

ON CHITONS FROM THE ANDAMAN AND NICOBAR ISLANDS*

A. S. RAJAGOPAL AND N. V. SUBBA RAO

Zoological Survey of India, Calcutta, India

ABSTRACT

The paper deals with a systematic study of the Chiton collections from the Andaman and Nicobar Islands present in the Zoological Survey of India. Opportunity was also taken to examine the Type specimens available in the National Zoological Collections.

Of the 7 genera and 12 species represented in the collection one species namely, *Callistochiton pulchellus* (Gray) originally reported from the Peruvian Coast (East Pacific) has now been recorded for the first time from the Indian Ocean. Also another species viz., *Acanthochiton mahensis* Winckworth hitherto known occurring along the coast of the mainland India is now recorded from the Nicobars. The distribution of each species is as given completely as possible and the Zoogeographical significance is also discussed.

This study reveals that out of 12 species as many as 6 species are found to be common both to Indian Ocean and West Pacific regions, while 4 others are known from the Indian Ocean only. A solitary species is found to have a wide distribution in Atlantic, Pacific and Indian Oceans. Another species which was hitherto occurring only in East Pacific appears to have found its way into the Indian Ocean also.

INTRODUCTION

STUDIES on molluscs of the seas around the Andaman and Nicobar Islands are not many though as a constituent of the rich marine fauna of this area the molluscs represent a large segment, if not the largest. Being confined to the limited works available, our knowledge of them is imperfect and in respect of some groups such as Chitons, very poor. The last mentioned are the least worked out group not only of this area but perhaps of the whole of the Indian Ocean. Hence the need for paying them more attention than hitherto. The present work is intended as a contribution, though in a small measure to such a study.

This paper, a systematic account of the Chitons of the Andaman and Nicobar Islands, is based on the collection present in the Zoological Survey of India, Calcutta.

As stated above, earlier references on the subject are not many. However, mention must be made here of the references of only two authors, i.e. a short paper by Winckworth (1933) on a new Chiton from the Andamans and the contributions by Leloup (1937, 1939, 1940a, 1940b and 1952) to the study of Polyplacophora of the Indian Ocean and Indo-Pacific regions based on the collections of the Indian Museum, Calcutta, and elsewhere. Of the several genera and species dealt with by the latter author, altogether 5 genera and 9 species are reported from these Islands.

*Presented at the 'Symposium on Indian Ocean and Adjacent Seas—Their Origin, Science and Resources' held by the Marine Biological Association of India at Cochin from January 12 to 18, 1971.

The material for our study, consists mainly of the collections made during several faunistic surveys of these Islands organised and conducted in recent years by the Zoological Survey of India. It also includes the Chitons from the biological collections (shore collections) made around these Islands during the years : 1887 and from 1924 to 1926 by the Surgeon Naturalist(s) attached to the Royal Indian Marine Survey steamer 'Investigator' as well as other collections, a substantial part of which was examined and reported on by Leloup (*op. cit.*). Besides these, some miscellaneous collections which had so long remained undetermined in the Survey are also included.

In the course of this study, opportunity was taken to examine also the type specimens available in the National Zoological Collections, Zoological Survey of India, of some of the species treated here and to compare some of the material(s) under study with the type specimens of the respective species for determining their specific identity.

An attempt is made here to bring together all species of Chitons known from this area which have remained hitherto scattered in isolated records.

The paper deals with 7 genera and 12 species of Chitons from these Islands. One species namely, *Callistochiton pulchellus* (Gray) is now recorded for the first time from the Indian Ocean. Another species, viz., *Acanthochitona mahensis* Winckworth is recorded for the first time from the Nicobar Islands.

A discussion on the distribution pattern of the species is also included at the end of the paper.

The collections studied for this paper are made from the following islands :

Andaman group of Islands :—Port Blair, Viper Island, Neil Island, Ross Island, Havelock Island, Passage Island, Long Island, and Little Andamans.

Nicobar group of Islands :—Car Nicobar, Katchal, Nancowry, amocerta, Trinket and Great Nicobar.

Abbreviations used :

Coll.—Collector or Collected by ; ex(s) — example(s) ; Reg. No.—Register Number ; Sta.—Station ; Z.S.I.—Zoological Survey of India.

Our thanks are due to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta for facilities and to Dr. A. Daniel, Superintending Zoologist for offering many useful suggestions and criticism.

LIST OF SPECIES OF CHITONS SO FAR KNOWN FROM THE ANDAMAN AND NICOBAR ISLANDS

Phylum Mollusca
Class Polyplacophora
Order Lepidopleurida
Family Lepidopleuridae

*1. *Lepidopleurus andamanicus* Smith

Order Chitonida
 Family Cryptoplacidae
 Subfamily Acanthochitoninae

**2. *Acanthochitona mahensis* Winckworth3. „ *penetrans* Winckworth

Subfamily Cryptoplacinae

4. *Cryptoplax larvaeformis* (Burrow) form *oculatus* (Quoy and Gaimard)

Family Ischnochitonidae

5. *Ischnochiton alatus* (Sowerby)6. „ *bouryi* Dupuis7. „ *winckworthi* Leloup**8. *Callistochiton pulchellus* (Gray)

Family Chitonidae

Subfamily Chitoninae

9. *Chiton granoradiatus* Leloup10. „ *hululensis* (Smith)11. „ *pulcherrimus* Sowerby

Subfamily Acanthopleurinae

12. *Squamopleura imitator* Nierstraz13. *Acanthopleura spiniger* Sowerby

KEY TO THE IDENTIFICATION OF CHITONS (UP TO GENERA) FROM THE ANDAMAN AND NICOBAR ISLANDS

1. Shell valves as a rule with clearly demarcated lateral areas which are separated from the central areas by conspicuous oblique ridge-like elevations. Upper surface of girdle with numerous closely packed scales or spines.....2

Shell valves without clearly demarcated lateral areas, Girdle thick, very muscular and covered on the upper surface with numerous shorter or longer bristle like spines.....3

* No further record of this species is known subsequent to its discovery by Smith in 1906 b. p. 251 (Lock Off North Sentinel Island, South Andamans, 240 fms 438.9 m) nor is there any representative of this in the Z. S. I. Collections

** First record from Nicobar Islands.

First record from Indian Ocean and adjacent seas.

[3]

2. Animal usually broad and oval ; shell valves transversely elongated but antero-posteriorly short ; girdle narrow ; insertion plates with characteristic pectinated teeth.4
- Animal generally more elongated ; shell valves relatively (shorter transversely, but longer anteroposteriorly ; girdle broader ; insertion plates not pectinated but with distinct slits.....6
3. Shell valves closer ; Posterior valve with two slits. Posterior insertion plate directed backwards, Girdle with usually 18 tufts of bristles.... *Acanthochitona*
- Shell valves reduced, sixth valve smallest, posterior four shell valves separated from each other. Anterior valve with three slits, following ones without any such ; posterior insertion plate thrown forward. (Animal vermiform). *Cryptoplax*
4. Shell with extra pigmentary eyes ; Girdle with long calcareous scales and spines..... *Acanthopleura*
5. Shell without extra pigmentary eyes, Girdle scaly.....5
- Shell with warty sculpture, median area with concentric grooves... *Squamopleura*
- Shell without any warty sculpture and rarely smooth..... *Chiton*
6. Shell mostly grooved or ridged, sometimes smooth ; scales on the girdle are compact smooth or ridged ; Insertion teeth straight..... *Ischnochiton*
- Shell not grooved ; Insertion teeth curved..... *Callistochiton*

SYSTEMATIC ACCOUNT

Genus *Acanthochitona*, Gray, 18211. *Acanthochitona mahensis* Winckworth, 1927

Acanthochitona mahensis Winckworth, 1927 London 17, p. 207, pt. 29, fig. 9 & 10 (Type-locality: Chombala near Mahe, S. India); Satyamurti, 1952, *Bull. Madras Government Mus. new Ser.* (Nat. Hist. Sec.), Madras, 1 (2), Pt. 6, p. 5, pl. 1, fig. 2.

Material :—1 ex.—Nancowry Id., Nicobars, 12-5-1966 (coll. A. Daniel)

Distribution : India : Mahe, Gulf of Mannar, Waltair, Gopalpur.

Remarks : This is represented by a simple small specimen in the collection. The typical tufts (18 in number) of brown spiculs on the girdle are clearly visible. We have also examined the Holotype (dry) Z. S. I. Reg. No. M 14376/2 which is in a dissected condition and with which the specimen under study is compared. No differentiation of lateral and median areas is seen in the valves:

Winckworth (1927) has given a detailed description of the species.

This species hitherto known only from the coasts of Indian mainland is now recorded for the first time from the Nicobar Islands.

2. *Acanthochitona penetrans* Winckworth, 1933

Acanthochitona penetrans Winckworth, 1933, *Proc. malac. Soc. Lond.*, 20 (6), pp. 318-319, pl. 26 figs. 1-14 (Type-locality: Andaman Seas).

Material: 1 ex. (in spirit, dissected), Z. S. I., Reg. No. M 15980/2 In a small crevice on rock, Bay of S. Corbyn's Cove, Port Blair, Andamans, 16-2-1934 (Coll.?).

Distribution: Andaman Seas.

Remarks: In addition to the above material we have examined the type collection in the Z. S. I., which consists of the Holotype (dry dissected) Z. S. I. Reg. No. M14380/2 and 12 examples of Paratypes (in spirit) Z. S. I. Reg. No. M17793/3 from holes bored by some other animal in *Trochus niloticus*, all collected by Dr. H. S. Rao. In the above specimen, the punctate appearance of the girdle due to the presence of white spicules in it and also the eighteen small and asbestoid tufts all round in the girdle are clearly seen.

Subfamily Cryptoplacinae

Genus *Cryptoplax* Blainville, 1818

3. *Cryptoplax larvaformis* (Burrow, 1815) form *oculatus* (Quoy et Gaimard, 1834)

**Chiton oculatus* Quoy et Gaimard, 1834, *Voy. 1 Astrolabe*, 3, p. 410, pl. 73, figs. 37, 38 (Type-locality: New Guinea or Vanikoro).

Cryptoplax larvaformis Burrow, 1815, *Elements Conch.*, p. 191, pl. 28 figs. 2-4 (No locality mentioned); Iredale et Hull, 1925, *Aust. Zool. Sydney*, 4 (2), pp. 101-104.; Leloup, 1940, *Bull. Mus. r. Hist. nat. Belg.*, Brussels, 16 (33), pp. 25-30, pl. 3, fig. 1 (Esthetes).

For detailed synonymy reference may be made to Iredale and Hull (1925), Taki and Taki (1930) and Leloup (1933, 1940b). Iredale and Hull also narrate in detail the complicated history of this species in their remarks.

Material: No. of examples studied: 10.

(1) 2 exs., ZSI Reg. No. M17757/3, Sta. 703-Nancowry Harbour (amongst coral on north side of Harbour), Nicobars, 14-1-1926; (2) 5 exs. ZSI Reg. No. M16008/2, 2 exs. ZSI Reg. No. M17756/3, Sta. 710-Trinket Island (amongst stones and corals), Nicobars, 11-11-1926 (Coll.: 'Investigator'); (3) 1 ex., ZSI Reg. No. M16009/2, Andamans (Coll.?).

* Reference not seen in original.

Distribution : Indian Ocean : South Africa, Algoa Bay; Pacific Ocean; Borneo, Sulu, Sunda Straits, Lucon, Kisser, Amboina, Bismarck Archipelago, Friendly Is., Fringing Reef, Torres straits, Queensland.

This form has not been recorded from coast of Indian mainland.

Remarks : This 'worm-like' chiton is distinguished by its large fleshy and densely spiculate girdle in which the much reduced and narrow valves are embedded. The sixth valve is very small. In the words of Iredale and Hull (1925) '... the first four valves are generally in contact, the fifth is a little separated and less than the fourth, the sixth further apart and still less, the seventh still further away but slightly larger, while the posterior approaches closely the seventh and is a little larger.' Pilsbry (1901) has shown how the gradual decrease in width of the valves and abrupt changes in some stages in their sculpture supervene from a young specimen as it advances in age.

Authors such as Reeve (1847), Pilsbry (1893) and Taki and Taki (1930) consider *larvaeformis* and *oculatus* as two distinct species while Iredale and Hull (1925) merge the latter with the former. Ashby (1936), however, says that *oculatus* can be separated from *larvaeformis* by the spicules. (In *larvaeformis* they are short and in *oculatus* the girdle is densely covered with long ones). Leloup (1940) while pointing out that Ashby indicates no other character for separating the two, relegates *oculatus* to the status of a form under *larvaeformis*.

Family Ischnochitonidae

Genus Ischnochiton Gray, 1947

4. *Ischnochiton alatus* (Sowerby, 1841)

Chiton alatus Sowerby, 1841, *Proc. Zool. Soc. Lond.*, London, pt. 9 p. 61 [Type-locality : Islands of Siquijor and Cabu, Philippines (under stones at low water)]

Ischnochiton herdmani Sykes, 1903, *Ceylon Pearl Oyster Fish, Suppl. Rep.*, 1, p. 178, fig. 6; Satyamurti, 1952, *Bull. Madras Govt. Mus. new Ser.* (Nat. Hist. Sec.), Madras, 1 (2), pt. 6, pp. 67, pl. 1, fig. 3a and 3b.

Ischnochiton alatus Leloup, 1937, *Proc. malac. Soc. Lond.*, London, 22 (4) pp. 163-617 figs. 1-11.

Material : No. of examples studied : 6.

(1) 3 exs., Sta. 3—North Bay, Port Blair, Andamans; (2) 1 ex. ZSI Reg. No. M 16011/2 Sta. 667—N.W. side of Neill Island, 8-2-1924; (3) 1 ex., ZSI Reg. No. M16012/2, Sta. 673 Southern horn of East Bay, Katchal Nicobars, 1-3-1925 (2 & 3 by 'Investigator'); (4) 1 ex., Sta., 3—Kwate-tu-Kwage, Little Andamans, 18-2-1961 (Coll. A. Daniel).

Distribution : India : Kilakarai (Ramnad Dist.), Krusadai Island, Andamans, Nicobars; Ceylon : Indo-China : Bay of Nha Trang, Isle Tre, Cauda, Bich Damen, Paulo Condore; Philippines.

Remarks : Sowerby's (1841) inadequate description of the species has been well supplemented by detailed descriptions by Reeve (1847) and Leloup (1937).

The specimens studied are distinctly elongated (? depressed) in form and the valves are prominently winged. The lateral areas are slightly raised and demarcated from the median areas by the diagonal ridge-like elevation.

5. *Ischnochiton bouryi* Dupuis, 1917

Ischnochiton variegatus Nierstraz, 1905, *Siboga Exped.*, 48 p. 23, pl. 1, fig. 9, pl. 3, figs. 71-76 [Type-locality: Amboina, Indonesia. Species name preoccupied by *Ischnochiton variegatus* (= *Lepidopleurus variegatus* H. Adams & Angas, 1864) from South Australia.]

Ischnochiton bouryi Dupuis 1917, *Bull. Mus. Hist. nat. Paris*, 23 (7), p. 535 (*nom. nov.*); Leloup, 1952, *Mém. Inst. r. Sci. nat. Belg., Brussels*, (2) No. 47, pp. 11-14, text fig. 5, pl. 3, fig. 4.

Ischnochiton asquigranulatus von Knorre, 1925, *Jena Zeit. Naturwiss.*, 61, pp. 605-611, pl. 32, fig. 55, pl. 33, fig. 57.

Ischnochiton gallensis Satyamurti, 1952, *Bull. Madras Govt. Mus. new ser. (Nat. Hist. Sec.)*, Madras, 1 (2), pt. 6, p. 7.

In place of *variegatus*, which is pre-occupied (*vide* synonymy) Dupuis (1917) proposed the term *bouryi* as *nomen novum* for this species after M. de Boury, a specialist in Scalariidae.

Material: No. of examples studied: 2.

(1) 1 ex., ZSI Reg. No. M16016/2, S. Corbyn's cove, Port Blair, Andamans, 13-3-1930; (2) 1 ex., ZSI Reg. No. M16017/2, Sta. 3-North Bay, Port Blair, Andamans, (Coll. H. S. Rao).

Distribution: India: Kathiwar: Port Okha, Krusadai Island, Andamans; Ceylon: Galle; Indonesia: Amboina.

Remarks: For a detailed description of the species Leloup (1952) may be consulted.

In the specimens examined, the girdle is comparatively narrow. The anterior terminal valve is without the characteristic raised lateral areas found in all the other valves.

6. *Ischnochiton winckworthi* Leloup, 1936

Ischnochiton winckworthi Leloup, 1936, *Proc. mal. Soc. Lond.*, 22, pp. 51-57, figs 1-9 & 12, (Type-locality:—Beach along Dutch Bay near Trincomalee, Ceylon).

Material: No. of examples studied: 13.

(1) 1 ex., ZSI Reg. No. M16018/2, sta. B2—Monian Bay off Viper Island, 3-4 fms. (5.5 to 7.3 m) Andamans 30-11-1923; (2) 2 exs., ZSI Reg. No. M16019/2, S. Corbyn's Cove, Port Blair, Andamans, 13-4-1930 (3) 1 ex., ZSI Reg. No. M16020/2, E. Ross Island, Port Blair, Andamans, 27-3-1933; (4) 4 exs., ZSI Reg. No. M16021/2, Blair reef, Port Blair, Andamans, 12-2-1934; (5) 3 exs., ZSI Reg. No. M16025/2, Long Island, Andamans (Coll. H. S. Rao); (6) 1 ex. ZSI Reg. No. M16024/2, Sta. 657-North side of E. end of Macpherson straits near Chiriya Tapu, Andamans, 20-1-1924 (Coll. 'Investigator') (7) 1 ex., St. 17-Aberdeen Bay, Port Blair, 27-2-1959 (Coll. K. K. Tiwari).

[7]

Distribution : India : Andaman Islands ; Ceylon : Trincomalee ; Burma : Cheduba, Mergui Archipelago ; Diamond Island, Elephant, Druid and Bedford rocks.

Remarks : The material examined includes also the collection which had been studied earlier by Leloup (1936 and 1952).

Genus *Callistochiton* Dall, 1882

Thiele (1931) subordinates this to *Lorica* H. & A. Adams, 1852.

7. *Callistochiton pulchellus* (Gray, 1828)

Chiton pulchellus Gray, 1828, *Specilegia Zoologica*, London, p. 6, pl. 3, fig. 9 (Type-locality : Arica, Peru) ; Reeve, 1847, *Conch: Icon*, London, 4. *Chiton*, Sp. No. 153, pl. 23, fig. 153, pl. 25, fig. 16f.

Callistochiton pulchellus Leloup, 1953, *Bull. Mus. r. Hist. nat. Belg.*, Brussels, 29 (30), pp. 18-19, fig. 3 ; Leloup, 1956, *K. fysiologx Sällsk. Handl.*, Lund, N. F. 67, Nr. 15, p. 46.

Material : 1 ex., sta. 10—W. Point of Cauarina Bay, Great Nicobar Id., 2-4-1966 (Coll. A. Daniel).

Distribution : Peru : Arica, Islay.

Remarks : This species is represented by a tiny specimen in the collection. It agrees remarkably well with Reeve's (1847) description of the species and that of Pilsbry (1892). We have compared it carefully with Leloup's (1953) *indica* with which it does not agree.

The terminal valves are radiately nodosely ribbed ; the lateral areas in other valves with two prominent ribs and median areas having a finely pitted (of honey comb style) appearance.

This is the first record of occurrence of this species not only for the Andaman and Nicobar Islands but also for the Indian Ocean and adjacent seas.

8. *Chiton granoradiatus* Leloup, 1937

Chiton granoradiatus Leloup, 1937, *Bull. Mus. r. Hist. nat. Belg.*, Brussels, 13 (38), p. 2 (Type-locality : Andamans, India) ; Leloup, 1952, *Mem. Inst. r. Sci. nat. Belg.* Brussels, (2) No. 47, pp. 20-23, text-fig. 8 (elements of the girdle) pl. I, fig. 5 (animal), pl. III, fig. 3 (Esthetes).

Chiton tuticorinensis Ray, 1958, *Arch. Molluskenk.*, Frankfurt, a M., 98 (3/4), pp. 151-154 text-figs. 1, 1a and 1b.

Material : No. of examples studied : 18.

(1) 11 exs. ZSI Reg. No. M 1544/1, Andamans (Colls. ?) (2) Ex., ZSI, Reg. No. M1546/1, Andamans, (Coll. ?) ; (3) 1 ex. ZSI Reg. No. M 19348/3, Sawai Bay, Car Nicobar, 27-2-1934, (4) 5 exs., ZSI Reg. No. M 19349/3, North of Camorta Island, 1-3-1934 [(2) and (3) from *Trochus niloticus*, coll. H. S. Rao].

Distribution : India : Bombay, Tuticorin, Waltair, Andamans and Nicobars.

Remarks : Leloup (1937 and 1952) has given a detailed description of this species.

We have examined the Holotype (in spirit) ZSI Reg. No. M 16003/2 which is represented by only three intermediate valves with the portion of the girdle on either side intact.

In the intermediate valves the median and lateral areas are sculptured differently; the median area possesses longitudinal ribs while the lateral areas have radial rows of granules. The terminal valves are, however, not demarcated in this fashion and they possess only the radiating rows of granules.

9. *Chiton hululensis* (Smith, 1906)

Ischnochiton hululensis Smith, 1906, in : Gardiner's *Fauna Geog. Maldive and Laccadive Archipelago*, 2 (2), p. 619, pl. 36, figs 3-6 (Type-locality : Maldive Islands).

Chiton hululensis Leloup, 1952, *Musc. Inst. r. Sci. nat. Belg.*, Brussels, (2) No. 47, pp. 23-26, Text-fig. 10 (elements of the girdle), pl. III, fig. 5 (Esthetes).

Material : 1 ex. Andamans, Off Passage Is, 17 fms. (31 m.). 1-11-1887 (Coll. 'Investigator'—Dr. Giles).

Distribution : India : Maldives, Laccadives, Hulule Islands ; Andamans ; Red Sea ; Indonesia : Banda ; Indochina ; Bay of Nha Trang, Tortue Id.

Remarks : Leloup's (1952) detailed description supplements very well the earlier one by Smith (1906a).

In the specimen represented in the collection, the two terminal valves are concentrically ridged. In the other valves the lateral areas possess undulating ridge-like structures and the median areas are smooth.

10. *Chiton pulcherrimus* Sowerby, 1841

Chiton pulcherrimus Sowerby, 1841, *Proc. Zool. Soc. Lond.*, London pt. 9, pp. 103-104 [Type-locality : Gindulman, Bohol, Phillipines (in the crevices of rocks at low water)] ; Reeve, 1847, *Conch. Icon.*, London 4, *Chiton* Sp. No. 132, pl. 20, fig. 132 ; Leloup, 1952, *Mem. Inst. r. Sci. nat. Belg.*, Brussels, (2) No. 47, pp. 34-38, Text-fig. 13 (Elements of the girdle, pl. I, fig. 2 (Animal), pl. 4, fig. 1 (Esthetes)).

Material : No. of examples studied : 2

(1) 1 ex., ZSI Reg. No. M16006/2, Sta. 710-Trinket Island, Nicobars, 11-2-1926 (Coll. 'Investigator') (2) 1 ex., on *Trochus niloticus*, S. & E. Coast of Nancowry Island, Nicobars, 2-3-1934 (Coll. H. S. Rao).

Distribution : India : Nicobars ; Indochina : Bay of Nha Trang, Poulo Condore, East Bay, Ream ; Phillipines ; Australia : Queensland : Isle of Capricorn.

Remarks : Sowerby's (1841) description of the species is very meagre and that of Reeve's (1847) inadequate. Leloup (1952) has given a fairly elaborate description.

This is a species of great beauty in which the median area is somewhat angularly raised and the lateral areas are with nodulose ribs prominently radiating. The girdle is covered with typically fine, smooth scales.

This species has not been recorded so far from coast of the Indian mainland.

11. *Squamopleura imitator* Nierstrasz, 1905

**Squamopleura imitator* Nierstrasz, 1905, *Siboga Exped.*, Leiden, 48, pp. 102-103, figs. 212128 (Type-locality : East Indian Archipelago); Leloup, 1933, *Mém. Mus. r. Hist. Nat. Belg.*, Brussels, (2) 13, p. 19, pl. I, fig. 4 (animal); Leloup, 1939, *Bull. Mus. r. Hist. nat. Belg.-Brussels*, 15 (3), pp. 4-8, figs. 3, 4, 10, 11, 20-27.

Material : No. of examples studied : 31.

(1) 20 exs., ZSI Reg. No. M 16032/2, sta. 660—Sandstone Cliff to the north of Jackson Creek, Little Andamans, 24-1-1924; (2) 6 exs. ZSI Reg. No. M 16033/2 sta. 680—Reef and beach to the south of Chinese fishing village, Katchall Island, Nicobars, 10-4-1925; (coll. 'Investigator'); (3) 5 exs. ZSI Reg. Nos. M16031/2 and 17755/3, Sta. B4—Outer reefs along North Bay, Andamans (Coll ?).

Distribution : Andamans & Nicobar Islands; Sumatra, Raja, Java, Bali, Point Cloates, N. W. Australia, Pulo Samao, Mansfield, Timor; Tonkin, Indo-China.

Remarks : Besides, Nierstrasz (1905), Leloup (1939) has given a detailed description of the species. Further, Leloup (1940a) considers that *imitator* can be classified as a form with two others namely, *salisbury* Winckworth and *miles* s. s. under the group *Squamopleura miles* Pilsbry, according to the geographical area each of them occupies and the variations of sculpture and appearance of the specimens.

Leloup (1940a) also traces in detail the variations in sculpture exhibited by the above examples, studied by him earlier, in the nature shape and compactness of granules, the number of radiating ribs in the lateral areas and the nature and disposition of the grooves in the median area.

12. *Acanthopleura spiniger* (Sowerby, 1840)

Chiton spiniger Sowerby, 1840. *Ann. Mag. nat. Hist.*, London, N. S. 4, p. 287 pl. 16, fig 2. (Type-locality—No locality mentioned); Reeve, 1847, *Conch. Icon.*, London, 4, Chiton, sp. No. 75, pl. 14, fig. 75.

Acanthopleura spiniger Grey, *Proc. Zool. Soc. Lond.*, 15, p. 68, Leloup, 1952, *M. em. Inst. r. Sci. nat. Belg.* Brussels, (2), No. 47, pp. 41-42, Text-fig. 15 (Elements of the girdle), pl. 2, fig. 3 (Eesthetes).

For a detailed synonymy Leloup (1933) may be consulted.

* The original reference is not seen.

Material : No. of examples studied : 94 :

(1) 1 ex. ZSI Reg. No. M 16000/2, South Point, Port Blair, Andamans, 11-3-1921 ; (2) 20 exs. ZSI Reg. No. M 1599/2, sta. B1 - Andamans, Dec. 1923
(3) 3 exs. Reg. No. M15996/2, sta. B4—Outer reefs along North Bay, Andamans ;
(4) 3 exs., ZSI Reg. No. M15997/2, Sta. B—10—Port Blair (Coll. ?).

(5) 2 exs., ZSI Reg. No. M. 15988/2, sta. 662—Havelock Id., Ritchie Archipelago, 3-2-1924 ; (6) 3 exs., ZSI Reg. No. M 15983/2, sta. 666—Coral and mud-reef, S.W. of Strait Id., Andamans, 6-2-1924 ; (7) 2 exs. ZSI Reg. No. M 15985/2, sta. 710—Trinkut Id., Nancowry Harbour, 11-2-1926 (Coll. 'Investigator').

(8) 1 ex., ZSI Reg. No. M 15990/2, Ross Islands, Port Blair, 5-2-1930 ; (9) 6 exs. ZSI Reg. No. M 15993/2, Long Island, July, 1931 ; (10) 2 exs., ZSI Reg. No. M15994/2, Ross Island, Port Blair, January, 1932 ; (11) 3 exs., ZSI Reg. No. M 15991/2, North of S. Corbyn's Cave, Port Blair, 30-1-1933 ; (12) 3 exs., ZSI Reg. No. M 15992/2 South of S. Corbyn's Cave, 28-7-1933 (Coll. H. S. Rao).

(13) 4 exs., Rangachang, about 18 km, from Aberdeen, Port Blair, 14-3-1952 (Coll. H. C. Ray).

(14) 8 exs. sta. 17—South Point, Port Blair 5 & 6-3-1959 ; (15) 2 exs., sta. 19—Ross Island, Port Blair, 14-3-1959 ; (16) 3 exs. sta. 6—Long Island, Middle Andamans, 20-3-1959 (coll. K.K. Tiwari). (17) 4 exs. sta. 1—Mid-Littoral fringe at Chatham, Port Blair, 10-2-1961 ; (18) 5 exs., sta. 2—Opp. The Dugong Creek, Tokoibuea, Little Andamans, 13-2-1961 ; (19) 4 exs., sta. 2—Laitora—1.5 km N. of Tokoibuea, L. Andamans, 14-2-1961 ; (20) 3 exs. sta. 2—Bedeabdal Coast, 18 km S. of Tokoibuea, L. Andamans, 16-2-1961 ; (21) 3 exs., Tailanda, 22 km N. of Kwate-tu-Kwage, L. Andamans, 19-2-1961 ; (22) 1 ex., sta. 4—Ingoie L. Andamans, 21-2-1961 ; (23) 1 ex., sta. 4—Taibolowe, 16 km E. of Ingoie, L. Andamans, 22-2-1961 ; (24) 1 ex., sta. 6—Ingitekadda shore, 11 km, N. of Nachuge, L. Andamans, 28-2-1961 ; (25) 2 exs. sta. 1—Campbell Bay, Great Nicobars, 2-3-1966 ; (26) 1 ex., sta. 3—Corbin's Rock, Great Nicobars, 14-3-1966 ; (27) 2 exs. sta. 6—Galathea Bayarea, Great Nicobars, 21 to 25-3-1966 ; (28) 2 exs. sta. 10—Casuarina Bay, Great Nicobars, 14-4-1966 ; (29) 1 ex. Inshore region of Chatham, Port Blair, 23-5-1966 (coll. A. Daniel) ; (30) 1 ex. Port Blair, (coll. ?).

Distribution : Indian Ocean : South African Coast, Comoro, Madagascar, Diego carcias, Mergui Achipelago, coast of Sumatra (Padang) ; Pacific Ocean : Malay Achipelago, Sumatra ; Tandjong Morawa, Java, Sunda, Timor, Amboina, Phillippines, New Guinea, New Calendonia, South-West and North-West Coasts of Australia, Queensland, Chinese Coast, Society Islands, Fiji.

Remarks : The original description by Sowerby (1840) though brief, is adequate. Besides this, Leloup (1952) has also given a detailed description of this species.

The specimens of this 'Thorny Chiton' attain a considerably large size. The general colour is like 'faded leaf' the girdle with numerous slightly curved spines.

The species is very common in the Andaman and Nicobar Islands. However, it is noteworthy that, it has so far not been recorded from coast of the Indian mainland.

[13]

REMARKS ON DISTRIBUTION

Chitons are common intertidal molluscs occupying generally the upper littoral zone in all oceans and land/seas and all latitudes. Some are deep forms such as the family Lepidopleuridae which occur even at a depth of 4000 m. *Lepidopleurus andamanicus*, a representative of this family was first recorded (Smith, 1906) from the Andaman Sea at a depth of 240 fms (438.9 m) but a further record of it is lacking although the RIMS Investigator worked some deep sea dredgings during 1916 to 1926 in the area.

Of the 34 species of Chitons known from the Indian Ocean and adjacent seas, 12 species or 35.30% are represented around the Andaman and Nicobar Islands.

The majority of the species dealt with in this paper are predominantly intertidal forms. *Ischnochiton winckworthi* Leloup occurring generally in the intertidal zone has also been recorded from 3-4 fms (5.5 to 7.3 m) and it is commonly found inhabiting the empty bivalve shells. *Chiton hululensis* (Smith) appears to be an inshore form, the record of the present material being at a depth of 17 fms. (31 m.).

The species occurring around the Andaman and Nicobar Islands are confined to the tropical zone in the Indo-West Pacific except *Cryptoplax larvaeformis* form *oculatus* and *Acanthopleura spiniger* which have a very wide range of latitudinal distribution extending to the colder regions.

Four species namely, *Acanthochitona mahensis*, *A. penetrans*, *Ischnochiton winckworthi* and *Chiton granoradiatus* are confined to the Indian Ocean region. *A. penetrans* has so far been reported only from the Andaman Sea. *I. winckworthi* has a very restricted distribution occurring along the coast of Ceylon, Andaman Islands, and Burma. The other two species, viz., *A. mahensis* and *C. granoradiatus* are common along the West and East Coasts of India and the Andaman and Nicobar Islands.

Six more species i. e. *I. alatus*, *I. bouryi*, *C. hululensis*, *C. pulcheerimus*, *Squamopleura imitator* and *Acanthopleura spiniger* have a wider distribution occurring both in the Indian Ocean and the West Pacific regions. Of these, the last mentioned species namely, *A. spiniger* is distributed in the Indian Ocean including the Red Sea, the West and East Pacific (Valparaiso, Chile) and recorded from the Cape of Good Hope in the Atlantic. It does not appear to have been recorded from the Western Part of the Atlantic.

Cryptoplax larvaeformis (Burrow) *F. oculatus* (Quoy et Gaimard) :—The opinions of authors are not uniform regarding the identity of *C. larvaeformis* and *oculatus*. On the one hand, authors like Reeve (1847), Pilsbry (1873), Taki and Taki (1930) and Ashby (1936), have considered the two as distinct species, on the other, Iredale, et Hull (1925) have merged *oculatus* with *larvaeformis*. Leloup (1940), however, has struck a middle course in treating *oculatus* as a form of *larvaeformis*.

While studying the distribution pattern of these two forms certain interesting points are noticed by which we find that Leloup's treatment of *Oculatus* as a form of *larvaeformis* appears to be quite justified: *C. larvaeformis* which has an extensive distribution in the entire West Pacific from the Malayan Archipelago through the Philippine Islands to Fiji, Samoa and Friendly Islands has also extended upto the

Californian Coast (San Diego) in the East Pacific. There is no authentic record of this form in the Indian Ocean.

The form *oculatus* though as widely distributed as *larvaeformis*, in the West Pacific region does not occur in the East Pacific. It has, however, been successful in extending West-wards into the Indian Ocean—into the Andaman and Nicobar Islands; N.W. Australia and as far West as S. Africa (Algoa Bay). Further, the absence of any record from the coast of Indian mainland is also noteworthy.

Callistochiton pulchellus (Gray) :—Though this species is represented by a solitary example in the collection studied and it needs further confirmation to the effect that it is not a stray case its occurrence in the Nicobars, far away from its original home—the Peruvian Coast, is noteworthy. It is difficult to ascertain the exact causal factor (s) for its occurrence here. It is assumed that factor (s) similar but working in the opposite direction, to those that favoured *Cryptoplax larveformis* to cross the Pacific Ocean and to reach the Californian Coast, might have favoured this species to reach the Indian Ocean from Peru. At best it can be considered now as probably a ship-borne immigrant to the Indian Ocean.

Squamopleura imitator Nierstrasz : Leloup (1940) has discussed at some length the distribution pattern of the group *Squamopleura miles* Pilsbry, the specimens of which are very variable. According to him, on the basis of variations and diversity exhibited in the sculpture of the grooves in the median areas of the valves and rays of granules on the lateral areas, the specimens are described and figured under different appellations by authors. He has further listed as many as seven different names ascribed to it by authors.

The group *Sq. miles* has an extensive geographical area under its distribution in the Indo-West Pacific stretching from the Island of Ceylon in the West upto Loyalty Islands in the East. According to regions which it inhabits and the variations of sculpture exhibited by specimens Leloup (op. cit) has classified it under three different forms namely; form *salisburyi* Winckworth, form *imitator* Nierstrasz, and form *miles* sensu stricto.

The distribution pattern of these three forms shows that they yield place of their respective area of distribution from one form to another in a sequence as we proceed from West to East. The form *salisburyi* extends its distribution from Ceylon to the Andaman and Nicobar Islands. The form *miles* s.s. has its distribution mainly in the West Pacific i.e. in Torres Strait and around New Caledonia and other islands close by. Its record in the Indian ocean is from Point Cloates (N.W. Australia). The distribution of *imitator* stretches from the Andaman and Nicobar Islands through the Malayan Archipelago to Point Cloates (N.W. Australia) in South and Tonkin in the North. In other words, its area of distribution is in the Indo-West Pacific and lies intermediate between those of the other two forms. The chief place of overlapping is the Andaman and Nicobar Islands for *salisburyi* and *imitator* on the one hand, and Point Cloates (N.W. Australia) for *imitator* and *miles* on the other.

REFERENCES

- ASBHY, E. 1926. Review of a monograph of the Australian Loricates *Proc. malac. Soc. Lond.*, London, 22 (1); 7.
- DUPUIS, P. 1917. Notes prises au cours de l'examen de la collection de Polyplacophores due Mussum de Paris, *Bull. Mus. Hist. nat. Paris*, Paris, 23 : 533-538.

- IREDALE, T. AND A. F. B. HULL. 1925—A monograph of the Australian Loricates (Phylum Mollusca order Loricata) V. *Austr. Zool.*, 4 (2): 75-111.
- LELOUP, E. 1933. Resultats scientifiques du voyage aux Indes Orientales Néerlandaises. 3. Amphineures. *Mem. Mus. r. Hist. nat. Belg.*, Brussels, 11 (13): 15-33.
- 1936. Descriptions de deux espèces d' Amphineures provenant de Trincomali (Ceylon) *Proc. malac. Soc. Lond.*, London, 22 (2): 51-61.
- 1937a. Notes sur les Polyplacophores. *Ibid.*, 22 (4): 163-176.
- 1937b. Diagnoses de six nouvelles espèces d' amphineures Polyplacophores de la région Indo-Pacifique. *Bull. Mus. r. Hist. nat. Belg.*, Brussels, 13 (38): 1-3.
- 1939. Caractères anatomiques de certains Amphineures du genre *Squamopleura*. *Ibid.*, 15 (33): 1-12.
- 1940a. A propos des espèces du genre *Squamopleura* Nierstraz, 1905 (Amphineures). *Ibid.*, 16 (9), pp 1-7.
- 1940b. Les Chitons du genre *Cryptoplax* Blainvilli 1818. *Ibid.*, 16 (33): 1-32.
- 1952. I. Polyplacophores de l'Océan Indien. *Mem. Inst. r. Sci. nat. Belg.* Brussels. (2) Fasc., 47: 3-47.
- 1953. Caractères anatomiques de certains Callistochitons. *Bull. Mus. r. Hist. nat. Belg.*, Brussels, 29 (3): 1-19.
- PILSBRY, H. A. 1892: *Man. Conch.*, Philadelphia, 14: xxxiv + 350 pp.
- 1901. Morphological and descriptive notes on the genus *Cryptoplax*. *Proc. Malac. Soc. Lond.*, London, 4 (4): 151-157.
- REEVE, L. A. 1847. *Conch. Icon.* London, 4: *Chiton*, pls. 1-27; *Chitonellus*, pl. 1.
- SMITH, E. A. 1906a in: Gardiner's Fauna and Geography of the Maldivé and Laccadive Archipelagoes, 2: 589-630.
- 1906b. Natural History Notes from R. I. M. S. 'Investigator'—Ser. III, No. 10. On Molluscs from the Bay of Bengal and the Arabian Sea. *Ann. Mag. nat. Hist.*, London, (7) 18: 245-264.
- SOWERBY, G. B. 1840. Descriptions of some new Chitons. *Ibid.*, N. S. 4: 287-294.
- 1841. Descriptions of several new species of *Chitones*, brought by H. Cuming Esq., from the Philippine Islands. *Proc. Zool. Soc. Lond.*, London, pt. 9: 61-62.
- TAKI, I. S. AND IW. TAKI. 1930. Studies on Japanese Chitons (4)—List of the known species of the genus *Cryptoplax* Venus, Kyoto, 2 (3): 103-107.
- THIELE, J. 1931. *Handbuch der systematischen Weichtierkunde*, Jena, 1, vi. + 778 pp.
- WINCKWORTH, R. 1927. New species of Chitons from Aden and South India. *Proc. malac. Soc. Lond.*, London, 17: 206-208.
- 1933. A new Chiton from the Andaman Islands. *Proc. Malac. Soc. Lond.*, London, 22: 318-319.