MARINE INTERTIDAL BARNACLES IN THE INDIAN OCEAN

by A. DANIEL, *Marine Survey Division, Zoological Survey of India, Calcutta*

A detailed study extended over a period of twenty years of the barnacle fauna of the intertidal region of the coasts of the Indian mainland and the Little Andaman and the Great Nicobar Islands has been made, based on (a) extensive collections made by the author, (b) the collections available in the Zoological Survey of India and other Museums, and (c) all published records available in the literature. The intertidal barnacle species occurring in the different regions and their vertical zonation patterns within the intertidal zone are presented. This study has revealed that even fairly narrow seas offer a barrier to predominantly intertidal species of the genera *Chthamalus, Balanus, Tetraclita,* and *Lithotrya*. These species which are 'non-fouling' ones have spread along the coast probably because their free-swimming naupliar and early stage cyprid larvae have been carried by the tidal streams and residual currents which are obviously stronger when parallel to the shore than at right angles to it. At the time of settlement, factors like intensity of illumination, gregarious attraction, stage of tide, colour of substratum, water currents and wave action, primary film and the presence of other organisms become operative and influence the settlement of the settling-stage cyprid larvae.

Marshalling evidences from the results of earlier long-term experiments conducted during 1949–'60 at Madras and the role of these factors in influencing the settlement of the cyprids of two species of intertidal barnacles, i.e. *Balanus amphitrite variegatus* Darwin and *Chthamalus stellatus stellatus* (Poli) are analysed. The results of later short-term experiments conducted during February–March 1961 at Little Andaman Island, January–May 1964 at Cochin, February–May 1966 at Great Nicobar Island, and March 1968 at Sagar Island, lend support to the earlier findings.

It is clear from the experiments that the reactions of the cyprids to many of these factors at the time of settlement may play an important part in leading them to settle in the zones where the adults are found. The probable sequence of the responses of the cyprid larvae and the relative importance of the different factors in influencing their settlement are discussed.

INTRODUCTION

The thoracic cirripedes are a diverse group of marine crustaceans occurring in or on fixed substrates, in or on other animals, and on inanimate objects floating in the sea. In the Indian Ocean, the thoracic cirripedes are represented by 280 species/subspecies (Stubbings 1936; Nilsson-Cantell 1938; Daniel 1956*a*). Of these, only 48 species are recorded from the intertidal zone of which a few account for their abundance in this zone.

In the present paper the intertidal barnacle species occurring in different regions in the Indian Ocean, their vertical zonation pattern, their habitats and abundance, their geographical distribution with remarks on their 'fouling' and 'non-fouling' characteristics are presented (Table I). This study has been made on the basis of extensive survey, collections, test-panel, test-pole, test-block studies made

TABLE I

Thoracic cirripedia from the intertidal zone in the Indian Ocean

Species	Habitat and abundance	Distribution	Remarks
Lithotrya nicobarica Reinhardt, 1850	Burrowing into corals or coral remains and rocks. Occurs at halftide zone and mainly in subtidal zone; very rarely at high tide. Abundant in Great Nicobar and Little Nicobar and Maldive Islands. Not recorded from coral zones of Andamans and south-east and north-west coasts of India, although corals are present.	**Indian Ocean** : Great Nicobar, Katchal Islands; Maldives, Timor, Lombok, Funafuti, Christmas Islands. **Elsewhere** : Fiji Island, New South Wales, New Zealand, Australia.	Non-fouling
Lithotrya valentiana (Gray) 1825	Burrowing into corals, coral remains and rocks. Extends from halftide zone to subtidal zone. Few specimens recorded so far. In the Indian Ocean distributed in the western part.	**Indian Ocean** : Red Sea, Zanzibar, Mozambique, Baluchistan. **Elsewhere** : Malay Archipelago, Friendly Islands; South Sea Islands.	–do–
Lithotrya truncata (Quoy & Gaimard) 1834	Burrowing into corals, coral remains and rocks. Occurs rarely at halftide zone and mainly in subtidal zone. Very few specimens recorded so far.	**Indian Ocean** : Zanzibar **Elsewhere** : Malay Archipelago ; Friendly Islands.	–do–
Ibla cumingi Darwin, 1851	On rocks and stones. Mainly at intertidal zone. Common in localities where they have been recorded.	**Indian Ocean** : Laccadive Sea, Ganjam coast, Madras coast, Andamans Burma. **Elsewhere** : Malay Archipelago, Western part of Pacific Ocean to Japan.	–do– –do–
Ibla quadrivalvis (Cuvier) 1817	On rocks. Intertidal zone. Few specimens recorded from Southwestern Indian Ocean. Common in Pacific.	**Indian Ocean** : Madagascar, East coast of Africa. **Elsewhere** : South coast of Australia, Fiji Island, New Zealand.	

Chthamalus stellatus stellatus (Poli) 1795	Abundantly occurs on high beach rock, stones, shells, of other barnacles (hard substrata) covered only during high tides in exposed beach with strong wave action. Mostly occur only on fixed structures and rarely on floating structures. Also distributed in estuaries, especially the Hooghly. The commonest Chthamalid of the Indian coast. Forms distinct zones.	**Indian Ocean :** East and west coasts of India Andamans, Nicobars, Laccadivas, Maldives, East coast of Africa, Suez. **Elsewhere :** Malay Archipelago, extends up to England, Mediterranean Sea, West coast of Africa.	Non-fouling mainly. Also rarely occurs as fouling constituent.
Chthamalus challengeri Hoek, 1883	Abundant in high beach rocks, covered only during high tide in wave-exposed localities.	**Indian Ocean :** Colombo, Bombay, Pamban bridge, Red Sea. **Elsewhere :** Malay Archipelago, Japan.	Non fouling
Chthamalus malayensis Pilsbry, 1916	Rare species occurring in high intertidal zone on rocks and other barnacles. Recorded at Pamban Bridge on east coast and at Bombay on west coast.	**Indian Ocean :** Bombay, Pamban Bridge, Burma. **Elsewhere :** Malay Archipelago.	–do–
Chthamalus withersi Pilsbry, 1916	Occurs on leaves of mangrove, on bark and wood. Extends from half-tide level to subtidal zone. In estuaries of India, found mainly subtidally. Also cocurs on Molluscs and Crustacean hard parts. Inconspicuous species.	**Indian Ocean :** Orissa,, Bombay, Calcutta, Burma; Mergui Archipelago. **Elsewhere :** Malay Archipelago.	Occurs as fouling constituent.
Chthamalus hembeli (Conrad) 1837	Occurs on stone and rocks in high intertidal zone. Rare. Known from few localities. The largest sized species among the Chthamalids.	**Indian Ocean :** Mergui Archipelago **Elsewhere :** Malay Archipelago, Japan, Hawaii.	Non-fouling
Chthamalus dentatus Krauss, 1848	Occurs on stone, rocks and other barnacles in high intertidal zone. Known only from the shores of west coast of Africa and Gulf of Aden. Not recorded from Indian Ocean.	**Indian Ocean :** Gulf of Aden, Madagascar, Durban **Elsewhere :** Atlantic	–do–

TABLE 1—*Contd.*

Species	Habitat and abundance	Distribution	Remarks
Chthamalus moro Pilsbry, 1916	Occurs in high intertidal zone on rocks. Rare species . In Indian Ocean recorded only once from Nias island. Not recorded from Indian Coast.	**Indian Ocean :** Nias Island **Elsewhere :** Abo, Malay Archipelago	Non-fouling
Tetrachthamalus oblitteratus Newman, 1967	Occurs on rocks, limestone, mangrove roots along with *Tetraclita squamosa rufotincta*. Occupies high intertidal zone. Disjunct and Restricted distribution. The smallest-sized species of the chthamalids. The only four plated Chthamalid.	**Indian Ocean :** Red Sea, Islands of the Seychelles—Mauritius Ridge.	-do-
Octomeris intermedia Nilsson-Cantell 1921	From half-tide zone to subtidal zone on stone. Rare forms. Recorded only twice so far from the Eastern Indian Ocean.	**Indian Ocean :** Mergui Archipelage; Java. **Elsewhere :** Malay Archipelago.	-do-
Octomeris angulosa Sowerby, 1825	At half tide zone or below in shore. Rare. Known only from South African and Australian coasts.	**Indian Ocean :** Durban, Port Elizabeth. **Elsewhere :** South Africa, Australia.	-do-
Balanus tintinnabulum tintinnabulum Linne, 1767	Shore and surface; Rarely at half tide level; Abounds in sublittoral fringe of rocky shores and shady sides of rocks. Occurs on rocks, stones and also on ships bottoms. Recorded up to a depth of 180 metres.	**Indian Ocean :** East and West coasts of India, Andamans, Nicobars, Burma. **Elsewhere :** Meditteranean, Atlantic.	Important fouling organism of Indian coasts.
Balanus tintinnabulum occator Darwin, 1854	On rocks and stones at Shore and surface. Also on ship bottom. Rare.	**Indian Ocean :** Madras, Andamans. **Elsewhere :** Pacific	Inconspicuous Fouling species
Balanus tintinnabulum volcano Pilsbry, 1916	On stones and rocks shore and surface; also on ship's bottoms. Rare.	**Indian Ocean :** Gulf of Mannar, Andamans. **Elsewhere :** Japan.	-do-

Balanus tintinnabulum validus Darwin, 1854	Shore and surface : on stones and rocks. Very rare.	**Indian Ocean:** Gulf of Mannar, Andamans. **Elsewhere :** Malay Archipelago.	Fouling
Balanus ajax Darwin, 1954	Rarely at half tide : mainly subtidal on corals. Rare.	**Indian Ocean :** Maldives. **Elsewhere :** Philippines, Salomon Island New-Caledonia.	Non-foluing
Balanus amphitrite variegatus Darwin, 1854	Extends from half-tide level to subtidal zone. Abundant about halfmetre below lowtide level. Settles on fixed structures and also floating and submerged structures.	**Indian Ocean :** East and west coasts of India, Andamans, Nicobars, Ceylon, Arakan coast, Mergui Archipelago, Sumatra. **Elsewhere :** Malay Archipelago, China, New South Wales, New Zealand.	The most important fouler on the coasts of India.
Balanus amphitrite communis Darwin, 1854	Extends from halftide level to subtidal zone. Recorded up to 165 metres. Occurs on molluscan shells, stones, rocks, wood, piers etc. Very common on east coast and estuarine and marine zones. Rare on West coast.	**Indian Ocean :** East coast of India in estuarine and marine zones, west coast of India, Ceylon, Arakan coast. **Elsewhere :** Mediterranean, West and South Africa, Malay Archipelago, New South Wales, Pacific Ocean.	Important fouling constituent, next to previous species.
Balanus amphitrite hawaiiensis Broch, 1922	Occurs in rocks and molluscan shells in midlittoral zone. At Bombay shore it forms a distinct zone and occurs extensively.	**Indian Ocean :** Persian Gulf. **Elsewhere :** Malay Archipelago, Hawaiian Islands.	Non-fouling mainly. Rarely also recorded as fouler.
Balanus amphitrite niveus Darwin, 1854	Occurs on snail and mussel shells. Rarely at half-tide zone and mainly in subtidal zone. Rare.	**Indian Ocean :** East coast of Africa, Persian Gulf, Madagascar. **Elsewhere :** Pacific.	Non-fouling
Balanus amphitrite cirratus Darwin, 1854	Occurs on wood, snail shells; Rare at half-tide and mainly at subtidal zone; occurs on drift-wood. Rare.	**Indian Ocean :** East and west coasts of India, Arakan coast, Mergui Archipelago. **Elsewhere :** Malay Archipelago, China, Australia, Pacific.	Fouling and non-fouling

TABLE 1—*Contd.*

Species	Habitat and abundance	Distribution	Remarks
Balanus patellaris (Spengler) 1780	Occurs on fixed and floating structures at the half-tide zone in marine environment and subtidally in estuaries.	**Indian Ocean :** R. Hooghly, Orissa coast, Arakan coast. **Elsewhere :** Malay Archipelago	A conspicuous fouling constituent in the east coast of India.
Balanus amaryllis euamaryllis Broch, 1922	Extends from half-tide zone to below. Recorded upto 500 metres depth. Occurs on shells of Ostrea, mussels and on ships bottoms.	**Indian Ocean :** East coast of India-Madras, Ganjam coast, Orissa coast Canning, Ceylon, Burma, Mergui Archipelago, Malay Archipelago, China, Japan, **Elsewhere :** Australia-northern coast.	Fouling
Balanus perforatus Bruguiere 1789	Occurs on stones and wood at half tide rarely and is mainly a subtidal species. In Andamans it occurs mainly as a intertidal form.	**Indian Ocean :** Madras, Andamans, East coast of Africa. **Elsewhere :** Atlantic Ocean Mediteranean Sea.	-do-
Balanus longirostrum krusadaiensis Daniel, 1956	Occurs at low tide zone in sponges. Abundant in zones where they occur.	**Indian Ocean :** Gulf of Mannar, Madras coast.	Non-fouling
Balanus madrasensis Daniel, 1958	Occurs from half tide level to lowtide level on fixed structures. Common on bottom of boats and catamarans on East coast.	**Indian Ocean :** Madras, Andamans	An important constituent of the fouling complex on east coast and Andamans.
Balanus roonwali Premkumar and Daniel, 1968	Occurs in sponges from lowtide zone to subtidal zone.	**Indian Ocean :** Madras, Mandapam.	Occurs inconspicuously Non-fouling.
Balanus sinnurensis Daniel 1962	Occurs on shells of molluscs from high tide level to a depth of 2 meters. Inconspicuous and rare.	**Indian Ocean :** Porto Novo.	Non-fouling

Creusia spinulosus euspinosus Broch, 1931	Burrow or are buried in living corals; occur in corals in situations where they receive mechanical protection from bends, and folds, in the coral skeleton. Rare.	**Indian Ocean :** Burma, Andaman Island, Mergui Archipelago.	–do–
Pyrgoma projectum Nilsson Cantell, 1938	Shore ; At lowtide and also subtidally in corals. Recorded only once in Indian Ocean. (from Persian Gulf).	**Indian Ocean :** Persian Gulf.	–do–
Pyrgoma gonioporae Hiro, 1935	Shore; on corals at lowtide and subtidal zone. Recorded from Eastern part of Indian Ocean. Rare.	**Indian Ocean :** Mergin Archipelago. **Elsewhere :** Japan.	–do–
Pyrgoma conjugatum Darwin, 1854	Shore; on Corals at low-tide and subtidal zone. Rare.	**Indian Ocean :** Madras coast, Gulf of Mannar, Ceylon, Red Sea. **Elsewhere :** Japan.	–do–
Pyrgoma grande (Sowerby) 1839	From 0 to 25 metres in corals. Rare.	**Indian Ocean :** Andamans, Mergui Archipelago. **Elsewhere :** Malay Archipelago, Japan.	–do–
Tetraclita squamosa viridis Darwin, 1854	Between tide mark on stone, corals, tree-trunks, *Ostrea* shells. Common in high intertidal zone.	**Indian Ocean :** Burma, Andamans, Nicobars. **Elsewhere :** Malay Archipelago, China, Japan, West Africa, Australia, South Sea Islands.	–do–
Tetraclita squamosa patellaris Darwin, 1854	Between tide marks on corals Rare form. Occurs only at Andamans.	**Indian Ocean :** Andamans.	–do–
Tetraclita squamosa rufotincta Pilsbry, 1916	Between tide marks on rocks. Common in high intertidal Forms distinct zone in shores of north-west coast of India.	**Indian Ocean :** East coast of Africa (Suez, Zanzibar); Madagascar; West coast of India—(Okha-Veraval)	–do–
Tetraclita squamosa serrata Darwin, 1854.	Between tide marks on rocks and corals. Occurs only on the west coast of South Africa and also in Ceylon. Rare.	**Indian Ocean :** South Africa (East London to Durban); Ceylon	–do–

TABLE 1—*Contd.*

Species	Habitat and abundance	Distribution	Remarks
Tetraclita squamosa communis Darwin, 1854	High intertidal zone on rocks. Rare. Recorded only from the Kuria Muria Islands.	**Indian Ocean :** Hallaniya Islands; Kuria Muria Islands.	Non Fouling
Tetraclita vitiata Darwin, 1854	On old tree trunks between tide marks. Rare in Indian Ocean.	**Indian Ocean :** Nicobar. **Elsewhere :** Malay Archipelago, Philippines, Australia, Barrier Reef.	–do–
Tetraclita coerulescens (Spengler) 1790	Occurs on *B. tintinnabulum* and on stones. From midtide level to lowtide region.	**Indian Ocean :** Bay of Bengal, Mergui Archipelago. **Elsewhere :** Malay Archipelago, Pacific Ocean.	Only species of genus known as "fouling" organism.
Tetraclita alba Nilson-Cantell, 1932	Shore— High intertidal zone. Rare. Known only from one locality on west coast of Africa.	**Indian Ocean :** Dar-es-Salam.	'Non fouling'
Tetraclita purpurascens (Wood) 1815	On stones, rocks and from ship gone aground. Occurs from halftide to low-tide. Forms distinct zones in Bombay.	**Indian Ocean :** Bombay, Madras, Madagascar.	–do–
Tetraclita r osea (Krauss) 1848	High intertidal on rocks and stones. Known only from South Africa and Australia.	**Indian Ocean :** South Africa. **Elsewhere :** Australia.	–do–
Tetraclita wireni africana Nilsson-Cantell, 1921	High intertidal on rocks and stones. Known only from one locality in Dar-es-Salam.	**Indian Ocean :** Dar-es-Salam	–do–

by the author for over a period of 20 years, the collections available in the Zoological Survey of India and other museums, and all published records.

Observations and Discussions

An analysis of the Table shows that of the 48 species/subspecies of barnacles occurring in the intertidal zone, only 15 contribute to the fouling complex of which 5 are dominant, i.e. *Balanus amphitrite variegatus* Darwin, *B. amphitrite communis* Darwin, *B. patellaris* (Spengler), *B. madrasensis* Daniel, and *Balanus tintinnabulum tintinnabulum* Linne. Ten species/subspecies are inconspicuous 'fouling' members and these are *Balanus tintinnabulum occator* Darwin, *Balanus tintinnabulum volcano* Pilsbry, *Balanus tintinnabulum validus* Darwin, *Balanus perforatus* Bruguiere, *Balanus amphitrite hawaiiensis* Broch, *Balanus amphitrite cirratus* Darwin, *Balanus amaryllis euamaryllis* Broch, *Tetraclita coerulescens* (Spengler), *Chthamalus withersi* Pilsbry, and *Chthamalus stellatus stellatus* (Poli). *C. S. Stellatus* is the commonest Chthamalid of the Indian coast and occurs abundantly on fixed structures and rarely on floating objects and ship bottoms.

Barnacles found with corals are often specialised burrowing forms. The pedunculate genus *Lithotrya* extends from the midtidal to subtidal zone and is very rarely found at hightide zone. Similarly, the sessile barnacles *Pyrgoma* and *Creusia* and some species of the genus *Balanus* which burrow or are buried in living corals occupy mainly the zone from midtide to subtidal zone and are rarely recorded from the higher intertidal zone. Further, the actual number of species and individuals in coral reefs is small. This was first recognized by Darwin (1851, 1854) who pointed out, that for some reason, coral reefs are apparently unfavourable for barnacles. (*see also* Newman 1960).

The pedunculate barnacles of the genus *Ibla*; the sessile genera *Chthamalus* and *Tetraclita*; and some members of the genus *Balanus* are true intertidal forms and rarely occur on molluscs and crustacean hard parts or ship bottoms and under rocks (*see* Table I).

Many of the intertidal species have restricted and disjunct distribution in the Indian Ocean. For example, *Lithotrya nicobarica* Reinhardt occurring in the Nicobar group of Islands and Maldives does not occur in the coral zones of the Andamans or the East coast of India (Krusadi Island) and North-West coast of India (Okha and Pirotin Island areas), although corals are present. Similarly, the two other species of the genus *Lithotrya*; and the genera *Ibla, Chthamalus* (except *stellatus*—which occurs as fouling organism), *Tetrachthamalus* and some members of *Balanus,* and *Tetraclita* have restricted distribution (*vide* Table I).

Thus, as pointed out by Crisp and Southward (1953), it appears that even fairly narrow seas offer a barrier to predominant intertidal species. These are mainly "non-fouling ones" and have spread along the coast probably because their short lived free-swimming naupliar and cyprid larvae have been carried by the tidal streams and residual currents which are obviously stronger when parallel to the shore than at right angles to it. The explanations offered by Newman (1967) on the isolated and apparently disjunct distribution of *Tetrachthamalus obliteratus* Newman, which he considered to be due to (*i*) species, being a geographical and biological relict having

had a substantial wider distribution in the past, (*ii*) or those populations occurring on mangroves being transported by natural drifts, and (*iii*) or it is presently much more widely distributed than available evidences indicate, may hold good for a few other intertidal species also.

Studies on the settlement of the commoner intertidal barnacles, *Balanus amphitrite variegatus, B. tintinabulum tintinabulum* and *Chthamalus stellatus stellatus* in Madras, have revealed that at the time of settlement, factors like intensity of illumination, gregarious attraction, stage of tide, colour of substratum, water currents and wave action, primary film and presence of other organisms become operative and influence the settlement of the settling-stage cyprid larvae (Daniel 1955 *a, b;* 1956 *b;* 1957 *a, b;* 1958 *a, b;* 1963). The results of later shor-term experiments conducted during February–March 1961 at little Andaman Island, January–May 1964 at Cochin, February–May 1966 at Great Nicobar Island, and March 1968 at Sagar Island, lend support to the earlier findings.

It is clear from the experiments that the reactions of the cyprids to many of these factors at the time of settlement may play an important part in leading them to settle in the zone where the adults are found.

In assessing the relative importance of the different factors one must be guided by a judgement of the probable sequence of the responses of the larvae. To illustrate—A cyprid larva of *B. amphitrite* swimming about in the water will first react to light and water currents swimming away from not only light from above but any area which is bright and reflects light from the bottom. It will tend to swim away from an area where water is moving very fast. Next in order of temporal succession and therefore of biological importance would be different substrata already occupied by sessile organisms. Any surface coated by sessile organisms is likely to be dark in appearance and not be completely red, blue, green, etc. The results obtained by laboratory experiments on different coloured panels may indicate the biological range of the organisms in its relation to coloured surfaces, whereas in its natural habitat, *B. amphitrite* will hardly have to choose between the colours we confront them with, in the laboratory. Even the bright-coloured bivalves like *Mytilus* are covered over with dark film and a layer of sediment. Thus the cyprid larva when it approaches a substratum previously settled by sessile animals, has next to choose the particular community, it should become a member of. In this, the gregarious attraction of previously settled barnacles prevails. Finally, at the end of the series of responses to the different factors of attraction, the cyprid settles. But in settling it requires the primary film, which is therefore not a factor of attraction but a necessity.

Acknowledgements

The author is thankful to Dr. M. L. Roonwal, F.N.A., former Director, Dr. A. P. Kapur, Director, and Dr. B. S. Chauhan, Deputy Director, for facilities to undertake and complete this work. He is also thankful to Prof. P. N. Ganapati, F.N.A., for reading the manuscript and offering valuable suggestions.

References

Bhatt, Y. M., and Bal, D. V. (1960). New records of barnacles from Bombay shores. *Curr. Sci.*, 29, 439–440.

Crisp, D. J., and Southward, A. J. (1953). Isolation of intertidal animals by sea barriers. *Nature. Lond.*, **172**, 208–209.

Daniel, A. (1955 *a*). Gregarious attraction as a factor influencing the settlement of barnacle cyprids. *J. Madras Univ.*, B **25**, 97–107.

————(1955 *b*). The primary film as a factor in the settlement of marine foulers. *J. Madras Univ.*, B **25**, 189–200.

————(1956 *a*). The Cirripedia of the Madras coast. *Bull. Madras Govt. Mus.* (New Ser) *nat. hist. Sec.*, **6**, 1–40.

————(1956 *b*). Colour as a factor influencing the settlement of barnacles. *Curr. Sci.*, **25**, 21–22.

————(1957 *a*). Illumination and its effect on the settlement of barnacle cyprids. *Proc. Zool. Soc., Lond.*, **129**, 305–313.

————(1957 *b*). Influence of stage of tide on the attachment of barnacle cyprids. *J. Bombay. nat. Hist. Soc.*, **54**, 866–868.

————(1958 *a*). The development and metamorphosis of three species of sessils barnacles. *J. Madras. Univ.*, B **28**, 23–47.

————(1958 *b*). Settlement of marine foulers and borers in the Madras harbour in relation to velocity of water currents. *J. sci. indust. Res.*, C **17**, 18–20.

————(1963). Factors influencing the settlement of marine foulers and borers in tropical seas. *Proc. 1st Summer School Zoology* (Simla, 1961) 363–382.

Darwin, C. (1851). A monograph of the subclass Cirripedia. I. Lepadidae. Ray Society, London.

————(1854). A monograph on the subclass Cirripedia(II. Balanidae. Ray Society, London.

Karande, A. A., and Palekar, V. C. (1966). The sessile barnacles (Cirripedia) of the Bombay coast. *J. Bombay nat. Hist. Soc.*, **63**, 139–151.

Newman, W. A. (1960). The paucity of intertidal barnacles in the tropical Western Pacific. *Veliger*, **2**, 92–97.

————(1967). A new genus of Chthamalidae (Cirripedia, Balanomorpha) from the Red Sea and Indian Ocean. *Ann. Zool. Lond.*, **153**, 423–435.

Nilsson-Cantell, C. A. (1938). Cirripedes from the Indian Ocean in the collections of the Indian Museum, Calcutta. *Mem. Indian Mus.*, **13**, 1–81.

Stubbings, H. G. (1936). Cirripedia. *I. Murray Exp.* 1933–34. Scient. Report **IV**, No. 1, British Musem (Nat. Hist.) London.