PROCEEDINGS

OF THE

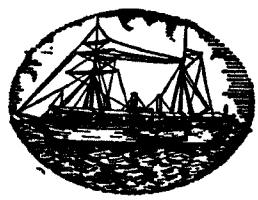
SYMPOSIUM ON MOLLUSCA

HELD AT

COCHIN

FROM JANUARY 12 TO 16, 1968

PART III



SYMPOSIUM SERIES 3

MARINE BIOLOGICAL ASSOCIATION OF INDIA

MARINE FISHERIES P.O., MANDAPAM CAMP

INDIA

PEARL OYSTERS OF THE INDIAN REGION*

K. VIRABHADRA RAO

Central Marine Fisheries Research Institute, Mandapam Camp, India

ABSTRACT

An account of the distribution of the pearl oyster species under the genus *Pinctada* Roding in the Indian region has been given. The synonymy of *P. fucata* (Gould) and *P. vulgaris* (Schumacher) is discussed. In addition to *P. margaritifera*, *P. fucata* (Syn. *P. vulgaris*), *P. chemnitzi*, *P. anomioides* and *P. atropurpurea* hitherto known from the Indian coasts, a sixth species, *viz.*, *P. sugillata* (Reeve) collected for the first time from the pearl beds of Tuticorin and subsequently from the Madras harbour has been described.

INTRODUCTION

THE family Pteriidae under Bivalvia includes three genera, *viz.*, *Pteria* Scopoli, *Pinctada* Roding and *Electroma* Stolickzka. The members of the family are characterised by the presence of a straight toothless hinge, the lower border of which may, however, bear one small tooth-like projection at or near, one or both the ends, of the ligamental area; the outer surface of the valves is scaly. In *Pteria* (the wing mussels) the hinge is long, the anterior and the posterior ears of the shell are prolonged and the long axis of the shell is directed backwards and is at an obtuse angle to the hinge. In *Pinctada*, which includes the pearl oysters, the hinge is moderately long, the ears are short, the posterior one may even be absent and the long axis of the shell is at right angles to the hinge. In *Electroma* the hinge is very short, the ears are altogether absent and the long axis of the shell is obtusely directed backwards. The present paper deals with the taxonomic descriptions of the pearl oyster shells collected by the author from the Madras harbour, the pearl beds of the Gulf of Mannar off Tuticorin, the Palk Bay lagoons in the vicinity of Mandapam and the Andaman Islands, off Port Blair and Mayabundar. The report aims at clarifying certain doubts generally held in regard to nomenclature and the true identity of the pearl shells occurring on the Indian coasts. Prashad and Bhaduri (1933) had stated that all the pearl oysters till then known from the Indian coasts could be ascribed to five well-defined species. The occurrence of *P. sugillata* recorded here from Tuticorin beds was hitherto not known from the Indian coasts.

Genus **Pinctada** Roding

The true pearl oysters ascribed earlier to the sub-genus *Margaritifera* under the genus *Pteria* (Jameson, 1901) are now referable to the genus *Pinctada* as pointed out by Prashad (1932), Prashad and Bhaduri (1933), Iredale (1939) and Hynd (1955). The generic characters may be briefly stated as follows: a long straight hinge uniting the two valves; long axis of the shell at right angles to the hinge; the left valve a little deeper than the right one; a byssal notch on each valve at the base of the anterior lobe; a variedly coloured periostracum which is generally brownish, often with radial markings; inner surface of the valve lined with nacre of brilliant lustre. The diagnosis of the species under the genus is based usually on (1) the presence or absence of the hinge teeth and the nature and their disposition when present; (2) the general contour of the shell, the extent of the development of the ear lobes and the colouration and markings on the surface; (3) the spread of the nacreous border in relation to the non-nacreous portion of the inner surface of the valves and

* Published with the permission of the Director, Central Marine Fisheries Research Institute, Mandapam Camp, India.

(4) the nature of the growth processes on the margins of the shells. The form and some of the other characters of the species are subject to wide variations.

Pinctada margaritifera (Linnaeus)

(Figs. 1, A to 1 D)

Mytilus margaritiferus Linnaeus, 1758, p. 740.

Avicula margaritifera Reeve, 1857, *Avicula*, pl. 8. fig. 21.

Pteria (*Margaritifera*) *margaritifera* var. *typica* Jameson, 1901, p. 374,

Margaritifera margaritifera Hornell, 1921, P. 165.

Pinctada margaritifera Prashad, 1932, p. 98.

Pinctada margaritifera. Prashad and Bhaduri, 1933, p. 168.

Pteria margaritifera Gravely, 1941, p. 38.

Pinctada margaritifera Hynd, 1955, p. 108, pl. 2, figs, 1, 2; Satyamurti, 1956, p. 51, pl, 7, fig. 1 *b*; Ancn., *Wealth of India*, 1966, p. 205.

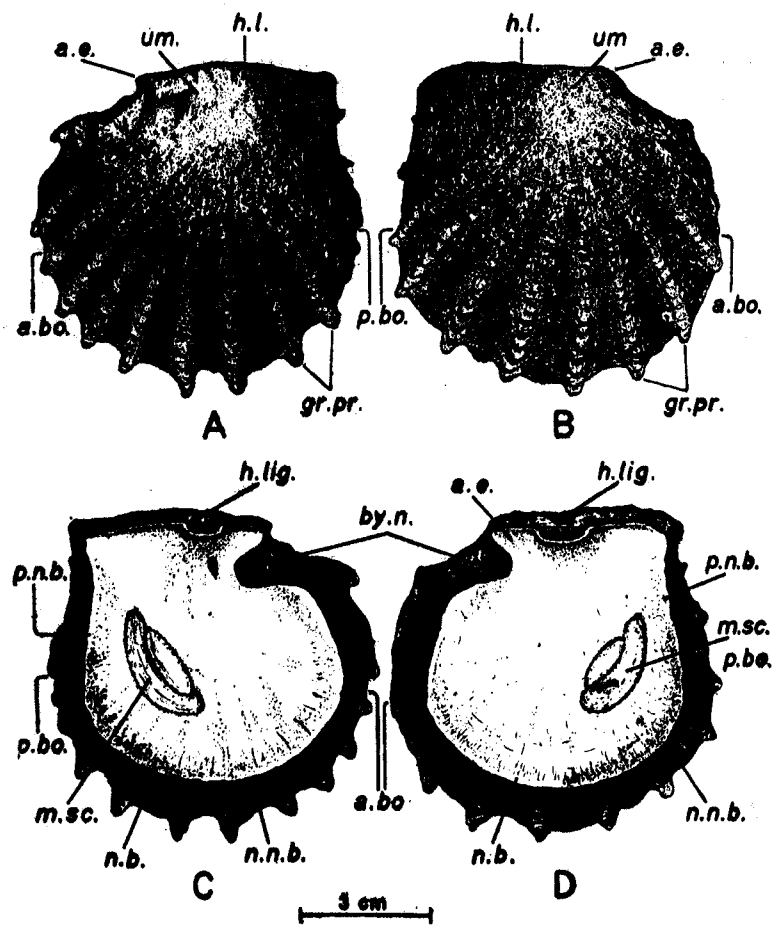


FIG. 1. *Pinctada margaritifera* (Linnaeus). A. Left valve outer surface; B. right valve outer surface; C. left valve inner view; D. right valve inner view.

The hinge which is devoid of teeth is very much shorter than the width of the shell in its broades part. The most outstanding feature of the shell of this species is the extension of the anterior border far in advance of the anterior ear lobe. The byssal notch is broad indicating a strong development of the byssus. The anterior ear is fairly well developed, but the posterior one is absent and in correlation with this, the posterior sinus is also absent. Another prominent feature of the shell is that its posterior border meets the hinge almost at a right angle. The shell valves are moderately convex, the general colouration externally is dark grayish-brown, with a greenish tinge when observed fresh, and with continuous white spots radially arranged. These spots represent the basal portions of the successive growth processes. The nacreous layer is iridescent with a silvery sheen for the most part except distally where it is hued sooty black. The non-nacreous border is very dark, sometimes with faint markings. Because of this dark marginal colouration on the interior of the valves, the shell of this species has come to be known as the 'black lip' in commerce. The width of the nacreous region at the hinge is about two-thirds of the same in the broadest region of the body of the shell valve.

Jameson (1901) has distinguished several varieties under the species, *viz.*, *P. margaritifera* var. *typica* presumably from Malay Archipelago, var. *zanzibarensis* from the east coast of Africa, var. *persica* from the Persian Gulf, var. *erythraensis* from the Red Sea, var. *cumingi* from the Eastern Polynesia and var. *mazatlanica* off Panama (Mazatlan, etc.). No doubt some of these are well known in commerce as the Zanzibar shell, Panama shell, etc., as coming from distinct geographical regions, but some of these varieties so closely resemble the var. *typica* except in small variations as size and colour that the distinction into varieties has been pointed out to be doubtful and rather artificial (Prashad and Bhaduri, *loc. cit.*).

The species is widely distributed in the entire Indo-Pacific region. On the Indian coasts it is sparsely present, but in the Persian Gulf, Red Sea, south-western part of the Indian Ocean and in the Pacific Ocean it supports the mother-of-pearl fisheries of importance. A well-shaped large specimen from a reef in Mayabundar (Andaman Islands) measured 7·5 cm. in the widest antero-posterior axis, 5·5 cm. on hinge line, 1·1 cm. in the length of the anterior ear, 4·1 cm. in the nacreous region at hinge line, 6·0 cm. in the nacreous region in the widest part of the antero-posterior axis and 1·1 cm. in thickness.

Pinctada fucata (Gould)

(Figs. 2 A to 2 D)

Perlamater vulgaris Schumacher, 1817, p. 108, pl. 20, fig. 3.

Avicula fucata Gould, 1850, p. 309; 1852, p. 441, figs. 551, 551 *a*.

Avicula lurida Gould, 1850, p. 310; 1852, p. 440, figs. 550, 550 *a*.

Avicula periviridis; *A. occa; A. lacunata; A. aerata; A. fucata:* Reeve, 1857, pl. 8, fig. 20; fig. 24; pl. 10, fig. 29; fig. 32; pl. 17, fig. 74.

Pteria (*Margaritifera*) *vulgaris* Jameson, 1901, p. 384.

Margaritifera vulgaris Hornell, 1922, p. 116, fig. 1.

Pinctada vulgaris Prashad, 1932, p. 99; Prashad and Bhaduri, 1933, p. 169.

Pteria vulgaris Gravely, 1941, p. 38.

Pinctada fucata Hynd, 1955, p. 113, pl. 1; pl. 4, figs. 1, 2; pl. 5, figs. 1–3.

Pinctada vulgaris Satyamurti, 1956, p. 52, pl. 7, figs. 2 *a*, *b*; Anon., 1966, *Wealth of India*, 6, p. 204, fig. 84.

The form of the shell being very variable in specimens from different localities and also in those representing different growth stages even from the same locality, there has been much confusion in regard to its correct identification establishing the synonymy until Hynd (1955) reviewed the earlier work. Jameson (1901) was of the opinion that *Perlamater vulgaris* of Schumacher (1817) was a recognisable species and that the hitherto specific name *fucata* of Gould (1850) should be

replaced by the former, but Hynd (*loc. cit.*) held that the description of Schumacher was too brief to be of any value and that in the absence of the type specimen and the type locality, the species should be regarded as unidentifiable. Hynd points out that Gould's (1850) *Avicula fucata* is a recognisable species and therefore this specific name should be used to denote the form now commonly described under *P. vulgaris* (Schumacher). Several of the species described by Reeve (1857) under *Avicula*, viz. *fucata* from Japan, *occa* from the Red Sea, *aerata* and *periviridis* from Australia are considered by Jameson (1901) to be synonymous with *Pteria* (*Margaritifera*) *vulgaris*. Prashad and Bhaduri (1933) are of opinion that not only the aforesaid species but also *A. lentiginosa* of Reeve (1857) from the Banda Sea is synonymous with them.

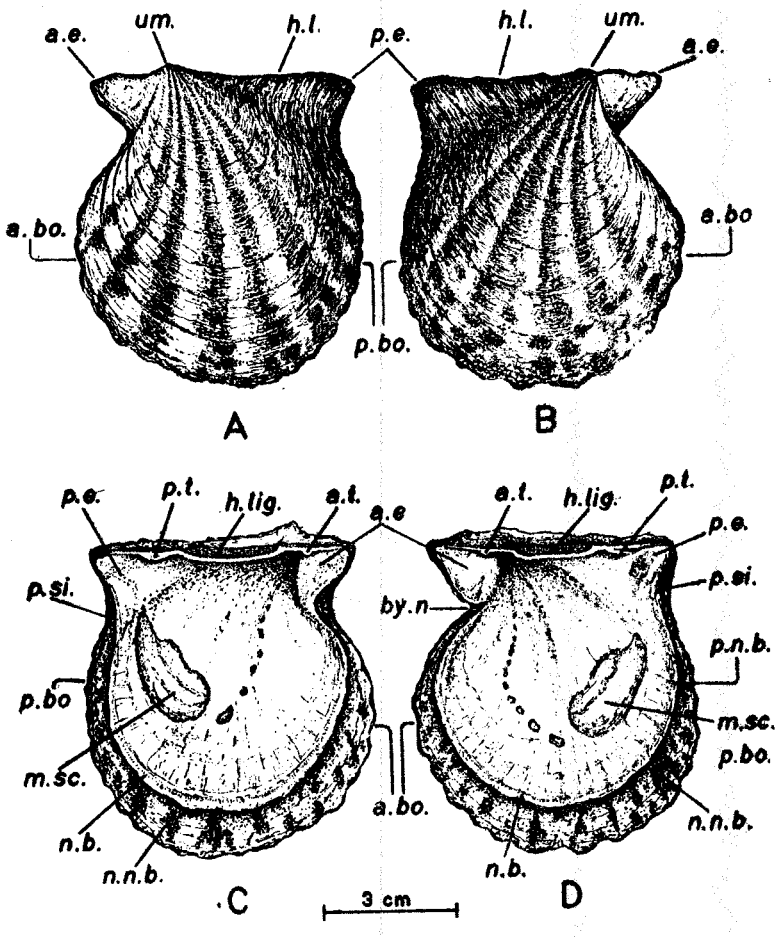


FIG. 2. *Pinctada fucata* (Gould). A. Left valve outer surface; B. right valve outer surface; C. left valve inner view; D. right valve inner view.

The hinge line in *P. fucata* is fairly long, its ratio to the broadest region of the body of the shell is 0·85 and its ratio to the longest dorso-ventral measurement is 0·76. In front of the hinge ligament, in both the valves, one in each, there is a thickening, the anterior hinge tooth. A similar posterior hinge tooth is present behind the hinge ligament in the valves. The anterior ear is relatively larger than in other species and the byssal notch at the junction of the body of the shell with the ear is slit-like. The posterior ear is fairly well developed and the posterior border of the shell shows a small or moderately large sinus. The anterior border of the broadest region of the shell

does not usually extend or extends only slightly in front of a vertical line with the extremity of the anterior ear. The angle at the posterior border where it meets the hinge line is acute. The valves are convex, the convexity of the left valve is greater than that of the right valve as in other members of the genus, but the convexity of both the valves is much greater than in other pearl oyster species in this region. The ratio of thickness of the shell to the broadest region in the antero-posterior axis of the shell is 0·45. Externally the shells of this species from Tuticorin pearl beds are reddish-brown to yellowish-brown with well-defined continuous rays of lighter hue alternating with darker ones extending on the surface from the umbo to the margin of the shell. The non-nacreous border on the inner surface of the valves bears dark brown or reddish blotches in a line with the external rays. The nacreous region is well developed in both the valves and is of strong metallic lustre of rich golden-yellow. The species grows to a size of about 8 cm. in its dorso-ventral measurement. The younger shells have thin, rather flat marginal radiating blunt projections.

This is the commonest pearl oyster of the Gulf of Mannar region on the pearl banks of the Indian coasts and off Ceylon, harvested from ancient times for natural pearls which are world famous as the "Lingha pearls" of the Orient. The pearl banks have for their substrata ridges of rock or dead coral formation in this region extending from Cape Comorin in the south to Kilakarai in the north with a central productive zone fished from Tuticorin base. In the Gulf of Kutch also they are found to some extent on the intertidal reefs and in the Palk Bay where they occur rather sparsely, they are found attached to submerged objects. Stray individuals are occasionally met with in all harbours and bays on the east and the west coasts. Its range of distribution extends over the Red Sea, Persian Gulf, Indian Ocean and the Western Pacific Ocean.

A well-grown large specimen from the pearl beds of Tuticorin measured 6·4 cm. in the widest antero-posterior axis, 7·2 cm. in the dorso-ventral axis, 6·0 cm. in the length of the hinge line, 1·4 cm. in the length of the anterior ear, 5·8 cm. in the nacreous region at the antero-posterior axis and 3·0 cm. in thickness of the shell.

Pinctada chemnitzii (Philippi)

(Figs. 3 A to 3 D)

Concha margaritifera laevis Chemnitz, 1785, p. 135, pl. 80, fig. 720.

Avicula atlantica var. *b.* Lamarck, 1819, p. 49.

Avicula chemnitzii Philippi, 1849, p. 19.

Avicula pretexta; A. tegulata, Reeve, 1857, pl. 7, fig. 15; pl. 7, fig. 17.

Avicula (*Meleagrina*) *chemnitzii* Dunker, 1872, p. 15, pl. 3, fig. 5.

Pteria (*Margaritifera*) *pretexta; P.* (*M.*) *Chemnitzii; P.* (*M.*) *tegulata*: Jameson, 1901, p. 387; p. 388; p. 392.

Pinctada chemnitzi Prashad and Bhaduri, 1933, p. 171.

Pteria chemnitzii Gravely, 1941, p. 38, fig. 15 *e* on p. 36.

Pinctada chemnitzi Hynd, 1955, p. 123, pl. 8, figs. 1, 2; pl. 9, figs. 1, 2.

Pinctada chemnitzi Anon., 1966; *Wealth of India*, 6, p. 204.

The first authentic description of this species under the name *Avicula chemnitzii* was that of Philippi (1849) from the China Sea. Reeve's *A. tegulata* of the Moreton Bay is identical with this species, but the name *tegulata* of Reeve being preoccupied by *tegulata* of Goldfuss (1836), Iredale (1939) as cited by Hynd (*loc. cit.*) has named it *P. epitheca.* The Philippine shell, *Avicula pretexta* of Reeve (1857) is also synonymous with this species. Prashad and Bhaduri (1933) recorded it for the first time from the Indian coasts.

In this species, the shell is very much like that of *P. fucata* except that the posterior ear is very well developed and the convexity of the valves is much less. The anterior ear is moderately well

developed and the byssal notch is slit-like. The hinge line is nearly as long as the longest antero-posterior measurement of the body of the shell. The ratio of the dorso-ventral measurement to the hinge line is 1·22. Both the anterior and the posterior hinge teeth are present, the former small and rounded and the latter large and well developed like a ridge starting a little in advance of the posterior region of the hinge ligament. Correlated with the greater development of the posterior ear, the posterior sinus is very conspicuous.

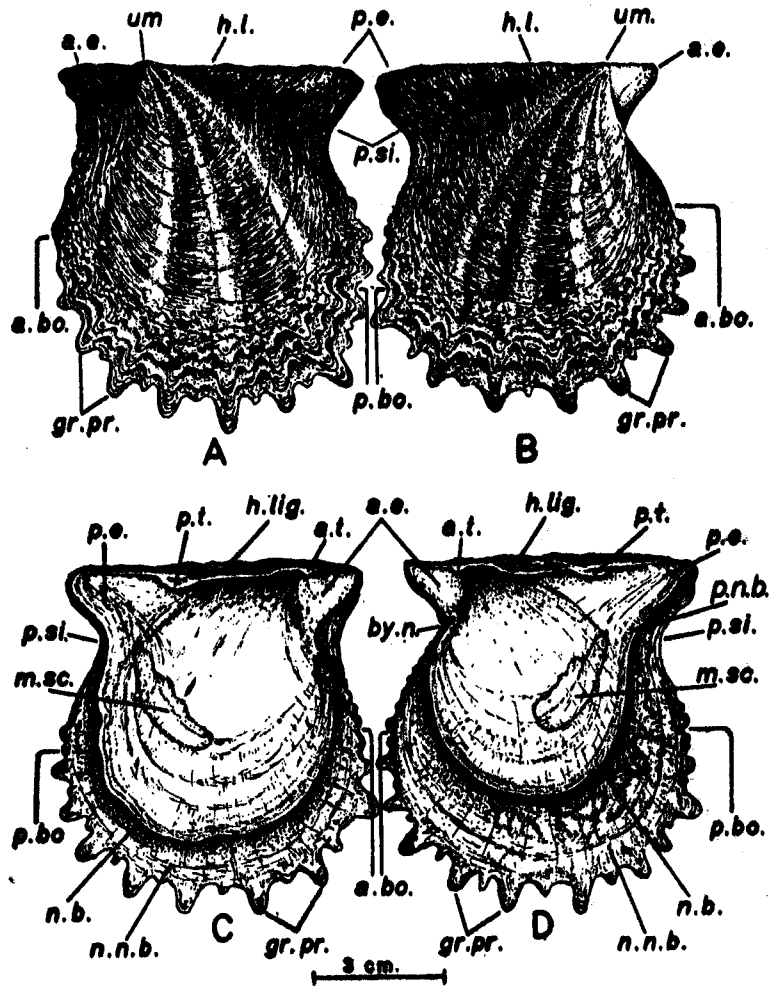


FIG. 3. *Pinctada chemnitzii* (Philippi). A. Left valve outer surface; B. right valve outer surface; C. left valve inner view; D. right valve inner view.

Externally the valves are reddish-brown with about four or more whitish or cream yellow radial markings from the umbo to the margin of the shell and the growth processes are rather broad. The nacreous lining is bright and lustrous and is developed to a far greater extent in the left valve than in the right valve and in the latter this border meets the hinge line obliquely outwards. The non-nacreous border is brownish without any conspicuous blotches of the kind met with in *P. fucata*. The shell grows to about 10 cm. in its dorso-ventral axis. A long hinge line, a prominent posterior hinge tooth, a well-developed posterior ear and a deep posterior sinus are the diagnostic features of the shell.

On the Indian coasts this shell is known to occur in Tranquebar, Madras harbour, Tuticorin pearl beds of the Gulf of Mannar, in the Palk Bay and off Balassore coast (Orissa). Outside the Indian coasts, it is known from Ceylon, Aden, Mergui Archipelago, Penang, Indonesian group of Islands, Australia, Hongkong, Philippines, China Sea and Japan.

A well-shaped shell from Madras harbour measured 7·0 cm. in the antero-posterior measurement, 8·5 cm. in the dorso-ventral measurement, 6·8 cm. in the hinge line, 1·4 cm. in the length of the anterior ear, 2·5 cm. in the posterior ear, 6·0 cm. in the nacreous region from the hinge line to the ventral border in the left valve, 5·1 cm., the same in the right valve and 2·0 cm. in thickness

Pinctada sugillata (Reeve)

(Figs. 4 A to 4 D)

Avicula fimbriata; A. sugillata; A. irradians; A. chamoides Reeve, 1857, *Avicula*, pl. 9, fig. 25; pl. 9, fig. 27; pl. 10, fig. 35; pl. 11, fig. 41.

Pteria (*Margaritifera*) *sugillata* Jameson, 1901, p. 380.

Meleagrina sugillata Hedley, 1910, p. 344.

Pinctada sugillata Hedley, 1916, p. 25.

Pinctada sugillata Prashad, 1932, p. 101.

Pinctada albina sugillata Hynd, 1955, p. 127, pl. 9, fig. 3; pl. 10, figs. 1–3; pl. 11, figs. 1–3; pl. 12, fig. 1; pl. 13, fig. 2.

Jameson (1901) considered *Avicula fimbriata, A. sugillata* and *A. irradians* of Reeve (1857) to be synonymous. The species *fimbriata* has page priority but is preoccupied by *A. fimbriata* of Dunker (1852) which is recognised as a valid and distinctly separate species by Jameson (1901) and Hynd (1955). *A. chamoides* of Reeve (1857) has been stated to be only a young specimen of *A. sugillata* (Hynd, *loc. cit.*). Prashad (1932) had considered *Meleagrina albina* of Lamarck (1819) to be synonymous with *Pinctada vulgaris* of Schumacher, but Hynd recognised it as a valid species synonymous with *P.* (*M.*) *carcharium* a name given by Jameson (*loc. cit.*) to the Shark Bay shell. Hynd considers two varieties under *Pinctada albina*, viz., *sugillata* (Reeve) and *carcharium* (Jameson).

In this species the hinge line is very much shorter than the widest antero-posterior axis of the body of the shell, they being in the ratio of 1: 1·3. The antero-posterior measurement almost equals the dorso-ventral measurement. The anterior ear in both the valves is small and the byssal notch is a moderately wide slit. The anterior ears are slightly bent towards the right so that the hinge line, when viewed from the top, is seen to be deflected anteriorly to the right side. This character recorded by Hynd (1955) in the Australian shell is noted prominently in the Indian shell. The posterior border of the shell shows a small, not well-defined sinus which is correlated with the very poor development of the posterior ear. The convexity of the valves is not marked, particularly that of the right valve which is only moderately convex. The hinge teeth are present but inconspicuous in the adult specimens examined, the anterior one roundish and small and the posterior one only faintly seen as a streak. Hynd (*loc. cit.*) states that the teeth are only faintly seen in the adult but prominent in the younger specimens. The colouration of the valves for the most part starting from the hinge and extending over the body of the shell is dark gray with a tinge of brown. The lower and posterior regions of the valves are light yellow and gray. There are about six yellowish radial markings starting from the umbo and extending towards the periphery. The nacreous region on the inner surface of both the valves is well developed. Posteriorly the nacreous border as it meets the hinge line presents a wavy course. Hynd stated that the nacreous region is bounded by a narrow black band on the non-nacreous border, but this was noticed only in one of the two specimens examined.

On the Indian coasts this species has been observed for the first time by the present writer. They were collected from the pearl oyster beds of Tuticorin and the Madras harbour. The earlier records of its distribution were off the coasts of Australia, Indonesian group of Islands, Borneo and Celebes.

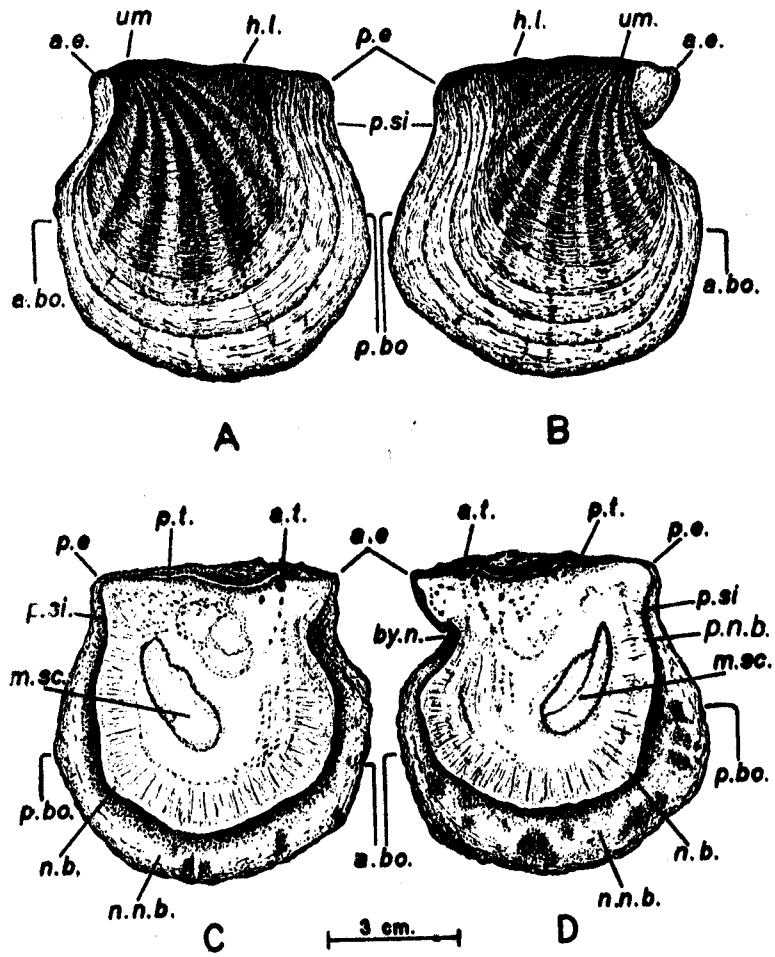


FIG. 4. *Pinctada sugillata* (Reeve). A. Left valve outer surface; B. right valve outer surface; C. left valve inner view; D. right valve inner view.

A well-shaped shell from the pearl oyster beds of Tuticorin measured 5·5 cm. in the hinge length, 7·1 cm. in the widest antero-posterior axis, 7·2 cm. in the dorso-ventral axis, 1·1 cm. in the length of the anterior ear, 5·1 cm. in the width of the nacreous border at hinge, 5·2 cm. in the width of the same at the broadest antero-posterior axis and 1·9 cm. in thickness.

Pinctada anomioides (Reeve)

(Fig. 5)

Avicula anomioides Reeve, 1857, *Avicula*, pl. 9, fig. 26.

Avicula (*Meleagrina*) *anomioides* Dunker, 1872, 7 (3); *Avicula*, p. 54, pl. 8, fig. 6.

Pteria (*Margaritifera*) *anomioides* Jameson, 1901, p. 384.

Pinctada anomioides Prashad, 1932, p. 100, pl. 3, figs. 5–8; Prashad and Bhaduri, 1933, p. 172; Anon., 1966, *Wealth of India*, 6, p. 205.

The present writer obtained two specimens one from the pearl oyster beds of Tuticorin and the other from Madras harbour. The hinge line is shorter than the width of the broadest region in the antero-posterior axis. The latter is more pronounced in one of the specimens. The hinge line and the dorso-ventral axis are in the ratio of 1 : 1·4 in both the shells. The hinge line and the broadest region of the antero-posterior axis are in the ratio of 1 : 1·5 in one shell and 1 : 1·2 in the second one. Hinge teeth are altogether absent in both. Prashad and Bhaduri (1933) have stated that in some shells the anterior hinge tooth may be faintly visible. The antero-posterior axis of the body of the shell is found to extend to some distance in front of the vertical line to the external border of the anterior ear. The anterior ear is very moderately developed and presents a deep byssal notch at its base. The posterior ear and the posterior sinus are absent. Externally the valves are yellowish with a light tinge of gray. There are faint radial markings. The valves are translucent. The nacreous region is well developed and its posterior border meets the hinge line at right angles.

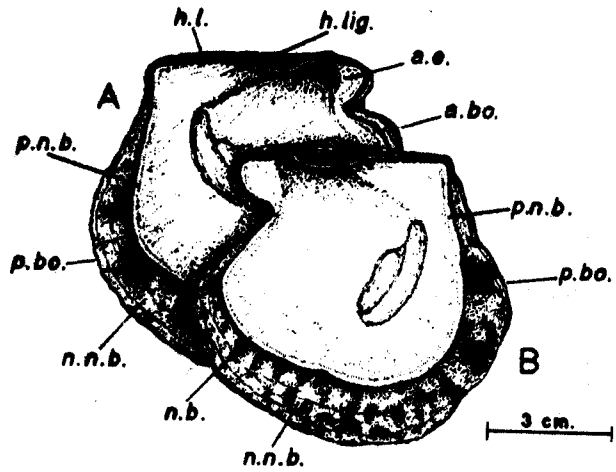


FIG. 5. *Pinctada anomioides* (Reeve). A & B. Left and right valves, inner view.

In India it is known to occur off Bombay, Madras, Tuticorin and Andaman Islands. Outside India it is recorded off Aden, Ceylon, Mergui Archipelago and the Indonesian group and the nearby Islands.

The measurements of the two shells in centimetres are as follows: Hinge line—5·0/5·5; antero-posterior axis in the broadest region—7·5/6·7; dorso-ventral measurement—7·0/7·8; length of the anterior ear—1·1/1·1; width of the nacreous region at the hinge—4·5/5·9; nacreous region at the broadest antero-posterior axis—6·0/5·3; thickness—2·1/2·1.

Pinctada atropurpurea (Dunker)

Avicula (*Meleagrina*) *atropurpurea* Dunker, 1852, 9, p. 76.

Avicula (*Meleagrina*) *atropurpurea* Dunker, 1872, 7 (3); *Avicula*, p. 14, pl. 3, fig. 3.

Pteria (*Margaritifera*) *atropurpurea* Jameson, 1901, p. 384.

Pinctada atropurpurea Prashad and Bhaduri, 1933, p. 174; Anon., 1966, *Wealth of India*, 6, p. 205.

The shell is roundish with a narrow hinge. The valves are thin, translucent, copper-coloured and moderately convex. The byssal notch is deep. The nacreous layer is thin and extends to a greater portion on each valve, leaving a non-nacreous copper coloured border. The posterior nacreous border meets the hinge line at an acute angle. A trace of an anterior hinge tooth may be present in some shells, but is not recognisable in the shell examined by the present author. Prashad and Bhaduri (1933) state that this species is closely allied to *P. anomioides* but distinguishable because of its coppery red colouration, thinner and more translucent valves and the posterior nacreous border meeting the hinge line at an acute angle.

On the Indian coasts it is now known from the Madras harbour and the Andaman Islands. Outside India, it is recorded from Ceylon, Mergui Archipelago and the Philippine Islands.

A single specimen examined from the Madras harbour measured 3·7 cm. in hinge line, 4·2 cm. in the broadest region of the shell in the antero-posterior axis, 4·5 cm. in the dorso-ventral axis and 1·9 cm. in thickness.

General Considerations

From the foregoing account it may be seen that very few are the pearl oyster species known to occur on the Indian coasts. In quantitative abundance and high quality pearl production, *P. fucata* is the only species supporting the Indian pearl fisheries which are located in Madras and Gujarat States. The annual revenue realised by the respective Governments is pretty high especially from the fisheries of the former State in which the net sale proceeds of the oysters fished in a single season in a productive year amount to several lakhs of rupees. The pearl fisheries are very unsteady and productive years are followed by long periods in which the pearl banks remain almost barren. Although every attempt is made to aim at sustaining yields by enforcing suitable regulations for exploitation and conservation of the resources, the objective is hardly achieved owing to factors in the environment over which human effort has little control.

In a fishery the oysters are removed from the natural beds in millions, but the quantity of pearls recovered from them is very low. tI is not every oyster that contains a pearl and probably, in a lot of hundred oysters not even one may contain a pearl worthy of being reckoned as a gem the majority of pearls being small seed pearls of very little value. Thus it may be seen that in a fishery millions of oysters are wastefully destroyed. Periodical inspections of the pearl banks and conducting the pearl fisheries in specially organised pearl camps involve enormous expenditure to the Governments. Unless sufficiently large numbers of oysters could reasonably be estimated to be fished in a season, the fishery is not announced. The demand for natural pearls of good quality and size from *P. fucata* has always been very great, but the pearl fisheries are a big game of chance.

In order to make the oysters yield the pearls under controlled conditions, cultural practices will have to be resorted to which will enable preventing undue destruction of the natural resources. In Japan as is well known numerous pearl farms are found where pearls of desired size and form are produced by employing techniques which were once guarded as professional secrets but are now fairly well known. More than the skill required in operating the oysters by introducing specially made shell beads which serve as nuclei around which nacre is allowed to be secreted from mantle grafts, the after-care of the treated oysters is of great importance for their well-being which ultimately determines the yield of good cultured pearls. In Japan the species of oyster chiefly employed for producing pearls is *Pinctada martensi* Dunker the shell of which has the same form, texture, brilliance of nacre and the general plan of colour markings as in *P. fucata* except for its smaller size and depth of colouration in certain parts. The Indian species appears to be admirably suited for pearl culture, as the colour, lustre and smoothness of skin of the pearls formed in nature in this species are of great excellence. Some initial experiments were conducted about three decades ago by the Department of Fisheries of the erstwhile Madras State in successfully acclimatising the

oysters to shallow water habitats. The oysters could be induced to form nacre around certain extraneous objects introduced between the shell and the mantle. They however did not succeed in producing round pearls. By suitably modifying the operational techniques it is hoped that the success of producing perfect cultured pearls is not impossible to achieve although it may involve some expense and failures in initial experimentation.

There are no suitable pearl oyster species occurring in such abundance as to support the mother-of-pearl fisheries on the Indian coasts. The texture of the shell of *Pinctada margaritifera* is sufficiently thick and the nacre lustrous enough to lend itself useful for making buttons, etc., but the species occurs very sparsely on the Indian coasts. Although abundant, the shell of *P. fucata* is too thin and fragile for being utilised in the mother-of-pearl industry. This industry is however supported by two gastropod species with massive shells, *viz.*, *Trochus niloticus* Linnaeus and *Turbo marmoratus* Linnaeus from the Andaman and Nicobar Islands in the Indian territory.

ACKNOWLEDGEMENTS

The writer is grateful to Dr. S. Jones, Director of the Central Marine Fisheries Research Institute, Mandapam Camp, for the encouragement received from him in the collection of the material and the presentation of this paper. He expresses his sincere thanks to Shri K. Prabhakaran Nair of the Central Marine Fisheries Research Sub-Station, Bombay, for very kindly making the original illustrations from the material collected.

LITERATURE CITED

ANON. 1966. Oysters, *Wealth of India*, **6**: 202–207.

CHEMNITZ, J. H. 1785. Neues systematisches Conchylien-Cabinet. 8. (Nurnberg.).

DUNKER, W. 1852. *Aviculacea nova. Z. Malakozool.*, 73–80.

——— 1872. Systematisches Conchylien-Cabinet. 7 (3): Die gattung *Avicula*. Ed. Martini u. Chemnitz.

GOULD, A. A. 1850. Shells from the United States exploring expedition. *Proc. Boston Soc. Nat. Hist.*, **3**: 309–312.

——— 1852. United States Exploring Expedition....1838–1842, **12**, Mollusca and Shells (Philadelphia).

GRAVELY, F. H. 1941. Shells and other animal remains found on the Madras beaches. 1. Groups other than snails, etc. *Bull. Madras Govt. Mus., N.S. Nat. Hist.*, **5** (1): 1–112.

HEDLEY, C. 1910. The marine fauna of Queensland. *Rep. Aust. Ass. Adv. Sci.*, **12**: 329–372.

———. 1916. A preliminary index of the Mollusca of Western Australia. *J. Roy. Soc. W. Aust.*, **1**: 155–226.

HERDMAN, W. A. 1903. Description of pearl oyster banks of the Gulf of Mannar. *Rep. Pearl Fish. Mannar*, **1**: 99–121.

HORNELL, J. 1922. The Indian pearl fisheries of the Gulf of Mannar and Palk Bay. *Bull. Madras Fish. Dept.*, **16**: 1–188.

HYND, J. S. 1955. A revision of the Australian pearl-shells, genus *Pinctada* (Lamellibranchia). *Aust. J. Mar. and F. water Res.*, **6** (1): 98–137.

IREDALE, T. 1939. Mollusca: Part I. *Sci. Rep. Gr. Barrier Reef Exped.*, **5**: 209–425.

JAMESON, H. L. 1901. On the identity and distribution of the mother-of-pearl oysters: with a revision of the sub-genus *Margaritifera*. *Proc. Zool. Soc. Lond.*, **1**: 372–494.

LAMARACK, J. 1819. *Histoire Naturelle des Animaux sans Vertebres*, **6** (1): Paris.

LINNAEUS, C. 1758. *Systema Naturae*. 10th Ed.

PHILIPPI, R. A. 1849. *Centuria teria testacesorum uovorum*. Sp. 76–100. *Zeit. Malakozool.*, 17–26.

PRASHAD, B. 1932. The Lamellibranchia of the Siboga expedition. Systematic Part II. Pelecypoda exclusive of the Pectinidae. *Monogr. Siboga Exped.*, **29**; *Mollusca* **3**: 1–353.

—— AND J. L. BHADURI 1933. The pearl oysters of the Indian waters. *Rec. Indian Mus.*, **35**: 167–174.

RAO, K. VIRABHADRA 1958. Molluscan fisheries. *Fisheries of the West Coast of India*, Central Marine Fisheries Research Institute, pp. 55–59.

REEVE, L. A. 1857. *Conchologia Isonica*, **10**, Monograph of the genus *Avicula* (London).

SATYAMURTI, S. T. 1956. The Mollusca of Krusadai Island. II. Scaphopoda, Pelecypoda and Cephalopoda. *Bull. Madras Govt. Mus., N.S. Nat. Hist.*, **1** (2), Pt. 7, 1–202.

SCHUMACHER, C. F. 1817. *Essai d'un Nouveau Systeme des Habitations des Vers Testaces.* Copenhagen.

KEY TO LETTERING

a.bo., Anterior border of shell valve; *a.e.*, anterior ear; *a.t.*, anterior hinge tooth; *by.n.*, byssal notch; *gr.pr.*, growth processes; *h.l.*., hinge line; *h. lig.*, hinge ligament; *m.sc.*, muscle scar; *n.b.*, nacreous border; *n.n.b.*, non-nacreous border; *p.bo.*, posterior border of shell valve; *p.e.*, posterior ear; *p.n.b.*, posterior nacreous border; *p. si.*, posterior sinus; *p.t.*, posterior hinge tooth; *u.m.*, umbo.

DISCUSSION

DR. B. N. DESAI: What are the localities where you made the oyster collections ?

MR. K. V. RAO: *Pinctada margaritifera* from Port Blair, Mandapam and Madras. *Pinctada fucata* large numbers were collected from the beds off Tuticorin, Kutch, Harbours in Madras and Bombay. *Pinctada chemnetzii* occur along with *P. fucata* though not in large numbers. *P. sugillata* were collected from the pearl oyster beds in the Gulf of Mannar off Tuticorin and Madras harbour. *P. atropurpurea* and *P. anomioides* from Madras and Bombay areas.

DR. D. J. TRANTER: Is *Pinctada sugillata* synonymous with the *P. albina* of Australian waters ?

MR. K. V. RAO: *P. albina sugillata* is the same I am referring to here.

DR. D. J. TRANTER: Anticipating that the blacklip pearl oyster *P. margaritifera* may be the species most amenable to pearl culture operations in this area, would Mr. Rao please tell me whether this species occurs commonly in Laccadives and other Islands Off Kerala Coast ?

MR. K. V. RAO: From my knowledge *P. fucata* is best suited for pearl culture operations and these are plentiful. *P. margaritifera* occurs sparsely; the lustre of its pearls is not so good as in *P. fucata.* Certainly *P. fucata* is the most suitable.