18. Boring and Fouling Echinoderms of Indian Waters

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Very little is known about the boring and fouling activities of echinoderms from Indian waters. The author, as a result of his studies on Indian echinoderms during the last 22 years, has collected a number of fouling echinoderms belonging to the classes Crinoidea, Asteroidea, Ophiuroidea, Echinoidea, and Holothuroidea in addition to sea urchins belonging to the families Stomopneustidae and Echinometridae, which bore into rocks in intertidal regions. These organisms are described.

INTRODUCTION

There is little information on echinoderms as boring organisms. This is largely because their boring activities never extend to wood and timber. However, they are of significance. Sea urchins are known to bore into steel pilings (Irwin 1953) and into rocks and coral stone, common sights on rocky coasts and coral reefs (Otter 1932, Clark 1976a).

Very little is also recorded about their fouling activities. All epizoic echinoderms, having limited movement, can readily settle on the undersides of boats, buoys, and cables. The younger stages of many echinoderms—notably the crinoids, ophiuroids, asteroids, and holothuroids—can also cause fouling. Kuriyan (1950) and Evangeline (1966a) reported echinoderms that foul pearl oyster cages and edible oyster cultches. Rao and Ganapati (1980) noted that some ophiuroids, e.g., *Ophiactis savignyi* and *Ophiothrix* sp., form 0.12 to 1.0% of the fouling bryozoans in which they are found at Visakhapatnam. The fouling of fishing nets by basket stars and asteroids is also an important area that has not received much attention.

BORING ORGANISMS

The boring activities of echinoderms are restricted to sea urchins belonging to the families Stomopneustidae and Echinometridae, found along the Indian coast. Sea urchins, such as *Stomopneustes variolaris, Echinostrephus molaris, Echinometra mathaei,* and *E. mathaei* var. *oblonga* bore through rocks.

S. variolaris is found at Visakhapatnam and Mandapam. It is a large sea urchin, which grows to 60 mm in horizontal diameter. This species bore into rocks only at Waltair, where there is heavy wave action. Sastry (1985) has studied the boring activity of this organism from Visakhapatnam (figures 1, 2). At Mandapam in the Gulf of Mannar where there is no wave action, they do not bore into rocks but simply attach firmly to them. Boring, therefore, is only a mechanism to avoid wave action and desiccation. Occasionally, this species can be found in Cymadocea eel grass beds, on which they feed, at Vedalai in the Gulf of Mannar. These sea urchins must be collected without alerting them, because once they are attached to the rocks by their tube feet, it is almost impossible to dislodge them. Their teeth and spines are used to widen their burrows. The spines on the oral side are light pink and blunt. By constantly exerting rotatory movements, these urchins are able to wear away rock slowly. Many individuals found in rock burrows permanently dwell there, although they may not necessarily return to the same burrow. About 8–10 burrows per linear meter can be found at Yerada and Rishikonda at Visakhapatnam. It is of interest that only large forms are found in the intertidal region.

E. molaris (figure 3A) is a typical rock-boring sea urchin found at Port Blair. It is small in size (5–25 mm horizontal diameter) and spherical. Adults make small, smooth cylindrical burrows (75–100 mm depth) in the rocks. The diameter of the burrow is such that it will just allow the urchin to move up and down in it. In undisturbed state, the urchin perches near the top of the burrow. Its presence is indicated by a tuft of long aboral spines. At the slightest disturbance, the urchin drops to the burrow's bottom and cannot be reached; it is necessary to break the stone into small pieces to collect them. Only the aboral spines are long, the others on the oral and ambital regions are very short and blunt. They help in burrowing by making circular movements (Mortensen 1943). This species is always found to live beyond the low water mark. They can only be seen with a mask and snorkel during low tide. Sometimes 50–60 individuals can be found distributed in a square meter.

E. mathaei var. *oblonga* and *E. mathaei* (figure 3 B) are good rock borers at Port Blair. Of the two, *E. mathaei* var. *oblonga* is the more powerful borer. The larger urchins lie at the bottoms of their U-shaped burrows, making it impossible to collect them without breaking the rocks. The smaller ones bore into rocks at an angle for some distance, then bore horizontally, finally tunnelling their way up, forming the U-shape groove. The urchin lives in the center of the groove in a depression. It depends for its food upon organisms swept along with the water during

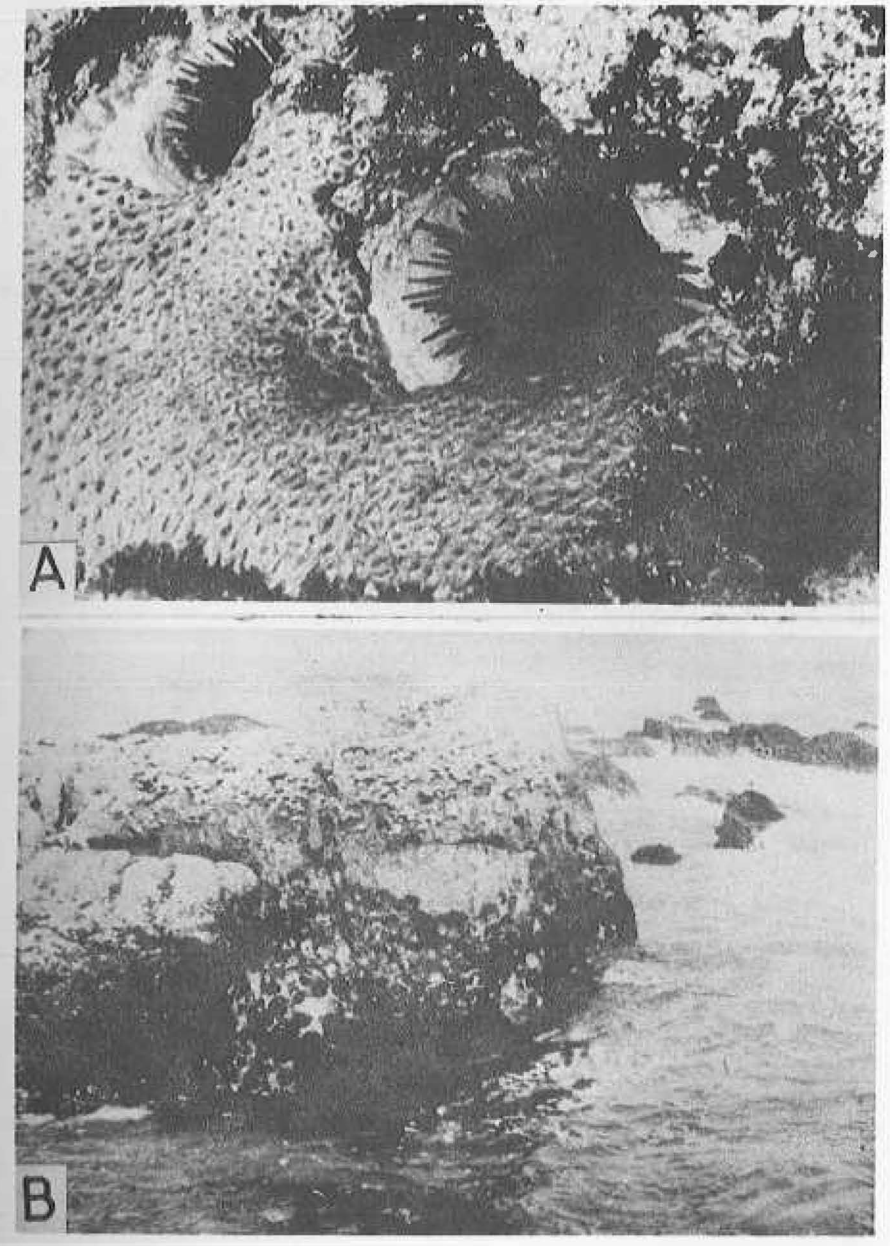

Figure 1. A. Close up of the sea urchin *Stomopneustes variolaris* (Lamarck). **B.** *S. variolaris* boring into rock.

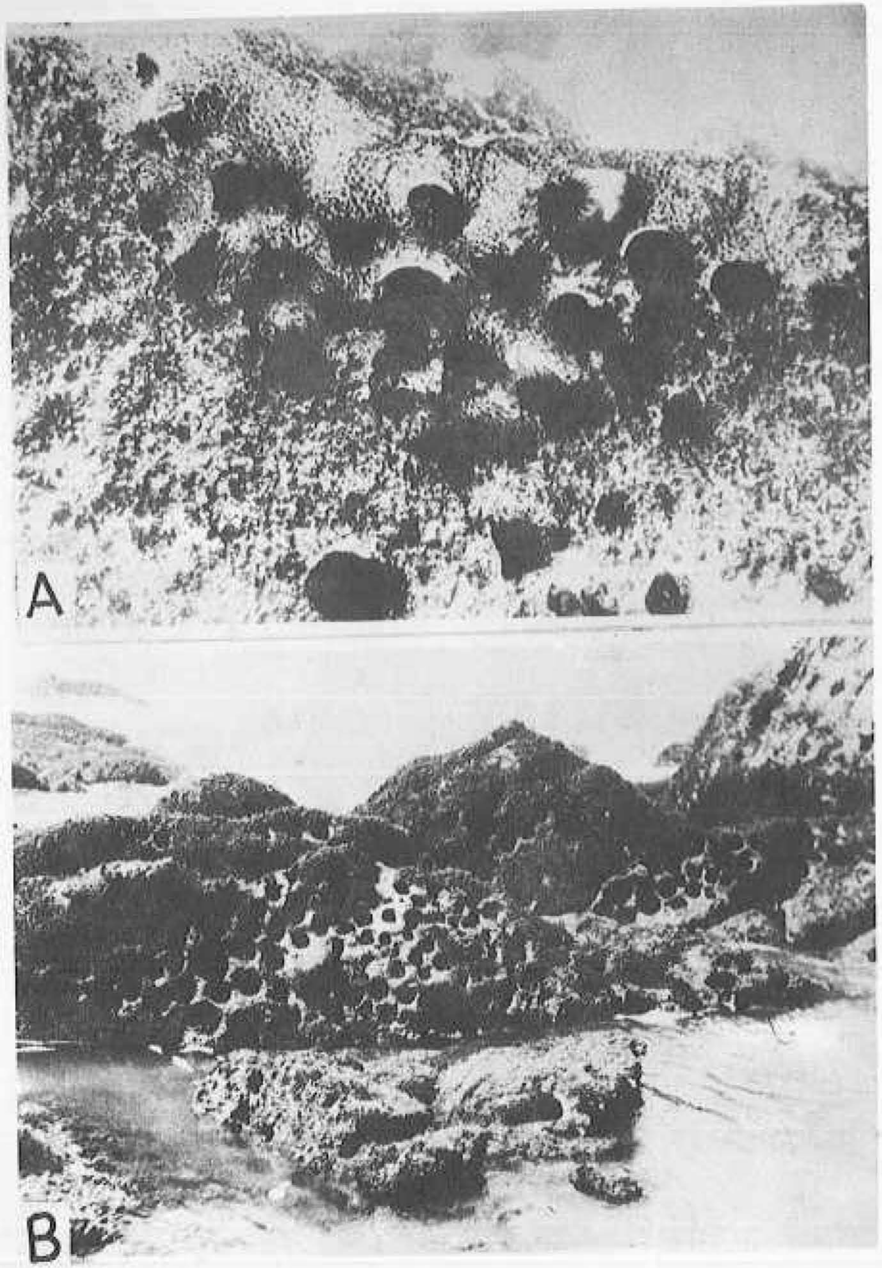

Figure 2. **A.** Close up of *Stomopneustes variolaris* boring into rock. **B.** *S. variolaris* making rocks into "honey combs."

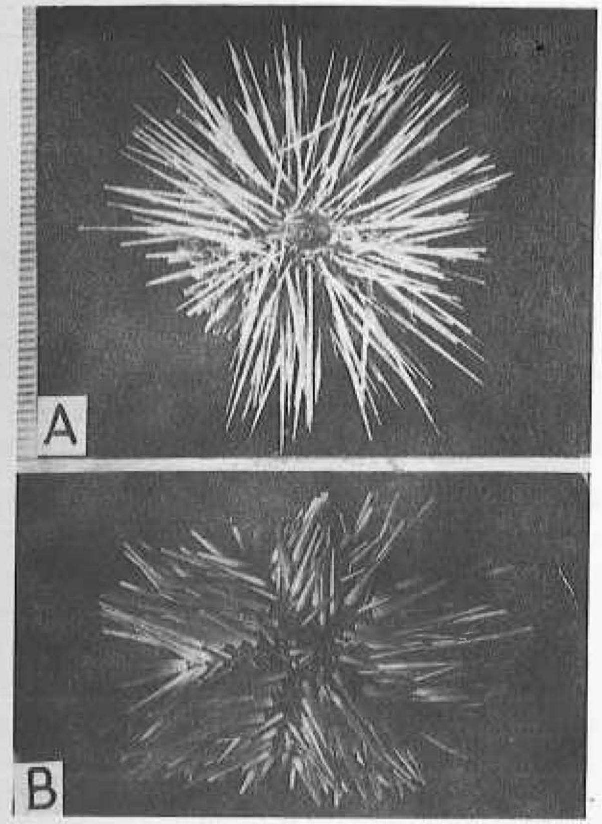

Figure 3 **A.** *Echinostrephus molaris* (de Blainville). **B.** *Echinometra mathaei* (de Blainville).

high tide (Hyman 1955) and upon the oxygen in the water for its respiration needs. Many become completely exposed during high tides although some water remains in their grooves. The spines on the oral side aid in boring into the rock. On the perignathic girdle of *E. mathaei* var. *oblonga* is a superstructure that gives additional support to the muscles of the Aristotle's lantern. *E. mathaei* is light green, whereas *E. mathaei* var. *oblonga* is black. Some *E. mathaei* collected from the Gulf of Mannar did not burrow. They were simply found attached to coral stones. This was due to the absence of wave action in the gulf.

FOULING ORGANISMS

All epizoic echinoderms that live on sponges, alcyonarians, gorgonians, and comatulids are fouling organisms. Many, particularly in the younger stages, attach to the undersides of boats and other objects. Clark (1976a) has reported on the tropical epizoic echinoderms and their distributions. The epizoic forms collected during the present study are presented in table 1. The complete list of echinoderms collected as fouling organisms is given in table 2.

Table 1. Epizoic echinoderms collected during the study.

Echinoderm	Host
Ophiothela danae Verril	Gorgonians
Ophiogymna lineata H.L. Clark	Alcyonarians
Ophiomaza cacaotica Lyman	*Tropiometra carinata*
Gymnolophus obscura (Ljungman)	*Comanthina schlegeli*
Ophiactis modesta Brock	*Spirastrella inconsfans*
Ophiothrix exigua Lyman	*Prostylyssa foetiala*
	Callispongia diffusa
	Oceanopia sp.

Table 2. Echinoderms collected as fouling organisms during the study.

Class: Crinoidea
Capillaster multiradiatus (Linnaeus)
Comanthina schlegeli (P.H. Carpenter)
Comaster gracilis (Hartlaub)
Comatella stelligera (P.H. Carpenter)
Heterometra reynaudi (J. Muller)
Lamprometra palmata (J. Muller)
Stephanometra indica (Smith)
Tropiometra carinata (Lamarck)

Class: Asteroidea
Astropecten indicus Doderlein
Asterina burtoni Gray
Asterina coronata var. Martens
Asterina lorioli Koehler
Asterina sarasini (de Loriol)
Pentaceraster regulus (Muller and Troschel)
Linckia multifora (Lamarck)

Class: Ophiuroidea
Astroboa nuda (Lyman)
Amphipholis squamata (D. Chiaje)
Ophiocomella sexradia (Duncan)

Class: Echinoidea
Salmacis virgulata L. Agassiz

Class: Holothuroidea
Synaptula recta (Semper)

Crinoids sometimes attach themselves to cable lines, buoys, and ropes used to tie boats. The cirri of comatulid crinoids are smooth, segmented, circular in cross-section, jointed to curl vertically downwards, and are well adapted for clinging to projections of substrates or to animate hosts. The feather stars *Tropiometra carinata* (figure 4 A) and *Lamprometra palmata* (figure 4 B) are common at Vedalai in the Gulf of Mannar.

The ophiuroid *Amphipholis squamata* lives among other fouling organisms. *Ophiactis modesta* is always found living inside the canals of the sponge *Spirastrella inconsfans*. A piece of sponge can contain a number of brittle stars of varying sizes. Most of the young specimens have six or seven arms. *Ophiothrix exigua* also lives only on sponges, such as *Prostylyssa foeticla, Callispongia diffusa,* and *Oceanopia* sp., which foul the bottoms of boats, buoys, etc. This species shows remarkable color diversity, a form of protection. It often assumes the same color as the sponge upon which it lives. *Ophiocomella sexradia* (figure 5 A) was found to be associated with the algae *Caulerpa* sp., which settles on the undersides of boats. *Ophiothela danae* entwine around branches of gorgonians, while the arm tips of *Ophiogymna lineater* (figure 5B) coil round the branches of alcyonarians. In these two species, the lower arm spines are modified as hooks for attachment. The ophiuroids *Gymnolophus obscura* and *Ophiomaza cacaotica* (figure 6 A) appear to be semiparasitic and are collected from *Comanthina schlegeli* and *T. carinata,* respectively. The brittle stars coil the tips of their arms on the basal portions of the arms of feather stars; the mouths of brittle stars face the mouths of the feather stars. They steal food from the upturned open ambulacral grooves as it passes from the arms to the mouth (Clark 1976b). There does not appear to be any host specificity. Clark (1921) noted that they occur on sea feathers of larger size, which can support them.

DISCUSSION

All doubts regarding the destructive nature of sea urchins were dispelled when Irwin (1953) reported that they bored into steel pilings. She stated that the sea urchin *Strongylocentrotus purpuratus* made depressions in the steel pilings of a pier belonging to the Signal Oil and Gas Company near Ellawood, California. About half of the 40 piles put up in 1929 were damaged by them. With more and more work now being done at sea by various companies and organizations, including the Oil and Natural Gas Commission, a careful watch has to be kept on the activities of the sea urchins, otherwise the damage caused by them could be disastrous.

The ability of sea urchins to bore into rocks needs more study since they can destroy rocks along shores as well as coral reefs, possibly creating

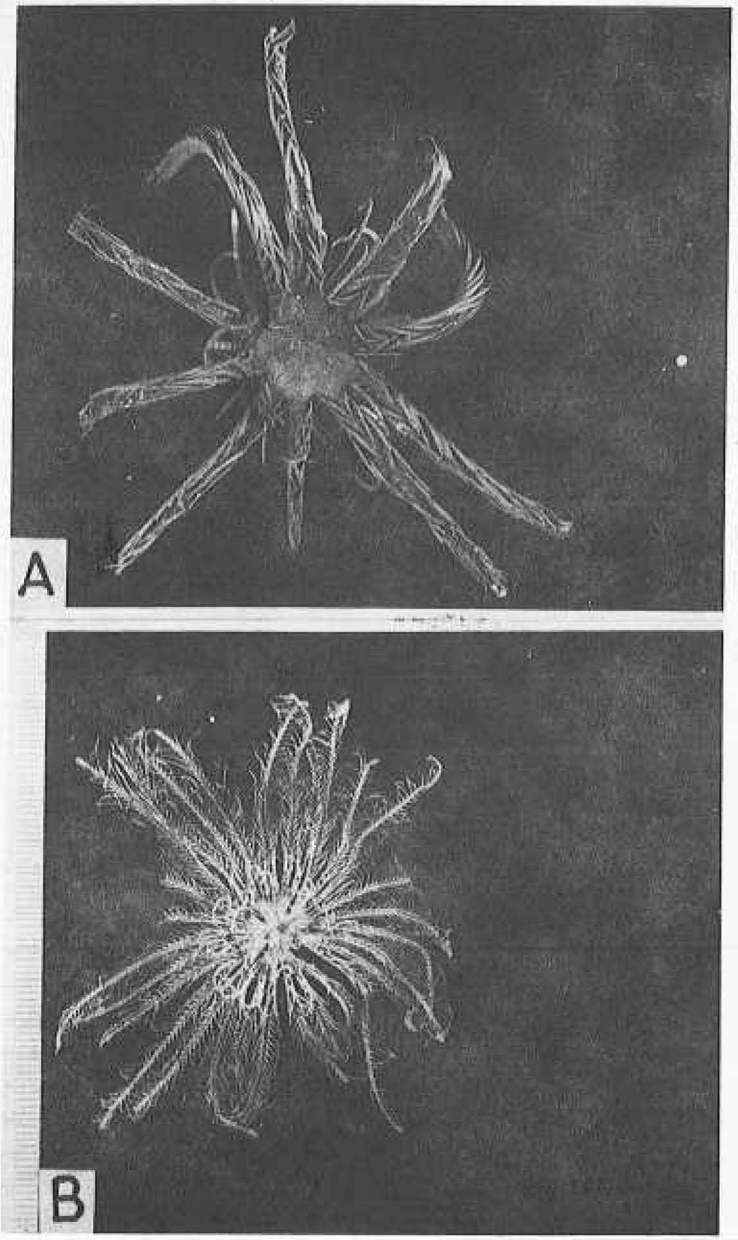

Figure 4. A. *Tropiometra carinata* (Lamarck). B. *Lamprometra palmata* (J. Muller).

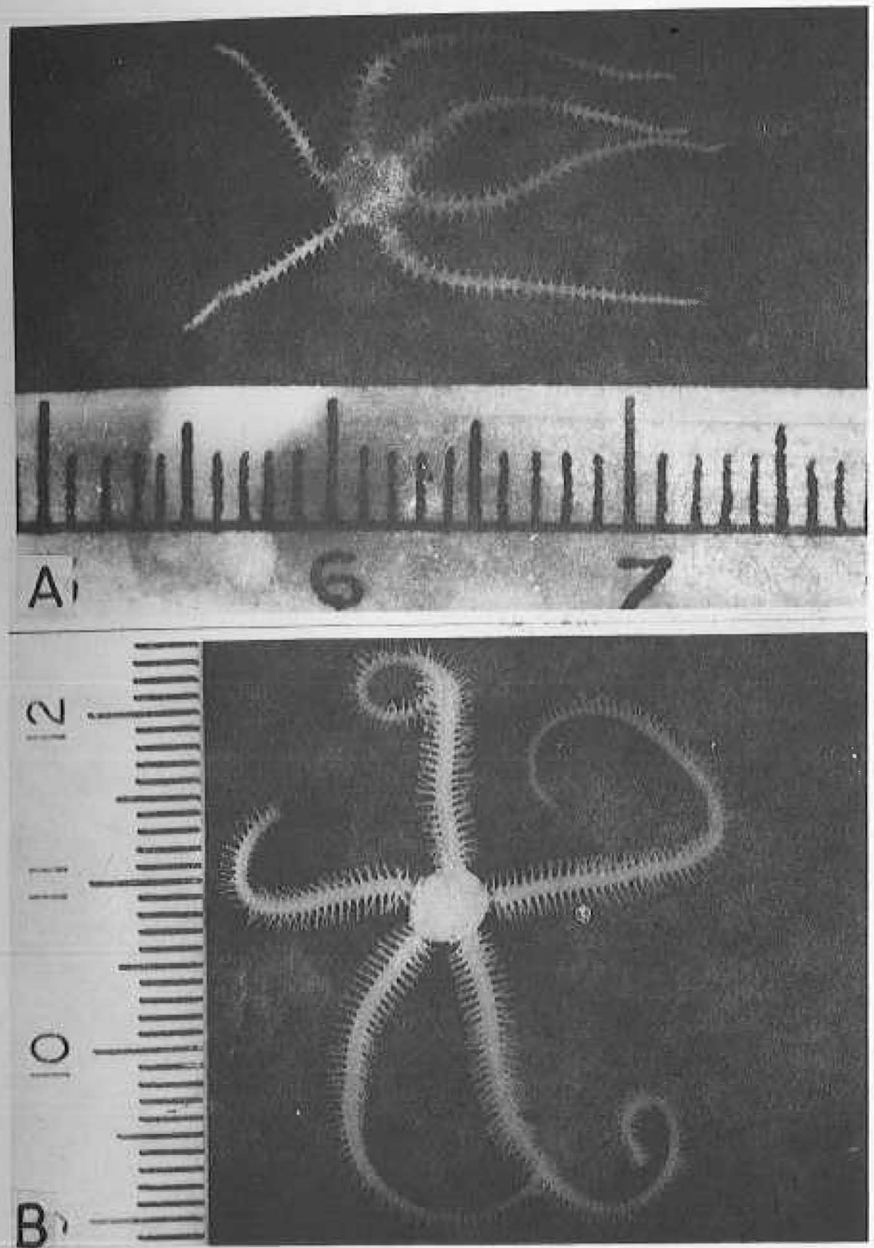

Figure 5. A. *Ophiocomella sexradia* (Duncan). B. *Ophiogymna lineater* H.L. Clark.

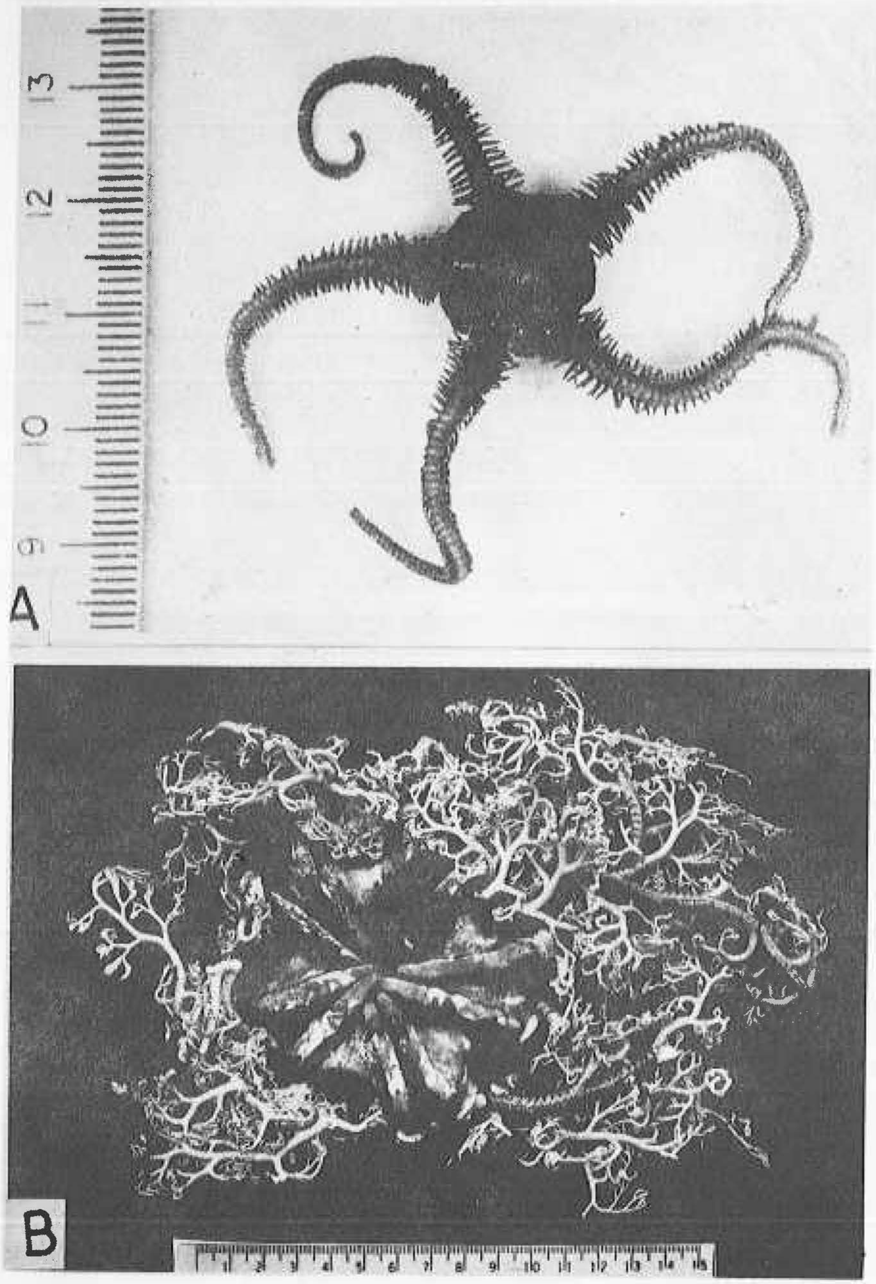

Figure 6. A. *Ophiomaza cacaotica* Lyman. **B.** *Astroboa nuda* (Lyman).

erosion problems. Several generations of sea urchins can cause rocks to look like honey combs (figure 2B). Such rocks, when exposed to wave action, can break into small pieces.

The role of echinoderms as fouling organisms in edible oyster cultches and pearl oyster cages must also be studied thoroughly because they hamper oyster growth and interfere with culture operations. Kuriyan (1950) made several observations on the fouling organisms of the pearl oyster cages at Krusadai Island in the Gulf of Mannar. According to him, *Pentaceraster regulus* was at maximum number in September and October, *Salmacis virgulata* in August, and *Astropecten indicus* in June, July, and August. Evangeline (1966a), who studied the fouling organisms of the edible oyster cultch in Ennore backwaters, stated that only a few specimens of *S. virgulata* settled in June 1957. During 1958, only in May was the ophiuroid *Ophiocnemis marmorata* collected. It was found to be rare. The same species was found to be gregarious, at times, in the Ennore estuary (Evangeline 1966b). *S. virgulata* was also noted to have a peculiar habit of picking up bits of shells, coral pieces, and other objects with its tube feet and then covering its body with them. Possibly, such a habit induces it to foul. Small specimens (12 mm horizontal diameter) of this species were collected from algal scrapings at Mandapam.

Very little attention has been given to the echinoderms that foul fishing nets and traps, hampering operations. Bell (1902) presented an interesting case of the starfish *Linckia laevigata* collected from baited baskets at Minicoy Island in the Lakshadweep. In another case, the basket star *Astroboa nuda* (figure 6 B) was found clinging to the side of the trawl net, which was operating off Parangipettai at night at a depth of 20 meters. They are known to spread their arms at night for feeding purposes (Tsurnmal and Marder 1966). Their lower arm spines are modified hooks and the tips of their branched arms can curl around objects. Some starfish, such as *Pentaceraster regulus*, have become a nuisance to fishermen who operate crab nets in the Gulf of Mannar.

In discussing the migration of echinoderms into and through the Suez Canal, James and Pearse (1971) stated that species such as *O. savignyi*, *Asterina burtoni*, and *Amphioplus laevis*—now established on the Mediterranian coast—might have been transported there by boats. This could have happened only if they had fouled the undersides of the boats. In fact, tropicopolitan distribution can be traced to the fouling habits of young echinoderms. James (1978) collected a small specimen of *Holothuria scabra*, 30 mm in length, from algal scrapings.

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