

STUDIES ON INDIAN ECHINODERMS—4
ON THE BRITTLE-STARS *AMPHIOPLUS GRAVELYI* SP. NOV., AND
AMPHIOPLUS DEPRESSUS (LJUNGMAN) FROM THE INDIAN COASTS*

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GRAVELY (1927) in his account on the echinoderms of Krusadai Island in the Gulf of Mannar reported the occurrence of a brittle-star *Ophiophragmus relictus* (Koehler). Under synonymy for this species he included *Amphiura relictus* Koehler. *Amphiura relictus* is currently regarded as a synonym of *Amphioplus depressus* (Ljungman). A re-examination of the specimens of Dr. F. H. Gravely at the Madras Museum revealed that they are not *A. depressus* but belong to an undescribed species of *Amphioplus*. They are named here as *Amphioplus gravelyi* after Dr. F. H. Gravely who collected the specimens. The types are present in the reference collections of the Madras Government Museum.

Amphioplus gravelyi sp. nov.

Ophiophragmus relictus Gravely, 1927, p. 170.

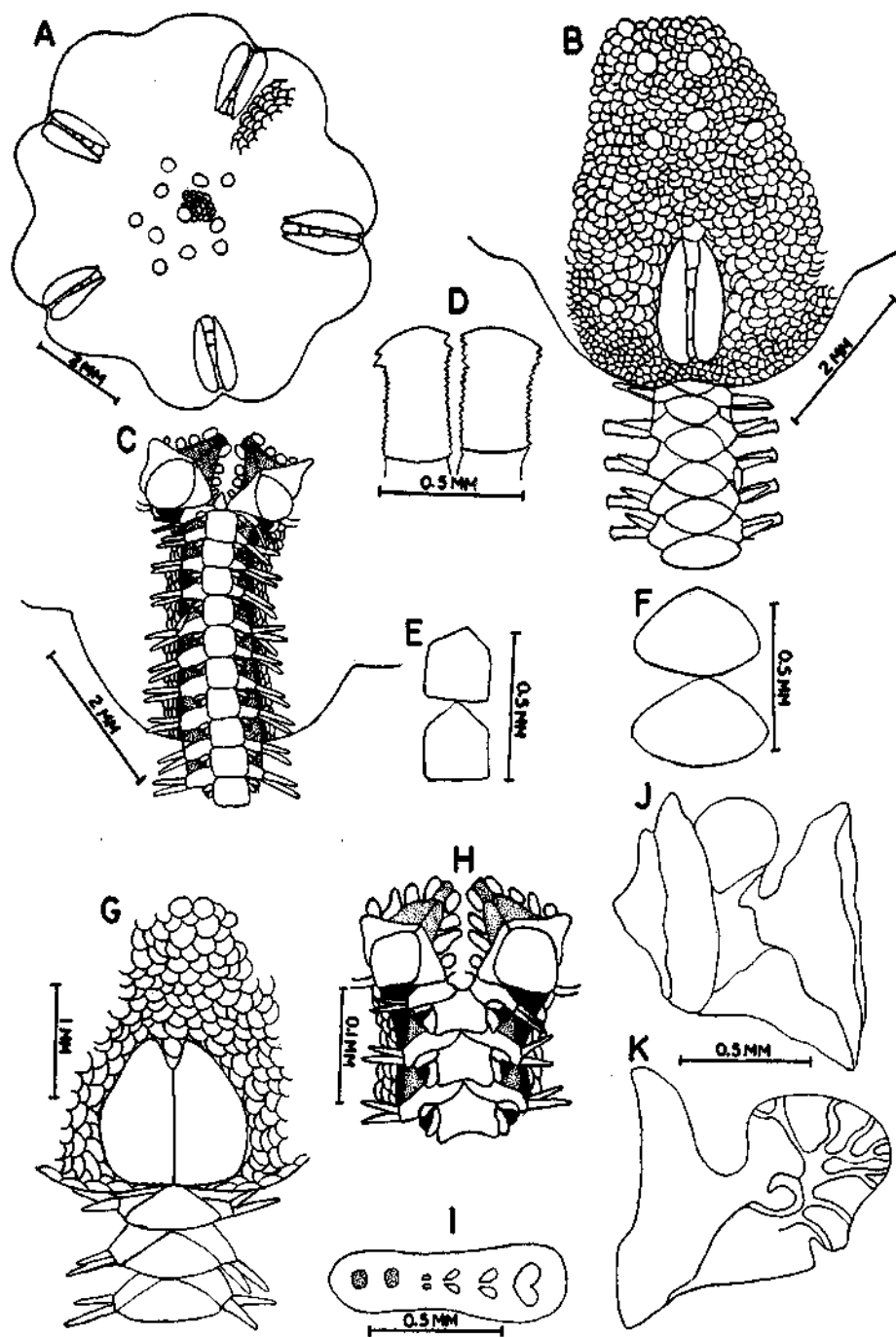
Material : Two specimens having disc diameter 8 and 9 mm. and with length of arms 100 and 110 mm. In the small specimen the dorsal covering of the disc is lost.

Localities : Krusadai Island and Pamban (Gulf of Mannar) ; September, 1925 collected by Dr. F. H. Gravely.

Description : The disc (Fig. 1, A) is five-lobed with numerous small imbricating scales. At the centre of the disc there is a small circular scale. Surrounding this scale and placed radially in position there are five circular scales forming the first circle. Alternating with these five scales there is a second circle of five other scales interradially arranged at some distance from the first circle. The size of these large scales is found to vary from 0.35-0.42 mm. The scales surrounding the radial shields (Fig. 1, B) are slightly larger than the other scales present on the disc. The scales at the margin of the disc are very small. The radial shields are long, pointed at the proximal end and they remain separated throughout their length. In between each pair of radial shields there is a row of three scales. The ratio of breadth to length of each radial shield is 1 : 4-1 : 4.2. The ratio of length of each radial shield to the diameter of the disc is 1 : 4.1.

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A-F. *Amphioptus gravelyi*; G-K. *Amphioptus depressus*. A. Dorsal side of the disc; B. Part of the disc and part of arm, dorsal view; C. Two jaws and part of arm, ventral view; D. Spatulate spines; E. Distal ventral arm plates; F. Distal dorsal arm plates; G. Part of disc and arm, dorsal view; H. Two jaws and part of arm, ventral view; I. Dental plate; J. Oral plate, adradial view; K. Oral plate, abradial view.

The interbrachial areas on the ventral side are completely covered with small imbricating scales.

There are four oral papillæ (Fig. 1, C) on each side of the jaw. They are arranged in a row without leaving any space. Of these the infradental papillæ are the largest and oval in shape. The distalmost papilla is the smallest of the four and situated on the adoral shield. The middle two papillæ are of the same size and are more or less circular in shape. The oral shield is large and pear-shaped. The adoral shields are slightly smaller, three-sided and meet interradially.

The dorsal arm plates are broadly elliptical proximally with the proximal and distal margins convex (Fig. 1, B) and the distal plates are fan-shaped (Fig. 1, F). The dorsal arm plates are contiguous with the successive plates. The ratio of length to breadth of the proximal plates is 1 : 2.2 and for the distal arm plates it is 1 : 1.4-1 : 1.6.

The first ventral arm plate is very small and three-sided. The proximal ventral arm plates are rectangular and contiguous. The ratio of breadth to length of each plate is 1 : 1.1-1 : 1.2. The distal ventral arm plates (Fig. 1, E) are pentagonal. The ratio of breadth to length of each plate is 1 : 1. There are two tentacle scales for each tentacle pore. The outer tentacle scale lies along the lateral arm plate and is slightly larger than the inner one which lies along the side of the ventral arm plate.

The first two free segments have five spines and the next 18 segments have four and the rest three spines. The spines are small, smooth, cylindrical and pointed. When there are four spines the third spine from the upper side is spatulate and when there are three spines the middle spine is spatulate (Fig. 1, D). The length of the three spines on the twentieth segment from the upper side is 5.49, 5.12 and 3.92 mm. respectively. At the tip of the arm all the three spines are smooth, cylindrical and pointed. The ratio of the longest spine to the segment length is 1 : 1.2.

The colour of the specimens in rectified spirit is whitish.

Remarks : The present species resembles *Amphioplus stenaspis* in having small radial shields which are separated throughout their length and in having the adoral shields which meet radially. H. L. Clark (1938) in his original description of *A. stenaspis* based on the holotype which has a disc diameter of 6 mm. stated 'primary plates are not to be distinguished; in smaller specimens the central and five radial plates are sometimes quite distinct.' In the present specimen which has a disc diameter of 9 mm. two circles of plates are distinctly seen (Fig. 1, A). The third papilla from the proximal end of the jaw is large and somewhat pointed in *A. stenaspis* but in *A. gravelyi* the infradental papilla is the largest and the distalmost papilla is the smallest. In *A. stenaspis* the spines are simply described as 'short and blunt' but in *A. gravelyi* they are spatulate as in the case of *A. iustus*. *A. gravelyi* differs from *A. iustus* in the presence of distinct primary plates and separate radial shields. The spatulate spines of *A. gravelyi* are very characteristic. They are flattened with fairly serrated margin (Fig. 1, D). The tips of the spines are rounded, slightly expanded and at the corner of each spine there are one or two small teeth. *Amphioplus gravelyi* can be separated from all the known species by the presence of distinct primary scales, small separate radial shields and the characteristic spatulate spines.

In addition to *A. gravelyi* sp. nov., described above the writer had opportunity to examine *Amphioplus depressus* collected from Cochin and other material kept

in the Indian Museum, now referable to *A. depressus* (Ljungman). Its synonymy, description and notes on its ecology are given in the following account.

***Amphioplus depressus* (Ljungman)**

- Amphipholis depressa* Ljungman, 1867, p. 312.
Ophiophragmus affinis Duncan, 1887, pp. 89-90, pl. viii, figs. 4-6.
Amphiura relictus Koehler, 1898, p. 68, pl. iv, figs. 37, 38.
 Koehler, 1900, p. 4, pl. xvi, figs. 15, 16.
Amphiura relictus (part) Koehler, 1905, p. 41.
Amphioplus relictus H. L. Clark, 1915, p. 256.
Amphioplus relictus (part) Koehler, 1922, p. 179, pl. 71, figs. 4-8.
Amphioplus relictus H. L. Clark, 1938, p. 251.
Amphioplus depressus H. L. Clark, 1915, p. 254.
 H. L. Clark, 1946, p. 205.

Material examined: Three specimens, 6-7 mm. in disc diameter, Syntypes of *Ophiophragmus affinis* (I. M. reg. no. 9454/6) collected by Dr. John Anderson from Eliphinstone and King Islands (Mergui Archipelago); one specimen 5 mm. in disc diameter, Holotype of *Amphiura relictus* (I. M. reg. no. ZEV 317/7) collected off Andaman, depth 13-18 metres; 13 specimens, 6-8 mm. in disc diameter collected from Cochin (Arabian Sea), depth 3-20 metres.

Description: The disc is circular in outline except at the radial regions where it is indented giving the disc a five-lobed appearance. In none of the specimens the arms are complete but it is estimated that a complete arm will be five to six times the diameter of the disc. The disc (Fig. 1, G) is covered by small overlapping scales. The scales at the centre of the disc and in the interradian regions are large. The radial shields are separated interradianly by 12-15 scales. In some of the specimens a primary rosette of plates is discernable. There is a distinct line of demarcation between the scales of the dorsal and ventral, sides of the disc. The radial shields are more or less semicircular, meeting each other except proximally where they are separated by a circular scale. The ratio of breadth to length of each radial shield is 1 : 1.8. The ratio of the length of the radial shield to the disc radius is 1 : 2.6.

There are four oral papillae (Fig. 1, H) on each side of the jaw. In one specimen collected from Cochin there are five oral papillae on each side of the jaw. When five papillae are present the one next to the infradental papilla is the smallest. The outermost papilla is small and arises on the adoral shield. The one next to the outermost papilla is the largest being a little enlarged but not opercular. There are six rectangular teeth with truncated ends. The oral shields are diamond-shaped. The adoral shields are small, three-sided and contiguous interradianly.

The dorsal arm plates are fan-shaped and barely touch each other. The proximal edges are straight and the distal edges are convex. The ratio of length to breadth of each plate is 1 : 2.3. The proximal plates are just contiguous and the distal plates are slightly separated from each other.

The first ventral arm plate is very small. The following plates are five-sided with all the edges slightly concave. The plates either just touch each other or leave some space between the consecutive ones. The ratio of length to breadth of each plate is 1:1.5. At the centre of each ventral arm plate there is a faint oval elevation. There are two large tentacle scales for each tentacle pore. The inner tentacle scale is larger than the outer one and lies along the side of the ventral arm plate and the outer and smaller one lies along the edge of the lateral arm plate.

There are three short, cylindrical and pointed spines to each segment. The middle spine is the longest and thickest and the lower spine the smallest of the three. The ratio of length of the longest spine to the segment length is 1:1.1.

The colour is dull yellowish-white in rectified spirit.

Murakami (1963) in his work on the Ophiuroidea pointed out the importance of the study of the dental and oral plates since they offer some diagnostic characters to clarify systematic interrelationships. The dental and oral plates of *A. depressus* which have hitherto been unknown are described below. The dental plate (Fig. 1, I) is wedge-shaped with the upper and lower margins broadly rounded. The lateral margins are slightly concave. The number of foramina varies with the size of the specimen. In large specimens of 5-8 mm. disc diameter there are seven foramina. The size of the foramina gradually decreases downwards. The first foramen is unpaired, large and heart-shaped. The other six foramina are situated very close to each other and are either wedge-shaped or oval. At the lower end of the dental plate there are two depressions.

The oral plates are wing-shaped. The abradial (Fig. 1, K) muscle area is large and ear-shaped with conspicuous distal wing which bears a distinct more or less irregularly branched indentation. The adradial (Fig. 1, J) muscle area is pear-shaped and restricted to the upper side only.

Remarks: Duncan (1887) while writing on the Ophiuroidea of the Mergui Archipelago described a new brittle-star *Ophiophragmus affinis* from the Eliphinstone and King Islands. A re-examination of the syntypes (I. M. reg. no. 9454/6) by the author at the Indian Museum revealed that it is synonymous with *Amphioplus depressus* (Ljungman). The author has also re-examined the holotype of *Amphiura relictus* (I. M. reg. no. ZEV 317/7) and is able to confirm the view of H. L. Clark (1946) that it is a synonym of *A. depressus*. In preservation often the middle and two oral papillae of the jaws come closer and project outwards for which Duncan (*op. cit.*) remarked in case of *Ophiophragmus affinis* 'the following more or less united'.

A. M. Clark (1967) has discussed the affinity of a number of species of *Amphioplus*. She is of the opinion that at least the specimens reported as *A. relictus* by Koehler (1905) from Makassar and Molo Strait in the East Indies and also those described by him in 1922 from Kagoshima should be referred to *A. japonicus* and not *A. relictus* because the distal edge of the oral shields is simply convex and also due to the presence of the distinct enlarged row of marginal disc scales contrasting with the uppermost row of smaller ventral scales. The characters of *Ophiophragmus affinis* and *Amphiura relictus* are compared with the characters of *Amphioplus depressus* in Table I.

Ecology: The brittle stars are collected from muddy bottom at a depth of 3-20 metres off Cochin. They are found to live in fairly dense communities with 10 to 20 individuals in each square metre. Barnard and Ziesenhenné (1961) have reported some Amphiurid brittle-star communities off the Southern Californian coast. They have recorded *Amphiura urtica*, *Amphiopholis squamata* and *Amphioplus hexacanthus* whose concentrations per square metre is 422, 44 and 13 respectively. *A.*

depressus can be collected throughout the year and the young ones are encountered during the months of September and October which indicates the breeding season of the brittle-star. They are found to tolerate a salinity range of 31.4-34.8‰.

TABLE I
Comparison of characters of *Ophiophragmus affinis* Duncan and *Amphiura relictus* Koehler with *Amphioplus depressus* (Ljungman)

Character	<i>Ophiophragmus affinis</i> (Syntypes)	<i>Amphiura relictus</i> (Holotype)	<i>Amphioplus depressus</i> (Specimens collected from Cochin)
Oral papillae	Third oral papilla enlarged.	Third oral papilla enlarged.	Third oral papilla enlarged.
Radial shields	More or less semicircular and joined throughout the length except proximally where they are separated by a scale.	More or less semicircular and joined throughout the length except proximally where they are separated by a scale.	More or less semicircular and joined throughout the length except proximally where they are separated by a scale.
Dorsal arm plates	Broadly elliptical	Broadly elliptical	Broadly elliptical
Ventral arm plates	Five-sided with two large tentacle scales.	Five-sided with two large tentacle scales.	Five-sided with two large tentacle scales.
Arm spines	Three	Three	Three
Radial shields (Length : Breadth)	2 : 1.1	2 : 1.0	2 : 1.0
Dorsal arm plates (Length : Breadth)	1 : 2.2	1 : 2.3	1 : 2.1
Ventral arm plates (Length : Breadth)	1 : 1.6	1 : 1.6	1 : 1.5

Distribution : It has been reported from East Indies, Philippines, Fiji, Northern and Western coasts of Australia, coast of Ganjam (India), Andamans and Mergui Archipelago. It is here recorded for the first time, from the Arabian Sea.

SUMMARY

Two brittle-stars reported by Gravely (1927) as *Ophiophragmus relictus* (Koehler) from the Gulf of Mannar have been re-examined and found to belong to an undescribed species of *Amphioplus*. They are described here as *Amphioplus gravelyi*.

A detailed description of *Amphioplus depressus* (Ljungman) is given and its synonymy is discussed from the material collected from the Arabian Sea off Cochin. The structure of oral and dental plates of the species is described for the first time. Some notes on the ecology of the species have also been added.

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*Not referred to in original.