. 484; H. L. Clark, 1946. *Carnegie Institution of Washington. Publication* 566, p. 134.

Material examined: A total of 199 specimens.

Localities: Trial Harbour; Granville Harbour; Boat Harbour; Wynyard; Cape Portland; Flinders Island; Bay of Fires; Binnalong Bay; 2 miles north of Scamander; Shelly Beach, Orford; Dodges Ferry; Roches Beach; Primrose Sands; Taroona; Coningham; Adventure Bay, Bruny Island; Bond Bay, Port Davey.

Habitat: Mid-littoral to 10 metres. Rocky shores and rock pools.

Distribution: Tasmania, south and east coasts of Australia from South Australia to Queensland.

Remarks: H. L. Clark (1946) employed the absence of suboral spines in this species to distinguish it from other members of the genus. The presence or absence of suboral spines is not a reliable characteristic of Tasmanian material and tends, also, to impute close relationships between *P. calcar* and the six-rayed '*gunnii*' forms.

The distribution of suboral spines in a sample of 199 specimens of Tasmanian *Patiriella calcar* is expressed in Table I.

'*exigua*' group

Patiriella exigua (Lamarck, 1816)

Restricted synonymy

Asterias exigua Lamarck, 1816. *Anim. sans Vert.*, vol. 2, p. 554.

Asterina exigua Perrier, 1876. *Arch Zool Exp.*, vol. 5, p. 222.

Patiriella exigua Verrill, 1913. *Amer. Jour. Sci.*, ser. 4, vol. 35, p. 484; H. L. Clark, 1946. *Carnegie Institution of Washington. Publication* 566, p. 136.

Material examined: A total of 257 specimens.

Localities: Trial Harbour; Granville Harbour; Marrawah; Rocky Cape; Boat Harbour; Greens Beach, East Sandy Cape; Cape Portland, Swan Island; Flinders Island; Shelly Beach, Orford; Maria Island; Port Arthur; Nubeena; Murdunna; Dunalley; Bellerive; Hobart; Blackmans Bay, Kingston; Coningham; Policemans Point; Simpsons Bay, Bruny Island; Roaring Beach, Port Davey.

Habitat: Upper and mid-littoral zones. Often found associated with the alga *Hormosira banksii*.

Distribution: Tasmania, south and eastern Australia, Lord Howe Island. Said to occur throughout the Indo-Pacific region.

Remarks: This author has now examined material from South Africa and from the New Guinea archipelago. Even though this material has been attributed to *Patiriella exigua* on external morphology some differences are observable. South African material, for instance, appears to attain a larger size than Australian *P. exigua*. More consistent sampling throughout the Indo-Pacific area will be needed to examine the proposition that the species known as *Patiriella exigua* is a polymorphic assemblage of forms.

Patiriella vivipara Dartnall, 1969

Dartnall, 1969. *Proc. Linn. Soc. N.S.W.* **93** (3): 294-196, pl. XXIX

Localities: Roches Beach; Midway Point; Lewisham; Tesselated Pavement; Blowhole, Eaglehawk Neck.

Habitat: Mid-littoral, gently sloping rocky shores.

Distribution: Restricted to S.E. Tasmania.

Remarks: It is suggested that *Patiriella vivipara* is a sibling species to *Patiriella exigua*.

'*gunnii*' group

Patiriella gunni (Gray, 1840)

Restricted synonymy

Asterina gunnii Gray, 1840. *Ann. Mag. Nat. Hist.*, vol. 6, p. 289.

Patiriella gunnii Verrill, 1913. *Amer. Jour. Sci.*, ser. 4, vol. 35; p. 484; H. L. Clark, 1946. *Carnegie Institution of Washington. Publication* 566, p. 135.

Patiriella gunnii A. M. Clark, 1966. *Mem. Nat. Mus. Vict.*, No. 27, p. 320; Shepherd, 1968. *Rec. S. Aust. Mus.*, vol. 15 (4), p. 747.

The genitive of modern patronymics would give '*gunni*' as the specific name of this species. No evidence has been given of typographical errors, *lapsus calami* or errors of transcription. Thus the rulings concerning customary usage must apply and '*gunnii*' retained (see Article 19 and Summary 8 of Opinions Rendered, Schenk and McMasters, 1936).

Material examined: A total of seventeen Tasmanian specimens.

Localities: Greens Beach; Cape Portland; Maria Island; Primrose Sands; Variety Bay, Bruny Island.

Habitat: Mid- and lower-littoral to 30 metres, under rocks and ledges.

Distribution: The north and east coasts of Tasmania, and the south and east coasts of Australia from Western Australia to New South Wales. Also recorded from Lord Howe Island.

Remarks: Gray's (1840, 1866) description of '*Asterina gunnii*' from material collected by R. C. Gunn in Van Diemens Land was concise and barely informative. Preserved material of '*gunnii*' fascies (i.e., of *Patiriella gunnii* and *Patiriella brevispina* H. L. Clark) has proven difficult to distinguish. Through the offices of Miss A. M. Clark, the Director and Trustees of the British Museum (Natural History) made available to me

specimens, determined by Gray, to redescribe the species.

A single specimen from a group of four from Sandy Bay, Hobart Town and registered in 1840 is designated the lectotype and three specimens from a series collected at George Town, Northern Tasmania and registered in 1849, paralectotypes.

Lectotype: British Museum Reg. No. 40.3.9.-10. Sandy, Bay, Hobart Town (type locality). Presented by R. C. Gunn.

Paralectotypes: Three specimens. British Museum Reg. Nos 49.11.19.-10-14-33. George Town, Tasmania. Presented by R. C. Gunn.

Description of lectotype: Plate I, figs (i) and (ii)—specimen 40.3.9.-10; R = 22 mm; r = 16 mm; r:R = 1:1.37; vh = 6 mm.

A six-rayed, asterinid sea star, markedly flattened, the actinal surface plain and with a very acute marginal angle.

The abactinal surface is paved with imbricating plates of two kinds. Those of the rays, the disc and most of the abactinal intermediate areas are crescentic at their free edge allowing the passage of papulae. The carinal row of papular plates of each ray are doubly notched allowing the passage of two rows of papulae, one on each side of the midline of the ray.

The plates of the interradial, abactinal areas near to the margin are smaller and non-papulate. Small secondary plates are present between the larger papulate plates.

The exposed surfaces of the abactinal plates are crowned with groups of small, blunt, thorny spinelets, some twenty-eight spinelets being present on the larger plates near the centre of the disc and six to eight spinelets on the plates near to the margin.

The madreporite is rounded, channelled and perforate and situated interradially some 3 mm from the centre of the disc. The anus is not visible in the lectotype.

The superomarginal plates are not distinct from the succeeding rows of abactinal plates. The inferomarginal plates form the edge of the body and each carries a fringing group of seven to nine spinelets.

The actinal surface between the ambulacral grooves is paved with imbricate plates. The largest chevron of plates, reaching from the tip of each ray to the mouth plates, carries one spine on each plate. The succeeding three inner chevrons of plates carry one spine on each plate for about the proximal half of their length and the remainder of the actinal intermediate plates two spines except towards the disc margin where some plates may carry three spines.

In the lectotype each adambulacral plate bears a single subambulacral spine and a pair of furrow spines. Furrow spines may be grouped in threes towards the mouth and singly towards the tip of the rays.

Each oral plate bears five oral spines, the innermost being the largest. The lectotype bears no suboral spines. Pedicellariae are absent.

Diagnosis: A flattened, six-rayed species of *Patiriella* closely related to *Patiriella brevispina* H. L. Clark. In Tasmanian material paired subambulacral spines distinguish *P. gunnii* from *P. brevispina* which most often has single subambulacral spines. A discussion of specific characteristics is given in a following section of this account.

Patiriella brevispina H. L. Clark, 1938

H. L. Clark, 1938. *Mem. Mus. Comp. Zool.*, vol. 55, p. 166, pl. 22, figs 2, 3

Material examined: A total of twelve Tasmanian specimens.

Localities: Burnie; Greens Beach; Cape Portland; Flinders Island.

Habitat: Mid- and lower-littoral to 10 metres on a rock substrate. Most often found under rocks.

Distribution: The north coast of Tasmania and the coasts of Western Australia, South Australia, Victoria, New South Wales and Southern Queensland.

Remarks: *Patiriella gunnii* and *Patiriella brevispina* have long been considered distinct forms by many Australian workers. H. L. Clark (1938, 1946) and A. M. Clark (1966) have both commented upon the validity of *P. brevispina*. A. M. Clark's comments and the brief description of *P. gunnii* offered by Gray (1840 and 1866) prompted an investigation into the characteristics of the material showing the six-rayed '*gunnii*' fascies.

Including the lectotype of *Patiriella gunnii* 250 specimens were available for study and the following characteristics were considered reliable enough to distinguish between the species:—

(1) *Size and shape*: *P. brevispina* may attain a size of 52 mm R as opposed to about 39 mm R in *P. gunnii*. *P. gunnii* is more flattened than *P. brevispina*. The range of vh:R for the two species was 0.21-0.26:1 in *P. gunnii* and 0.35-0.57:1 in *P. brevispina*, i.e., the latter is a more arched form.

(2) *Furrow spinulation*: *P. gunnii* carries more furrow spines on more adambulacral plates than *P. brevispina*.

(3) *Subambulacral spinulation*: *P. gunnii*, notwithstanding the description of the lectotype, most often carries paired subambulacral spines whilst the subambulacral spines of *P. brevispina* are most often monacanthid.

(4) *Colour when alive*: In life *Patiriella brevispina* is consistent in its rich purple colouration on both surfaces of the body and never possesses the mottled and varied colours of *Patiriella gunni*. The tube feet are pale straw coloured in *P. gunnii* and bright orange in *P. brevispina*.

Examination of a series of specimens from Western Australia suggests that intermediate or hybrid forms probably exist on the south-western seaboard of Australia and until more material is available the characteristics recorded here can only be applied to *Patiriella gunnii* and *Patiriella brevispina* from the Maugean Province of Australia.

KEY TO THE TASMANIAN ASTERINIDAE

1.	Abactinal surface clearly divided into two areas: one on the disc and along the crests of the rays of crescentic plates; and other, comprising the rest of the upper surface covered by close set, small, rounded plates	Genus **PARANEPANTHIA** Tasmanian Species *P. grandis* H. L. Clark
	Abactinal surface not clearly divided into two areas	(2)
2.	Carinal abactinal row of plates doubly notched for papulae	Genus **PATIRIELLA**
	Carinal abactinal row of plates with a single papular notch or none	Genus **ASTERINA** (8)
3.	Rays normally five in number	(4)
	Rays normally more than five	(6)
4.	Large, >15 mm. Gonoduct directed aborally	*Patiriella regularis* (Verrill)
	Small, R<15 mm. Gonoduct directed orally or absent	(5)
5.	Gonoduct absent; coelomic incubation of young. Actinal surface orange yellow	*Patiriella vivipara* Dartnall
	Gonoduct directed orally. No internal incubation. Actinal surface blue-green	*Patiriella exigua* (Lamarck)
6.	Rays six; actinal intermediate spines paired	(7)
	Rays seven to eleven, usually eight; actinal intermediate spines single	*Patiriella calcar* (Lamarck)
7.	Flattened; subambulacral spines usually diplacanthid. Colour varied	*Patiriella gunnii* (Gray)
	Arched; subambulacral spines usually monacanthid. Colour in life consistently deep purple	*Patiriella calcar* H. L. Clark
8.	Form stellate	*Asterina scobinata* Livingstone
	Form pentagonal, though margins may be concave	(9)
9.	Actinal intermediate plates with single spine or none	*Asterina atyphoida* H. L. Clark
	Actinal intermediate plates with fine spines in groups of two to four	*Asterina inopinata* Livingstone

Genus **PARANEPANTHIA** Fischer, 1917

Paranepanthia grandis (H. L. Clark, 1928)

Synonymy

Nepanthia grandis H. L. Clark, 1928. *Rec. S. Aust. Mus.* vol. 3, p. 393, fig. 113.

Paranepanthia grandis H. L. Clark, 1938. *Mem. Mus. Comp. Zool.*, vol. 55, p. 159.

Material examined: A total of four specimens.

Localities: Tasmania; D'Entrecasteaux Channel; Piersons Point, Derwent Estuary.

Habitat: All the Tasmanian material was collected between 4 and 6 fathoms. Shepherd (1968) gives the vertical range of this species as between 2 and 40 metres in South Australia.

Distribution: West Australia to Sydney Harbour and southwards to Tasmania.

ZOOGEOGRAPHY OF THE TASMANIAN ASTERINID FAUNA

Of the ten species of Tasmanian asterinids one, *Paranepanthia grandis*, cannot be included in any discussion of the zoogeography of the family. The material available only reflects localised collecting and although that species may be expected along the eastern and northern coasts of Tasmania discussion must await further evidence.

Patiriella regularis must also be excluded from discussion because evidence has been provided that the species is a recent recruit to the Tasmanian sea star fauna (Dartnall, 1969).

Only one species can be said to be endemic to Tasmania, viz. *Patiriella vivipara*, and only *Patiriella exigua* is distributed outside Australia and comment on the possible status of this form was made earlier in this account.

Two phenomena are of interest—

1. The distributions of *Asterina scobinata*, *Asterina atyphoida* and *Asterina inopinata* mesh in the crossroads of the Bass Strait. The distribution of these species is additional evidence for the south-eastern Australian 'Maugean' marine province as defined by Bennett and Pope (1960) and the overlapping of warm and cool temperate areas also described by these authors.
2. Pairs of sibling species occur whose distribution lies along various radii from the focal point of Bass Strait. These pairs are *Asterina atyphoida/inopinata*, *Asterina burtoni/scobinata*, *Patiriella exigua/vivipara* and *Patiriella gunnii/brevispina*. In two cases, those of *A. scobinata* and *P. vivipara* hermaphrodism occurs and *A. atyphoida* possesses orally directed gonoducts in contrast to *A. inopinata* where the gonoducts are orientated aborally. Thus each form of a species pair is isolated by a reproductive specialisation. It remains to be seen by what mechanism the *Patiriella gunnii/brevispina* species remain distinct, but investigation of the ecology and the temporal sequence of reproduction in the two species may provide a fruitful field of investigation.

The relationships of the Tasmanian asterinid fauna lie with Australia and the Indo-West-Pacific. The '*regularis*' forms of *Patiriella* have been successful in extending their distribution around

the Southern Hemisphere, perhaps by means of the West Wind Drift. The sequence of species eastwards in this case is (*a*) *Patiriella calcar* in Australia, (*b*) *Patiriella nigra* H. L. Clark, Lord Howe Island, (*c*) *Patiriella regularis* and *Patiriella oliveri* (Benham) in New Zealand and (*d*) *Patiriella calcarata* (Perrier) from the Juan Fernandez Islands and possibly the eastern coasts of South America. This author does not accept that Perrier's *Patiriella fimbriata* belongs to that genus and that form is not included here.

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TABLE I

Distribution of suboral spines in a sample of 199 specimens of *Patiriella calcar* from Tasmania.

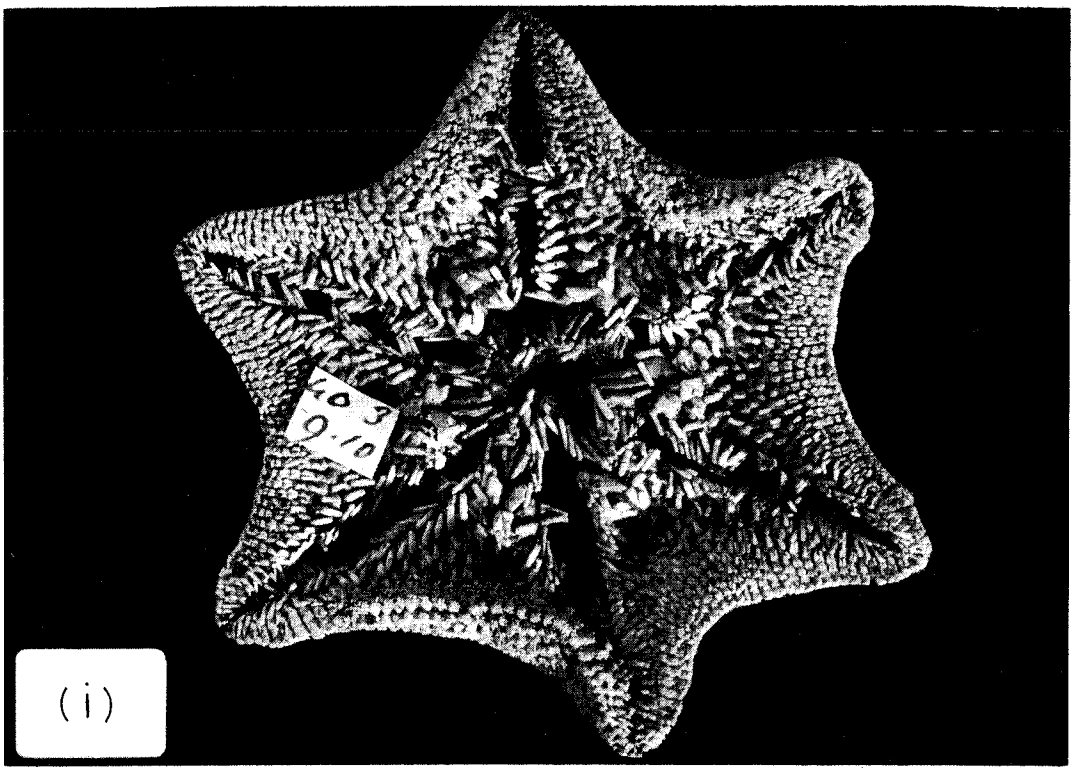
(*a*)

Number of Rays	Number of Specimens	Number of oral plates 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
8	56	6	7		2	2	4	5	2	1	2	2	4		3	4	12						
9	6				1	1			1								1		2				
10	3	1	2																				
11	1				1																		
Total ..	66	Number of specimens carrying single suboral spines																					

(*b*)

Number of Rays	Number of Specimens	Number of oral plates 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
8	8	1	2	2	3																		
10	1		1																				
Total ..	9	Number of specimens carrying paired suboral spines																					

Total number of specimens in sample 199
Number carrying suboral spines 75
Number without suboral spines 124
Number of specimens with one and two suboral spines on some plates .. 9



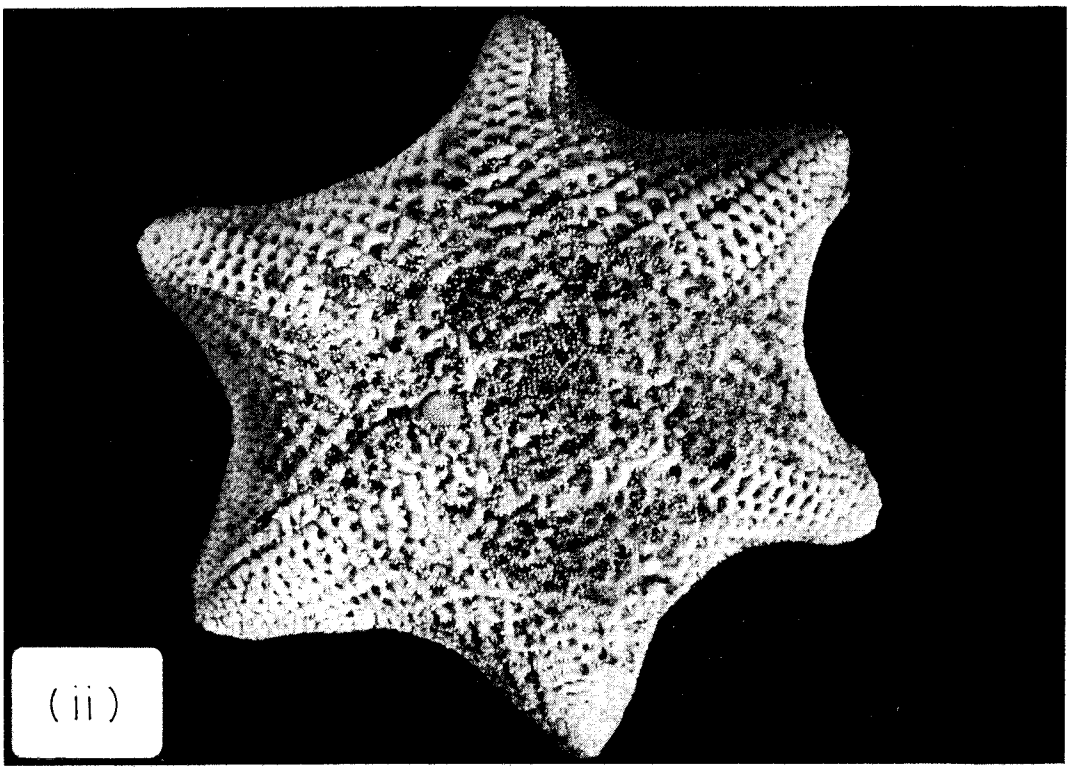


PLATE 1.—Lectotype *Patiriella gunnii* (Gray), British Museum (Natural History) register No. 40.3.9.-10.—
(i) Actinal surface.
(ii) Abactinal surface. [*Photographs*: C. G. Harrison