

## XVII. STUDIES ON THE ANATOMY OF INDIAN MOLLUSCA.

### 2. THE MARSUPIUM AND GLOCHIDIUM OF SOME UNIONIDAE AND ON THE INDIAN SPECIES HITHERTO ASSIGNED TO THE GENUS *NODULARIA*.

By B. PRASHAD, D.Sc., *Superintendent of Fisheries, Bengal, Bihar and Orissa, Calcutta.* (Communicated by permission of the Director of Fisheries, Bengal.)

(With text-figures 1—3.)

In part one<sup>1</sup> of this series I described the structure of the marsupium and the glochidium of two species of the genus *Physunio*, Simpson. The present communication consists of two parts, the first of which deals with the same structures in two of the common genera of Indian Unionidae *Lamellidens*, Simpson, and *Parreyssia*, Conrad, while in the second an account of the soft parts of the animal of an Indian genus hitherto confounded with the genus *Nodularia*, Conrad, is given. A new generic name, *Indonaia* is, therefore, proposed for the Indian species. An account of the structure of the glochidium of two of the species of this genus is also included. Further, a few records of the occurrence of encysted glochidia on the fins of some Indian fishes are given.

A full histological account of the structure of the gills in these genera is not included as I hope to come to this subject later and to deal with the Indian Unionidae as a whole.

The material for this investigation consists of a collection made by Babu D. N. Sen, Zoological Assistant, Bengal Fisheries Department, and the various collections made on different occasions by the officers of the Zoological Survey of India; these latter collections were very kindly placed at my disposal by the Director of the Zoological Survey of India.

I have also to express my indebtedness to Mr. T. Southwell, the Director of Fisheries, for the kind encouragement and the generous way in which he has met with my wishes at all times. To Babu D. N. Sen my thanks are due for the careful records of locality, preservation of specimens and willing help whilst working with me in the Fisheries Laboratory.

#### GENERAL.

The marsupium is of very great importance in the classification and natural grouping of the genera of the Unionidae, but unfortunately at the time of Simpson's<sup>2</sup> revision the anatomy of the Indian genera was not known in most cases. He, however, from a

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<sup>1</sup> *Rec. Ind. Mus.* XV, p. 183-185, pl. xxii (1918).

<sup>2</sup> *Proc. U. S. Nat. Mus.* XXII, p. 501-1075 (1900).

study of the shell characters alone, placed the genera in the groups established by him primarily on the structure of the marsupium. This tentative classification has necessarily proved to be wrong in many cases. It was shown in the first paper of this series, that the genus *Physunio* should be placed in the sub-group Mesogenae of the group Exobranchiae and not in the Endobranchiae as was done by Simpson. As a result of my investigations on three of the commoner Indian genera, it has been found that these also have been assigned wrong places. *Lamellidens* and *Parreyssia* were placed in the sub-family Hyrinae, which are, according to Simpson, primitive forms, and carry the glochidia in the inner pair of gills (Endobranchiae). Preston in the official "Fauna of British India"<sup>1</sup> has followed Simpson, *loc. cit.*, adding nothing new so far as the anatomy was concerned, and even neglected the various important contributions on the anatomy of some of the Indian Unionidae published since Simpson's revision was issued. These observations of mine are, in part, a confirmation of what was found by Ortmann<sup>2</sup> as a result of his study of the animals of *Parreyssia wynegungaënsis* (Lea) and *Lamellidens consobrinus*, Lea. Preston on page 180 of the volume cited above considers the latter to be only a subspecies of *Lamellidens marginalis* (Lamarck). Ortmann found that the position assigned by Simpson to the genera *Parreyssia* and *Lamellidens* was quite wrong. Both these genera were, from the structure of the marsupium, found to be exobranchous, and in his revision he placed them in the sub-family Unioninae of the family Unionidae. This sub-family he characterised as having the "Marsupium formed by all four gills or by the outer gills only; edge of marsupium always sharp and not distending; water-tubes not divided in the gravid female." Unfortunately the material which Ortmann had at his disposal was very small and consisted of sterile or unripe females from Bombay.

In the case of the third genus *Nodularia*, Conrad, it was found that in the two Indian species investigated the animal was quite different from that of *N. aequitaria* (Morelet), and *N. japonensis* (Lea), and that the Indian forms of this genus unlike the Japanese and the African endobranchous forms should be placed in the Exobranchiae. This subject is treated in detail further on in the account of the genus, which has for this reason been separated from the genus *Nodularia* and called *Indonaria*.

### Lamellidens.

Two varieties of the common Indian species *L. marginalis* (Lamarck) were studied. The first is a variety very little different from the typical form and may for the purpose of the present paper be considered as such. The nomenclature of the varieties and subspecies of *L. marginalis* is in a very confused condition. Gravid specimens of this form were collected in a tank at Bora near Serampur in the Hughly district, Bengal, on the 1st of April, 1918. The outer pair of gills, which alone formed the marsupium, were found to contain large numbers of unripe glochidia. Specimens were kept in large bowls in muddy water, but no further

<sup>1</sup> *Mollusca, Gastropoda and Pelecypoda*, p. 134 (1915).

<sup>2</sup> *Ann. Carnegie Mus.*, VIII, pp. 222-365, pls. xviii-xx (1911-12).

development took place. In the other variety *obesa* (H. and T.) also only the outer pair of gills serve as the marsupium. I have found by a study of sections of the gills of males, gravid and sterile females that the differences in the structure of the respiratory and marsupial gills, originally described by Peck<sup>1</sup> for the gills of *Anodonta* and later on found by Ortmann<sup>2</sup> to be constant in a large number of other genera as well, are the same in *Lamellidens* and *Parreyssia*, and so need not be detailed here. In the marsupial gills the inter-lamellar junctions are more numerous than in the respiratory gills, the epithelial covering of the lamellar junctions is modified; whereas in the purely respiratory gills of the female and those of the male the inter-lamellar junctions are fewer and the epithelial covering is of the ordinary type. As expected by Ortmann the gills do not swell very much when full of glochidia and their lower margins are always sharp and distended. In the first variety no glochidia were found but the embryos were found to be agglutinated together to form a flat more or less elliptic plate, thick and broad above, thin and tapering below.

The glochidia of the second variety *obesa* (H. and T.) may be described as semi-elliptic (fig. 1a) with a rounded ventral margin, the hinge-line rather long and nearly straight and measuring .248 mm. by .210 mm.

### Parreyssia.

The number of species and varieties of this genus which was studied was much larger than of the others. In the following table I give the locality, date on which collected, the gills in which the glochidia were found and the size of the glochidia. It is of interest to note that the specimens were from such widely separate localities as Eastern Bengal, Chota Nagpur and the Western Ghats in the Bombay Presidency. One of the forms which I have marked with a query seems to be either an undescribed variety of *P. favidens*, or possibly a distinct species.

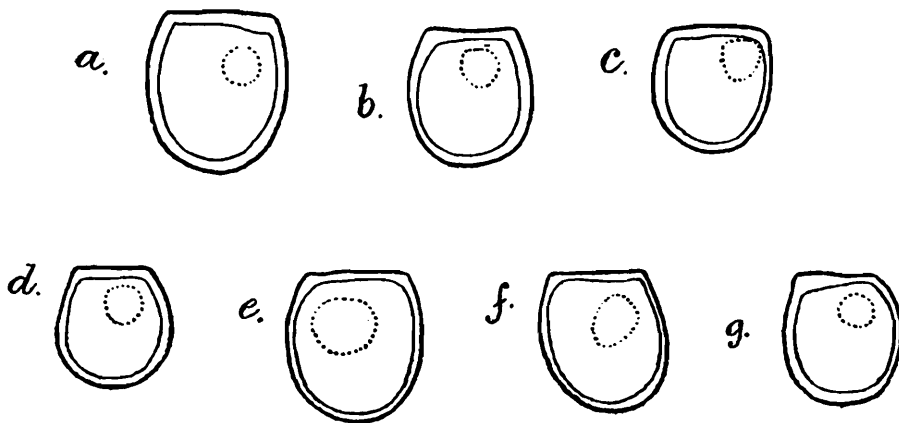
Name.	Locality.	Date of collection.	Gills with glochidia.	Size of glochidia.
<i>P. favidens</i> (Benson)	Mirpur, E. Bengal.	1st week of June, 1917.	All four gills	.210 mm. × .153 mm. (fig. 1b).
<i>P. favidens</i> var ?	Do.	Do.	Right inner gill	.190 mm. × .073 mm. (fig. 1c).
<i>P. favidens</i> var. <i>assamensis</i> , Preston.	Do.	Do.	Inner pair of gills	.172 mm. × .142 mm. (fig. 1d).
<i>P. favidens</i> var. <i>tripartitus</i> (Lea).	Do.	Do.	All four gills with embryos.	?
<i>P. favidens</i> var. <i>viridula</i> (Benson).	Chakradharpur, Chota Nagpur.	3rd February, 1918.	All four gills	.220 mm. × .190 mm. (fig. 1e).
<i>P. corrugata</i> (Müller)	Medha, Bombay Presidency.	27th February, 1918.	Do.	.191 mm. × .150 mm. (fig. 1f).
<i>P. corrugata</i> var. <i>nagpoorensis</i> (Lea).	Mirpur, E. Bengal.	1st week of June, 1917.	Outer left full, outer right with a few only.	.174 mm. × .153 mm. (fig. 1g).

<sup>1</sup> *Q. J. Microsc. Sci.* XVII, pp. 43-66 (1877).

<sup>2</sup> *Mem. Carnegie Mus.* IV, pp. 279-347, pls. lxxxvi-lxxxix (1911).

Though the glochidia were not found in all cases to fill up all the four gills, yet in *P. favidens* var. *tripartitus* all the four gills were full of embryos, and in the typical form of *favidens*, *P. favidens* var. *viridula*, and *P. corrugata* all the four gills contained glochidia. In the other varieties the structure of all the four gills was modified for a marsupial function and the absence of glochidia in some of the gills seems to be due to their having been shed before the specimens were collected.

The structure of the gills and the water-tubes is very similar to that in the genus *Lamellidens* described above.



*Fig. 1.*

Glochidia of (a) *L. marginalis* var. *obesa*, (b) *P. favidens*, (c) *P. favidens* var. ? (d) *P. favidens* var. *assamensis*, (e) *P. favidens* var. *viridula*, (f) *P. corrugata*, (g) *P. corrugata* var. *nagpoorensis*.

The glochidia, as will be seen from the figures (fig. 1 *b—g*) all of which are drawn magnified 75 times, are semi-circular or semi-elliptic. In their structure, sculpture of the shell and the nature of the flange on the inner and lower surface of the shells they are quite like those of the genus *Physunio* described in my paper, *loc cit.*

#### Indonaia, gen. nov.

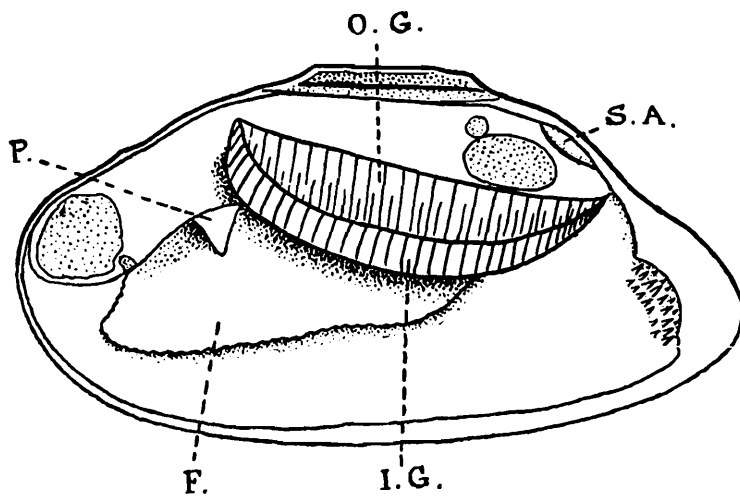
Simpson in the paper cited above included in the genus *Nodularia*, Conrad, a number of groups of shells of such wide range as Japan, China, Siam, India and Africa. The anatomy of some of the members was known, but the others like the Indian forms were included because of the shells having a close resemblance to those of the genus *Nodularia*. Haas<sup>1</sup> in his account of the genus *Nodularia* included only the species found in Siam, Cambodia, Annam, China, the Amur region, Korea and Japan, apparently considering the Indian species to belong to a distinct genus. As a result of my investigations of the soft parts of the animals of some of the Indian species, it was found that these species had no relationships with those that properly belong to the genus. Whereas the species *N. japonensis* (Lea), a Japanese form, and *N. aequitoria* (Morelet), an African one, carry the glochidia in the inner pair of gills (endobranchiae) and belong to the sub-family Hyrinae of the family

<sup>1</sup> Martini und Chemnitz, *Conch. Cab.*, (ed. Kuster) IX, Abth. 2, pt. 2, Die Unioniden (1910).

Unionidae of Simpson; the Indian species investigated carry the glochidia in all the four gills (endobranchiae), and will have to be placed in the sub-family Unioninae of Simpson or according to the later classification of Ortmann<sup>1</sup> in the restricted sub-family Unioninae, Ortmann. None of the older names being available, the generic name *Indonaia* is proposed for the Indian species with *Unio caeruleus*, Lea, as its type. I have as yet been able to examine the animals of *I. caerulea*, *I. caerulea* var. *gaudichaudi*, *I. pachysoma* and *I. pugio*. In these the description of the soft parts given below was found to be constant. It is to be expected that the structure of the animal in the other Indian species hitherto assigned to the genus *Nodularia*, would be similar, and the genus *Indonaia* would therefore include all the species described by Preston, *loc. cit.*, pp. 135-146.

I have nothing to add to the following description of the shell given by Simpson for the group of *N. caerulea*, "shell elliptical, inflated, pointed about midway up behind, the post basal region produced, with a well developed posterior ridge; beaks sculptured with numerous fine, radiating riblets, the central ones of which join below, the whole often more or less zigzagged, and extending well over the disk; epidermis generally bluish-green."

The animal (fig. 2) may be described as having the inner gills much wider than the outer both in front and behind. The inner lamellae of the inner gills are not free but united with the abdominal sac throughout and with each other behind to the end. The palpi are rather large;



*Fig. 2*

Animal of *Indonaia caerulea* var. *gaudichaudi*. F.=foot, I. G.=Inner gill, O. G.=Outer gill, P.=Palp, S. A.=supra-anal opening.

the mantle has the margin simple and not toothed; the branchial opening is large with three to four rows of pointed papillae; the anal opening smaller than the branchial of a light brown colour without any tubercles; the supra-anal opening separated from the anal by a distinct mantle connection which is rather short. The supra-anal opening itself is

<sup>1</sup> *Ann. Carnegie Mus.* VIII, pp. 223-224 (1911-12).

smaller than the anal and of a brownish colour. The glochidia are carried in all the four gills.

The glochidia are nearly ovoid, with a very small, straight hinge-line and a small hook on each shell (figs. 3 *a-c*). Gravid specimens of two species were obtained, *I. caerulea* var. *gaudichaudi* and *I. pachysoma*. Females of *I. pachysoma* were collected on the 14th of January 1912, in a lake nine miles from Berhampur, Bengal; the glochidia (fig. 3

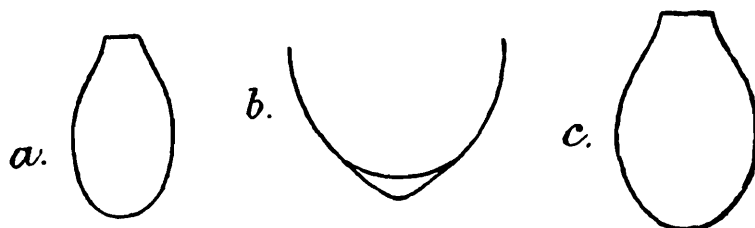


Fig. 3.

Glochidia of (*a*) *I. pachysoma*, side view. (*b*) Inner view of the lower portion of the shell of the glochidium of *I. pachysoma*, showing the hook. (*c*) Glochidium of *I. caerulea* var. *gaudichaudi*.

*a, b* are .248 mm. by .115 mm. in size. The specimens of *I. caerulea* var. *gaudichaudi* were collected on the 1st of April 1918, from a pond four miles from Serampur, in the District of Hughly, Bengal. The glochidia (fig. 3*c*) measure .289 mm. by .182 mm.; they are of the same type as that of *I. pachysoma* except that they are bigger.

The glochidia of this genus are very different from those of the other known Indian genera. They differ in shape and show a distinct advance in that the flange on the lower margin of the shell of each side is becoming more highly evolved and is restricted to a hook in the centre.

#### FISH HOSTS.

In this section I do not attempt at any specific identification of the glochidia, which were found encysted on the fins of a large collection of fishes from the Satara and Poona districts of the Bombay Presidency. The localities and the conditions under which these fishes were collected are fully discussed by Dr. Annandale in the systematic account of these fishes to be published shortly in the "Records," and I need no more than give a list of the various species which were found to have glochidia on their fins.

*Nemachilus savona* (Ham. Buch.).

*Nemachilus anguilla*, Annandale.

*Psijorhynchus tentaculatus*, Annandale.

*Cir hina reba* (Ham. Buch.).

*Barbus malabaricus*, Jerdon.

*Barbus jerdoni*, Day.

*Barbus ticto*, Day.

*Rasbora daniconius* (Ham. Buch.).

*Danio aequipinnatus* (McCl.).

*Chela boopis*, Day.

*Ophiocephalus gachua* (Ham. Buch.).

*Gobius bombayensis*, Annandale.