

The jaw is small and has rounded extremities. The cutting edge is concave and is provided with a central blunt projection and a subobsolete accessory projection on either side. The quadrate plate is narrow and rounded posteriorly.

The radula is fairly long and broad and has the formula 28. 12.1.12.28. The bases of the marginals are rather short and concave.

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THE PELECYPODA.

By B. PRASHAD.

The collection of Lamellibranchs from Manipur described in the following pages is of special interest, in that most of the species are represented by large series of both dry shells and specimens preserved in spirit. This has enabled me to describe the soft parts of most of the species investigated. I have also included here the description of a new species of the genus *Trapezoideus*, Simpson, collected by Mr. Sunder Lal Hora at Dimapur in Assam.

In the collection this class is represented by the two families Unionidae and Cyrenidae. Of the former, specimens of the genera *Indonaia*, *Lamellidens* and *Trapezoideus* are represented, and of the latter there are specimens of *Corbicula*, *Sphaerium* and *Pisidium*. The most common genera in the valley are *Indonaia* amongst the Unionidae and *Corbicula* and *Sphaerium* amongst the Cyrenidae.

Family UNIONIDAE.

Genus *Indonaia*, Prashad.

1918. *Indonaia*, Prashad, *Rec. Ind. Mus.* XV, pp. 146–148, fig. 2.

In the Manipur Valley the genus *Indonaia* is represented by five species. Of these *I. theobaldi* is apparently confined to the

Manipur Valley, not being known from elsewhere, *I. scobina* and *I. lima* are found in Burma, Assam and Eastern Bengal, while *I. bonneaudi* and *I. occatus* have a very wide range.

Indonaia occata (Lea).

1914. *Nodularia* (*Nodularia*) *occata*, Simpson, *Descr. Cat. Naiades*, p. 985.
 1915. *Nodularia* (*Nodularia*) *occata*, Preston, *Faun. Brit. Ind. Freshw.-Moll.*, pp. 138, 139.

The specimens from the Manipur Valley closely resemble those of this species from other parts of India and I have no hesitation in assigning them to it.

The soft-parts resemble those of *I. caerulea* var. *gaudichaudi* described by me in the paper cited, but differ in having the palps much longer and ellipsoid in outline, in the anal being comparatively larger, but of about the same size as the supra-anal and in the mantle connection between the supra-anal and anal being very small. None of the specimens are gravid but all the four gills have a marsupial structure.

Preston (*loc. cit.*) gives "Bengal" as the range of distribution of this species. There are, however, specimens from various localities in the United Provinces, the Central Provinces, Bengal, Assam and Burma in the Indian Museum collection. The species, therefore, has a very wide range in India and Burma.

Indonaia bonneaudi (Eydx).

1914. *Nodularia* (*Nodularia*) *bonneaudi*, Simpson, *op. cit.*, p. 988.
 1915. *Nodularia*, (*Nodularia*) *bonneaudi*, Preston, *op. cit.*, pp. 140, 141.

Preston has referred to the great variation exhibited by this species both as regards shape and in colour, and this is well brought out in the series before me.

The soft parts resemble those of *I. occata* except that the branchial aperture is much larger, and the anal and supra-anal, which are of the same size, are about one half of its length. The palpi are very elongate, somewhat triangular in outline and have a sharp tip. Only the outer pair of gills are fully charged with glochidia, and the inner pair have only a small number in them.

There are only two specimens of this species in the collection, one from the Thobal Stream near Phaidai and the other from Sikmai stream six miles from Kakchin on the Manipur-Burma Road.

Indonaia scobina (Hanley).

1856. *Unio scobina*, Hanley, *Recent Biv. Shells*, p. 382, pl. xxiii, fig. 40.
 1876. *Unio scobina*, Hanley and Theobald, *Conch. Indica*, p. 22, pl. xlv, fig. 2.
 1914. *Nodularia* (*Nodularia*) *scobina*, Simpson, *op. cit.*, p. 996.
 1915. *Nodularia* (*Nodularia*) *scobina*, Preston, *op. cit.*, pp. 142, 143.

This species was originally described from a unique specimen from Assam. Hanley and Theobald have given a good figure of the

shell, but the specimen from Belgaum, Deccan (pl. xlvi, fig. 3), which they consider as a link between *I. occatus* and *I. scobina* does not appear to belong to either species. *I. scobina* has a restricted range in Assam, Manipur and probably Burma, and does not occur in Peninsular India. The only two specimens in the Indian Museum collection are from Sibsagar, North Eastern Assam, and the record of the specimens from the Manipur Valley greatly extends the known range of this species.

Most of the shells collected by Mr. S. L. Hora from the Sikmai stream are much larger than the Sibsagar specimens; one of the largest is 27.8 mm. long, 17 mm. high and 11.5 mm. in thickness.

The animal differs from that of the other species in having the outer pair of gills shorter in both length and breadth than the inner pair and in the palps being rather small.

Indonaia theobaldi (Preston).

1912. *Nodularia (Nodularia) theobaldi*, Preston, *Rec. Ind. Mus.* VII, p. 292.
 1914. *Nodularia (Nodularia) theobaldi*; Simpson, *op. cit.*, p. 1002.
 1915. *Nodularia (Nodularia) theobaldi*, Preston, *op. cit.*, pp. 143, 144, fig. 8 (1-3).

Preston described this species from two specimens in the Indian Museum collection from Manipur. The exact locality, however, whence these specimens were collected is not known. The species is one of the largest of the Indian forms of the genus *Indonaia*.

Mr. S. L. Hora collected four specimens in the Sikmai Stream in the Manipur Valley. All these specimens, though a little smaller than the type-specimen, are quite like it in other respects. In all the specimens the umbones are much eroded.

The soft parts resemble those of the other species of the genus. None of the specimens are gravid.

Indonaia lima (Simpson).

1900. *Nodularia (Radiatula) lima*, Simpson, *op. cit.*, p. 820.
 1914. *Nodularia (Radiatula) lima*, Simpson, *op. cit.*, p. 1018.
 1915. *Nodularia (Radiatula) lima*, Preston, *op. cit.*, pp. 147, 148.

Simpson in 1900 established a new section *Radiatula* of the genus *Nodularia* for the two Indian species *Unio crispisulcatus* and *Unio radula* of Benson, he also changed the name of the latter to *Nodularia lima* owing to the specific name *radula* being preoccupied. In his later work, however, he expressed a doubt as to whether *N. lima* did not really belong to the *I. caerulea* group. The sculpture of the shell of this species differs from that of the type-species of the *Radiatula* section and is very like that of *occatus* and *scobina*. The soft parts also resemble those of the two species in all essentials. I therefore place *N. (R.) lima* of Simpson, with species like *occatus* and *scobina*, in my genus *Indonaia*.

Preston's *siliguriensis*, which is a variety of *L. lima* will also have to be removed from the *Radiatula* section.

It is not possible to decide definitely the exact position and relationships of *I. crispisulcatus*, the only other species left in the *Radiatula* section, as we know nothing of its anatomy, but its very characteristic sculpture alone might entitle it to a sectional rank.

The shells collected by Mr. S. L. Hora are from the Sikmai Stream on the Manipur-Burma Road. The specimens are quite typical of the species but have the umbones much eroded.

The soft parts resemble those of *I. occatus*.

Genus *Lamellidens*, Simpson.

- 1900. *Lamellidens*, Simpson, *op. cit.*: p. 854.
- 1912. *Lamellidens*, Ortmann, *Ann. Carnegie Mus.* VIII, p. 277.
- 1914. *Lamellidens*, Simpson, *op. cit.*, p. 1165.
- 1915. *Lamellidens*, Preston, *op. cit.*, p. 174.
- 1918. *Lamellidens*, Prashad, *Rec. Ind. Mus.* XV, pp. 144, 145.
- 1919. *Lamellidens*, *id., ib.*, XVI, p. 293, fig. 4.

Simpson in the two works cited has greatly cleared up the synonymy of the various Indian species, but owing to the limited material at his disposal his descriptions are not quite accurate in all cases. At the time of the publication of his first work nothing was known about the animal of any of the species and the position assigned by him to this genus in his classification was not correct. In his second work, though he included a reference to Ortmann's paper, he still stated that the soft parts were not known. Preston has unfortunately created a great deal of confusion as to the nomenclature of the various species and varieties by indiscriminately combining many good species without assigning any reasons and in other cases by describing already known species as new. In my papers on the anatomy of the genus *Lamellidens*, I followed Preston's nomenclature and my description of the soft parts of the genus was based on specimens which could, according to Preston's identifications, hardly be separated from *L. marginalis* subsp. *corrianus*. Having now carefully studied the large collection in the Indian Museum and the fresh collection from Manipur I find that the above conclusions were not justified. Preston's identifications of the Indian Museum collection are quite unreliable in many cases, the same species having been identified differently on different occasions. In this paper I do not attempt any more than to assign the Manipur shells to their proper species and to add notes on the distinctive characters of these forms.

On examining fully gravid specimens of the typical *L. marginalis*, it was found that the marsupium in this species is not formed by the outer pair of gills only but by all the four gills. In *L. consobrinus* and *L. corrianus* on the other hand only the outer pair of gills is marsupial. The soft parts of all these species are quite similar in other respects. It appears, therefore, that in

the genus *Lamellidens* we have probably two groups of species, in one of which the marsupium is formed by all the four gills and in the other by the outer pair only. This may possibly be correlated with the conditions under which the two groups of species are found. *L. marginalis* is a stream-form while *L. corrianus* is commonly found in ponds or very sluggish streams. In the case of typical stream-forms it may be necessary to produce as large a number of glochidia as possible as the chances of their being washed away are very great, and probably in response to this necessity all the four gills have taken on the marsupial function in these forms.

The formation of the marsupium by all the four gills in *L. marginalis* does not in any way affect the position assigned to the genus by Ortmann and myself in the subfamily Unioninae of Ortmann's classification, as the marsupium in this subfamily is stated to be formed either by all the four gills or by the outer pair of gills only.

***Lamellidens marginalis* (Lamarck).**

1914. *Lamellidens marginalis*, Simpson, *op. cit.*, pp. 1166-1168.

1919. *Lamellidens marginalis*, Prashad, *op. cit.*, p. 293, fig. 4.

In the paper cited above my description and figure of the animal of *L. marginalis* was based on specimens which I, with Preston, considered doubtfully to represent a variety of this species. As a result of a careful study of the whole collection in the Museum I find that these specimens really belong to *L. corrianus*, which I consider to be a distinct species.

The description of the shell of this species in Simpson's monograph is fairly complete, but the following distinctive characters may be noted. The shell is sub-elliptical with slightly inflated but not greatly elevated beaks. The dorsal slope is in most specimens a little curved and the posterior wing is very narrow. The hinge (fig. 29A) is formed by two lamellar pseudo-cardinals in the right valve; these are situated one below the other and the lower is better developed, both, however, are in continuation of the laterals; in the left valve there is only a single pseudo-cardinal like a feebly developed ridge, simple in most specimens but in a few becoming cut up by a notch into two. In the latter case, owing to the inclined nature of the notch and the unequal development of the two component parts of the ridge of the anterior edge, the posterior of the two teeth comes to lie at a slightly lower level than the anterior tooth and this results in the production of two distinct pseudo-cardinals in the left valve also. The gradual evolution of the two teeth can be traced in a large series. The lateral teeth are somewhat curved, there being two in the left and a single one in the right valve. A trace of a second lateral in the form of a minute ridge at the base of the lamellar lateral of the right valve can also be seen in some fully grown specimens.

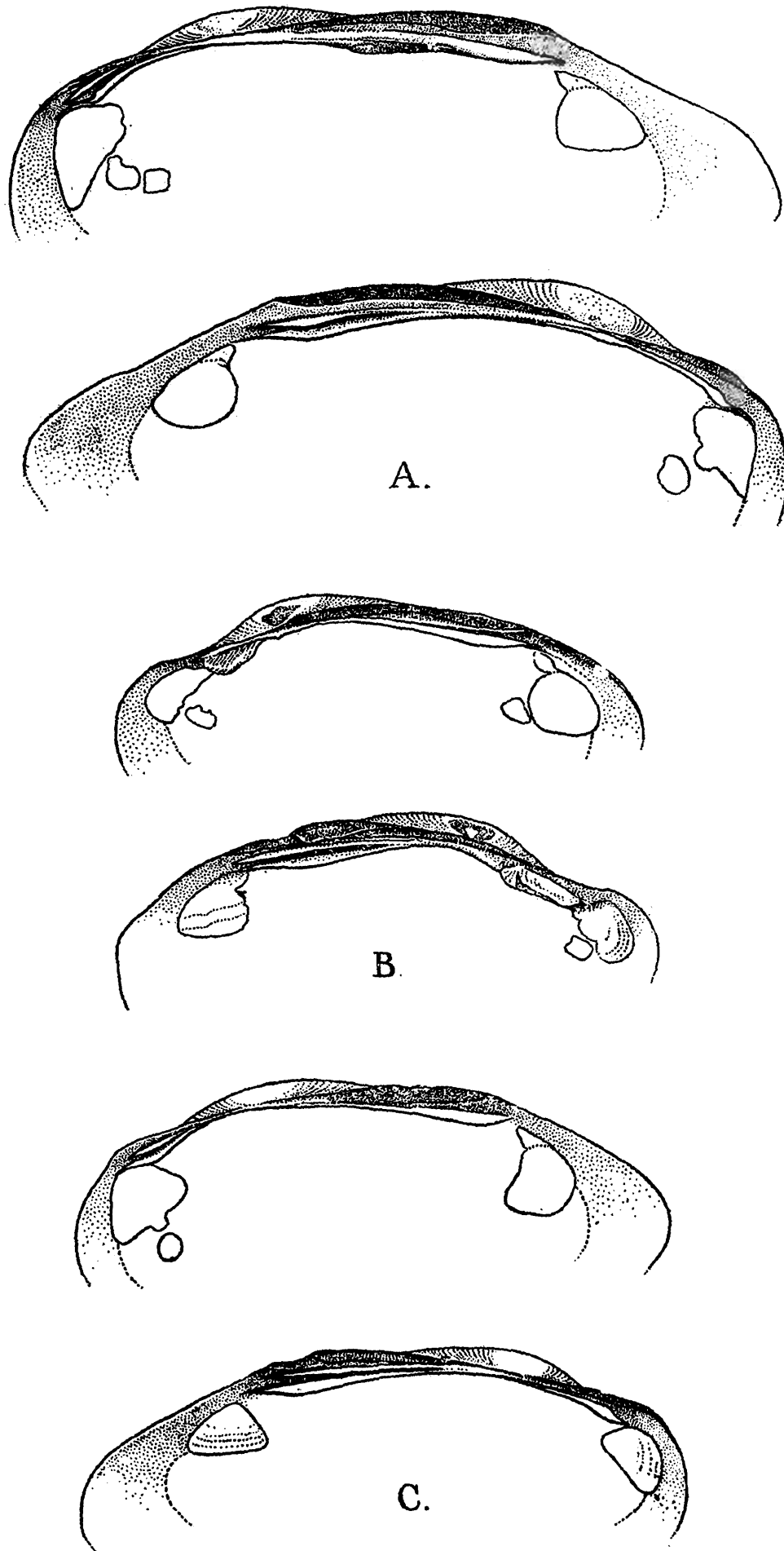


FIG. 29.—Hinge-teeth of *Lamellidens*.
A. *L. marginalis* (Lam.). B. *L. consobrinus* (Lea). C. *L. corrianus* (Lea).

The animal differs from that of *L. corrianus* described in the paper cited in the following characters:—The inner pair of gills is broader than the outer throughout its length. Both pairs of gills are marsupial and when fully charged with glochidia are of a dull brownish colour. The palpi are comparatively larger and elliptic in outline. The foot is better developed, being a powerful burrowing organ in this species. The branchial aperture is about one and a half times the size of the anal and has the papillae along its border more numerous and much larger.

Half a dozen specimens of this species were collected by Mr. S. L. Hora in a small rapid-running stream at Mara Khong at a distance of about six miles from Imphal on the Bishenpur Road. The shells of these specimens are quite typical of the species in shape but are rather thin.

Lamellidens consobrinus (Lea).

1911. *Lamellidens consobrinus*, Ortmann, *Nautilus* XXIV, p. 106, pl. vii, fig. 4.
 1914. *Lamellidens consobrinus* (in part), Simpson, *op. cit.*, pp. 1171, 1172.
 1915. *Lamellidens marginalis* subsp. *consobrina*, Preston, *op. cit.*, p. 180.

Preston considers *L. consobrinus* to be a subspecies of *L. marginalis*. After a careful comparison of large series of the two species I do not consider that this conclusion is justified. Preston was probably led to it by mixing up specimens of the two species while identifying the Indian Museum collection. Simpson includes *L. mainwaringi* (Nevill MS.), Preston, as a synonym of *L. consobrinus*. Unfortunately Preston's figures of the hinge of this species are very poor and his description of the shell also lacks precision in some important details. It may be noted briefly here that *L. mainwaringi* is a distinct species, not at all allied to *L. consobrinus*, its nearest relation amongst the Indian forms being *L. corrianus*.

The shell in this species is rhomboidal, rather solid, with the beaks more inflated and elevated than in *L. marginalis*. The dorsal slope is curved and obliquely truncate. The hinge (fig. 29 B) is very different from that of *L. marginalis*. In the right valve there are two widely separated pseudo-cardinals lying one below the other, of these the lower is much larger, thicker and better developed than the upper. The left valve has two somewhat ragged pseudo-cardinals more or less in the same line; the anterior of the two is very much larger and better developed. The laterals are distinctly arched, there being a single well developed and the rudiment of a second in the right and two fully developed ones in the left valve.

In a single male specimen in spirit the animal conforms to Ortmann's description.

The species is represented in the Manipur collection by a single specimen collected in the Sikmai Stream about six miles

from Kakching, on the Burma-Manipur Road, and many empty shells from the banks of the Amambi stream some eight miles from Imphal. The shells of this species are locally known as *Shuni-kongrein*, and are utilised for the manufacture of lime.

Lamellidens corrianus (Lea).

1914. *Lamellidens corrianus*, Simpson, *op. cit.*, pp. 1174, 1175.
 1915. *Lamellidens marginalis*, subsp. *corrianus*, Preston, *op. cit.*, pp. 183, 184.

This species is not a form of *L. marginalis*, as Preston thinks, but quite distinct, for not only are the shells different but the marsupium also is formed quite differently in the two species.

The shell of *L. corrianus* is very thin and delicate, elongate-elliptical in form, with the beaks only slightly inflated and not at all elevated. The dorsal slope is comparatively long and straight, or nearly so, and the posterior wing is much broader than in *L. marginalis*. There are two pseudo-cardinals (fig. 29C) in the right valve, the upper of the two being rather small and thin; in the left valve also the two pseudo-cardinals are distinct, but the upper and posterior one is feebly developed. The lateral teeth, which are two in the left and one in the right valve, are only slightly arched.

The soft parts have already been described and figured by me as those of a form of *L. marginalis*. In the Manipur specimens also the glochidia were found in the outer pair of gills only, the inner pair being purely respiratory in function.

This is the commonest Unionid in the Manipur Valley and is the only one found in the Loktak Lake. Large numbers of dead shells of this species were found by the Manipur Survey party in the swampy area at the north end of that body of water. Mr. S. L. Hora also collected specimens of it in various streams in the valley.

Genus *Trapezoideus*, Simpson.

1900. *Trapezoideus*, Simpson, *op. cit.*, p. 858.
 1914. *Trapezoideus*, Simpson, *op. cit.*, p. 1180.
 1915. *Trapezoideus*, Preston, *op. cit.*, p. 193.

Simpson established this genus in 1900 for a number of rather peculiar Burmese, Siamese, Cambodian and Sumatran Unionids and also included in it Benson's species *Unio theca* from the Cane River, Bundelkhand, Central India. I have not seen specimens of this latter species but from the description it is doubtful whether the species is congeneric with the Burmese forms.¹ A few specimens from the Koyna Valley, Satara District, Bombay Presidency in the collections of the Zoological Survey, which had been wrongly identified as *Trapezoideus foliaceus* (Gould), do not belong to this genus, but are specimens of the interesting form

¹ Simpson also on p. 1186 of his Catalogue (*loc. cit.*) expresses a doubt as to the exact systematic position of Benson's species.

Arcidopsis footei (Theobald). The genus therefore appears to be a true Eastern one confined to Assam, Burma, Siam, Cambodia and Sumatra.

In the collection the genus is represented by a single shell of *T. misellus* (Morelet) from the Manipur Valley and by many specimens of a new species from the base of the Naga Hills, Assam. Living specimens of the new species were brought to Calcutta by Mr. S. L. Hora and from these I am able to describe the hitherto unknown animal of this genus.

Animal with the outer and inner gills of nearly the same width posteriorly, but the outer shorter in length than the inner; inner lamellae of the inner pair of gills united in the anterior $\frac{2}{3}$ of their length to the abdominal mass on each side while in the posterior third the lamellae of the two sides are united with each other to the end. Palpi large. Mantle entire with quite simple margin. Branchial aperture large, of a light brownish colour, with many

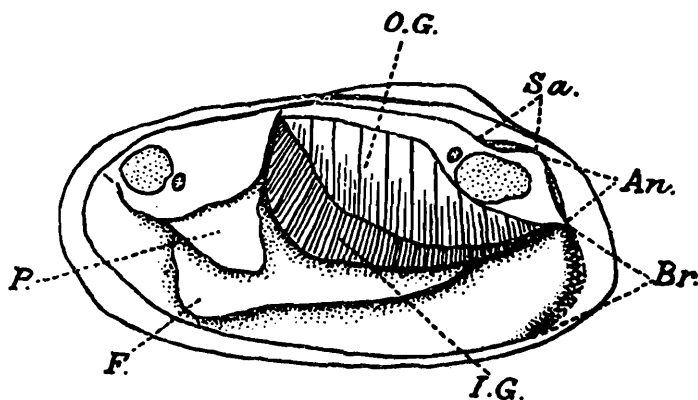


FIG. 30.—Soft parts of *Trapezoideus dhanushori*, Prashad.

An. Anal aperture; Br. branchial aperture; F. foot; I.G. inner gill; P. palp; O. G. outer gill; Sa. supra-anal aperture.

rows of elongate papillae along the border. Anal aperture about $\frac{3}{4}$ the size of the branchial, dark brown in colour and with a single row of minute papillae on its margins, supra-anal distinct, smaller than the anal and separated from it by a mantle connection about half the size of the anal. Marsupium formed by all the four gills.

Trapezoideus misellus (Morelet).

1900. *Trapezoideus misellus*, Simpson, *op. cit.*, p. 859.
 1914. *Trapezoideus misellus*, Simpson, *op. cit.*, pp. 1182, 1183.
 1915. *Trapezoideus misellus*, Preston, *op. cit.*, p. 194.

Mr. S. L. Hora picked up a dead shell of a half-grown specimen of this species at the edge of a swamp about five miles from the Thoubal Stream in the Manipur Valley.

The shell is quite typical in shape and hinge, but does not show any sculpture owing to the umbones being eroded.

The species was previously known from Siam, Tenasserim and Burma only.

Trapezoideus dhanushori, sp. nov.

This interesting species was found by Mr. S. L. Hora in a stream known as Dhanushori at a distance of about a mile from Dimapur, Assam, and is not a Manipur species. It may be described as follows:—

Shell (fig. 31) rather small, thin, trapezoidal, somewhat compressed, with a low posterior ridge and narrow wing. Umbones small, slightly tumid and deflexed inwards, sculptured with vertical ridges radiating outwards, more marked on the two sides than in the middle where they are less distinct. Anterior margin obliquely truncated rounded above, sharply curved backwards below; broadly rounded posteriorly. Ventral margin straight but slightly curved in near the middle. Surface concentrically sculptured with deeply impressed lines, a few radial lines are also to be

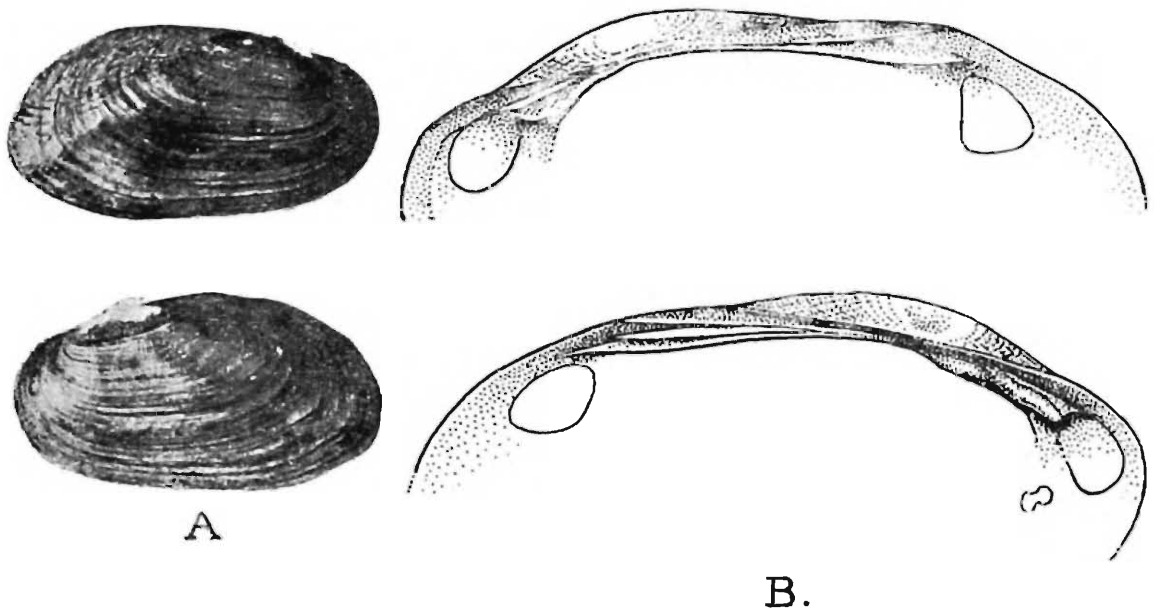


FIG. 31.—*Trapezoideus dhanushori*, Prashad.

- A. Photographs of the two valves of the type-shell.
B. Hinge-teeth.

seen on the posterior region. Epidermis brownish yellow. Right valve with two pseudo-cardinals, of which the outer is feebly developed, and a single slightly arched lateral; left valve with two pseudo-cardinals, of these the inner situated under the beak and continuous with the outer of the two laterals. Muscle-scars fairly impressed, anterior ones separate, posterior confluent; nacre greyish-yellow tinged with blue, under the beaks markedly yellow; slightly iridescent.

Measurements of Shells (in millimetres).

	1	2	3
Length	35.5	34.1	35.4
Breadth	19.7	17.3	18.2
Height	13.2	11.6	13.4

Type-series.—No. M 11962/2 in the Zool. Surv. Ind. (*Ind. Mus.*)

The soft parts conform to the description of the genus given already.

The type-series was collected in the Dhanushori stream in Assam.

T. dhanushori bears some superficial resemblance to *T. foliaceus* (Gould), but differs in the comparatively more elongate shell, more evenly rounded anterior margin, poorly developed posterior wing and more prominent umbones. The hinge also is different in the two species.

Family CYRENIDAE.

Genus *Corbicula*, Megerle.

This genus is represented in the collection by three species. Of these *C. striatella* is common throughout India and Burma, *C. occidens* has a wide distribution in the Central Provinces, United Provinces, Bengal, Bihar and Orissa. Sikkim and Assam, while the exact habitat of *C. subradiata* was hitherto unknown.

The only account of the anatomy of any of the Indian species is contained in a recent paper¹ by myself on the soft parts of *C. fluminalis*—the type-species of the genus. The soft parts of the three species here discussed are very like those of *C. fluminalis*; the differences from it are included in the notes on the different species.

Corbicula occidens, Deshayes.

1854. *Corbicula occidens*, Deshayes, *Cat. Brit. Mus. Conchifera*, p. 223.

1900. *Corbicula occidens*, Preston, *op. cit.*, p. 216.

The range of distribution of the species according to Preston is "Sikkim, Moradabad, Bengal," but in the collections of the Indian Museum there are specimens from various places in the Central Provinces, Bihar and Orissa, and Assam in addition to the localities given by Preston.

The only point of interest to note in connection with the shell is the slightly discontinuous pallial line. The line runs down as a vertical straight line from the lower edge of the impression of the posterior adductor muscle, and this part forms a little more than a right angle with its horizontal continuation forwards to the scar of the anterior adductor muscle. This condition is a little more advanced than that in *C. largillierti* figured by Prime² and is correlated with a better development of the siphonal muscles.

The soft parts generally resemble those of *C. fluminalis* described in the paper cited, but differ in having the siphonal muscles, the siphons and the foot a little better developed, in the inner pair of gills being much broader (about one and a half times)

¹ *Rec. Ind. Mus.* XVIII, pp. 209-211 (1920).

² *Ann. Lyceum Nat. Hist. N. York* VIII, d. 420, fig. 4 (1867).

than the outer and the outer pair being a little shorter in length. The palpi, however, are comparatively larger.

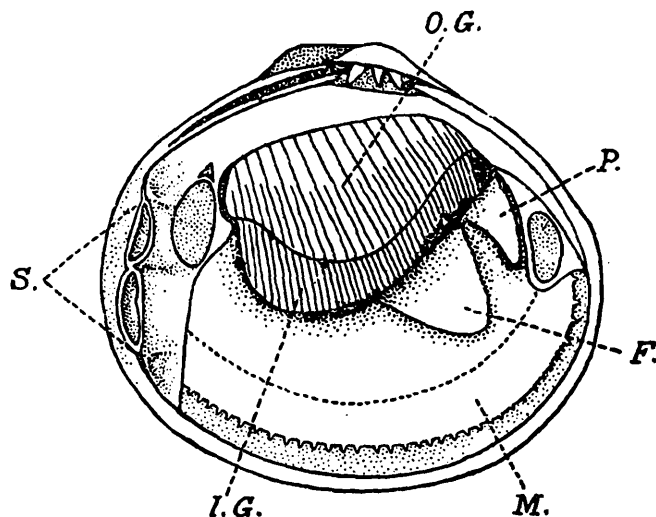


FIG. 32.—Soft parts of *Corbicula occidens*, Deshayes.

F. foot; *I.G.* inner gill; *M.* mantle; *O.G.* outer gill; *P.* palp; *S.* siphons.

Many specimens of this species were obtained by the Manipur Survey party from a muddy channel flowing into the Loktak Lake near Potsengbam Bungalow. Specimens were also collected from various other streams in the Manipur Valley.

Corbicula striatella, Deshayes.

1854. *Corbicula striatella*, Deshayes, *Proc. Zool. Soc. London* XXII, p. 344.

1867. *Corbicula striatella*, Prime, *Ann. Lyceum Nat. Hist. N. York* VII, p. 74, fig. 22.

This species is not confined to Pondicherry and Sind as Preston states, but is fairly common all over India. The only specimens in the present collection are from a small stream near Waikhong on the Manipur-Burma Road.

The sinus of the pallial line is much better marked in this species than in *C. occidens*, and the siphons and siphonal retractor muscles are accordingly much better developed and distinctly marked off from the pallial muscle. I hope to elaborate this point for the other Indian species in another place.

The soft parts, except for the differences noted above, are like those of *C. occidens*.

Corbicula subradiata, Prime.

1867. *Corbicula subradiata*, Prime, *op. cit.*, p. 75, fig. 23.

1915. *Corbicula subradiata*, Preston, *op. cit.*, p. 213.

The precise locality from which the type-specimens of this species were obtained is not given by Prime. In the *Conchologia Indica* Hanley and Theobald state that they never obtained any specimens of this species and consider it and *C. agrensis* to be prob-

ably based on immature specimens. In the Manipur collection there are specimens from small streams near Potsengbam and from a large shallow artificial tank called Ningyang Pukri at Imphal. All these specimens closely agree with Prime's description and figures and are sexually mature. The shell in this species is rather small and apparently does not grow larger than 15 mm. in length. The pallial line is a regular curve and does not show any sinus.

The soft parts resemble those of the other two species described already, but differ in the poor development of the siphonal retractor muscles and the siphons.

Genus *Sphaerium*, Scopoli.

1900. *Sphaerium*, Preston, *op. cit.*, pp. 223, 224.

Three species of this genus have hitherto been described from India; of these *S. indicum* is a widely distributed species both in



FIG. 33.—Hinge teeth of *Sphaerium*.

A. *S. indicum*, Deshayes.

B. *S. austeni*, Prashad.

the plains and in the Himalayas, while *S. avanum* is only known from Ava and Pegu in Burma. The third species, *S. montanum*, Tapparone-Canefri,¹ is only known from Burma but the original description is not sufficient to identify this species. In the collections of the Indian Museum I have found specimens of an undescribed species from the Naga Hills and Manipur, probably from the collections made in these parts by Lt.-Col. H. H. Godwin-Austen. The three species before me may be distinguished from one another by the use of the following key:—

1. Shell large, 9.5 mm. in length, much swollen, with very prominent umbones and with strongly impressed concentric sculpture *S. avanum*.
2. Shell smaller and not so much swollen as in *S. avanum*.
 - a. Shell ovato-rhomboid, thin and translucent, with the umbones only slightly prominent and with very faint sculpture *S. indicum*.

¹ *Ann. Mus. Civ. Stor. Nat. Genova* (2) VII, p. 356 (1889), see Addendum, p. 630.

- b. Shell elongate-ovate, rather thick and opaque, with the umbones more prominent than in *S. indicum*, but much less so than in *S. avanum*; sculpture better marked than in *S. indicum* *S. austeni*.

Sphaerium indicum, Deshayes.

1854. *Sphaerium indicum*, Deshayes, *Proc. Zool. Soc. London* XXII, p. 342.

1915. *Sphaerium indicum*, Preston, *op. cit.*, p. 224.

Preston is certainly mistaken in assigning this species to A. Adams and in considering Deshayes' name as a manuscript name only, for the reference to the original description of the species cited above and noted by Preston is a paper by Deshayes on new species of shells in Cumming's collection, and not by A. Adams as Preston states. A paper by A. Adams is published immediately preceding that of Deshayes and Preston apparently confused them when citing the references.

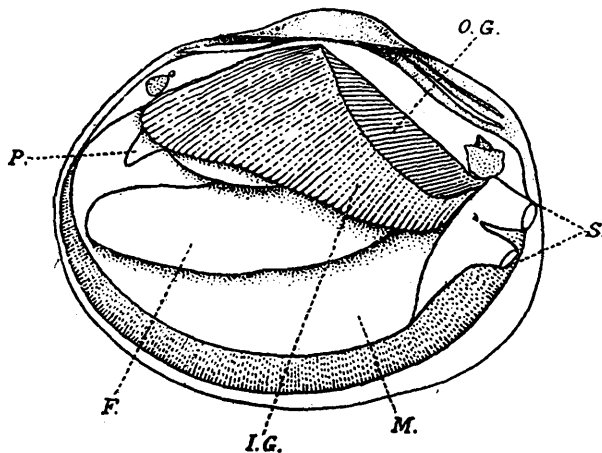


FIG. 34.—Soft parts of *Sphaerium indicum*.

F. foot; *I.G.* inner gill; *O.G.* outer gill; *M.* mantle; *P.* palp; *S.* siphons.

The hinge of this species differs from that of my new species, described further on, in the laterals being much better developed and less curved and in there being a single well-developed cardinal in the right valve, the second cardinal of this valve is much reduced or even absent in some specimens.

The soft parts of this species are described in detail below as no account of the anatomy of Indian species has been published before.

The animal conforms in shape to that of the shell and is of a whitish colour. Of the adductor muscles, the anterior is rather small and rounded while the posterior is much larger and somewhat quadrangular in outline. The posterior retractor pedals are well developed and lie above the posterior adductors. The pallial muscles consist of radiating muscle-fibres starting from just below the pallial attachment and are continued in the inwardly reflected region of the mantle. No siphonal retractors can be distinguished from the pallial fibres.

The mantle is very thin and without any papillae on the edge. Its flaps differ from those of the genus *Corbicula* in having a fairly broad portion of the free edge reflected inwards towards each other. The siphonal and pedal orifices are formed in the same way as in *Corbicula* by the union of the flaps of the two sides.

The two siphons, anal and branchial, are quite separate tubular structures capable of a fair amount of elongation; of the two the branchial is much better developed. Both siphons have smooth edges for the external openings, there being no papillae encircling them. Jacobsen¹ describes the siphons as having "filaments encircling the apertures," this seems to be a mistake as none are present in *S. indicum* and none are shown for the American species described and figured by Gilmore;² Fischer³ also describes the orifices of the siphons in this genus as simple.

Jacobsen's account of the gills in *S. cornea* is inaccurate when he says that "the interior gills overlap the exterior ones," and a good deal of what he says further on is not easy to follow. F. Leidig's⁴ and Oscar Schmidt's⁵ papers contain very little on the structure of the gills of the European species dealt with by them. I have not seen Drew's paper⁶ on the anatomy of *S. sulcatum* but from the summary in Gilmore's paper cited already these two accounts seem to be the best ones available. Gilmore's description of the attachment of the inner lamellae of the inner gills, however, does not appear to be accurate when he says "the inner lamella of the inner gill is attached to the body," for in *S. indicum*, as is usual in other Cyrenids, at least a portion of the inner gills (in this case nearly one-fourth of the total length) projects beyond the posterior limit of the body-mass. This posterior part of the inner lamella is not fused with that of the corresponding part of the lamella of the opposite side but is quite free. The two pairs of gills differ in length and width. The inner pair of gills is more than twice as broad as the outer throughout, while in the anterior region it is still broader, anteriorly it also extends a little further than the inner pair of gills.

In the specimens examined the marsupium was found to be formed by the cavities of the filaments of the inner pair of gills only, as was observed by Gilmore in the American species. The Manipur specimens were collected during February and March, 1920, and it appears, therefore, from the stage of development of the embryos in the brood-pouches that the breeding season of this species in Manipur starts some time in January if not earlier.

The labial palps are triangular, slightly elongate structures partly covered over by the anterior portion of the inner pair of

¹ *Proc. Roy. Dan. Soc. Nat. Hist.* III (1828), translated by Prime in *Bull. Mus. Comp. Zool. Harvard* V, pp. 49-54, pl. iii (1878).

² *Nautilus* XXXI, pp. 16-31, pls. v, vi (1917).

³ *Man. de Conchotirol.*, p. 1093 (1887).

⁴ *Müller's Arch. Anat. Physiol.* pp. 47-66, pl. vi, figs. 8-18 (1855).

⁵ *Ibid.*, pp. 428-439, pl. xvi (1854).

⁶ *Proc. Iowa Acad. Sci.* III (1895).

gills. The oesophageal region is short and curves back to open into the spacious stomach. The intestinal region is comparatively short without any loops, and after a postero-dorsal course curves back to form the rectum, which after passing through the pericardium curves down to open at the anus just behind the posterior adductor muscle. The liver is large and well developed, the greater part of it lying within the umbonal region. The foot is a very elongate, tongue-shaped structure in continuation of the abdominal mass and has the statocyst lying just a little below the boundary line between the abdominal mass and the foot.

The nervous and reproductive systems are quite similar to those of *Calyculina* figured by Gilmore.

The species is quite common in the Manipur Valley, and a large number of specimens was collected by the Manipur Survey party from various streams and ponds in different places.

Sphaerium austeni, sp. nov.

Shell elongate-ovate, swollen, sub-equilateral, comparatively thick, opaque; anterior margin small, broadly rounded; posterior margin truncated, nearly straight; lower border somewhat curved. Umbones prominent, somewhat swollen, incurved and nearly touching each other in the middle. Epidermis rather smooth in young, with closely situated concentric striae in full-grown specimens; of a dark horny to a yellowish-brown in colour, shining, and with a distinct pale band along the margin.



FIG. 35.—Shell of *Sphaerium austeni*, sp. nov.

Nacre whitish to light blue. Right valve with two lamellar laterals, of which the lower is better developed and has a broad triangular flange projecting inwards and upwards, and with two cardinals, of which the anterior is large and triangular and the posterior small and rounded. Left valve with a single lateral on each side and two cardinals, the anterior rounded and pad-like and the posterior small, thin and lamellar.

Measurements of Shells (in millimetres).

	A.	B.	C.
Length	9.4	7.5	5.8
Breadth	7.3	5.6	4.6
Thickness	5.7	3.4	2.9

Type-series.—M 7141-8/1 Zool. Surv. Ind. (*Ind. Mus.*).

The type-series is from the Naga Hills, Assam, and was probably collected by Lt.-Col. H. H. Godwin-Austen, with whose name I have associated the species. There is also another series of this species from Manipur in the Indian Museum.

The species though closely allied to *S. indicum* differs from it in the relative length and breadth of the shell, in the umbones being more swollen, in hinge-structure and the sculpture of the shells.

Genus *Pisidium*, Pfeiffer.

1913. *Pisidium*, Woodward, *Cat. Brit. Species of Pisidium*, pp. 1, 2.
 1915. *Pisidium*, Preston, *op. cit.*, pp. 224, 225.

The Indian species of this genus are very imperfectly known, the descriptions of older authors being incomplete. A revision of the Indian species is in preparation and will be published separately; here I have only assigned the Manipur specimens to their proper species.

Pisidium clarkeanum, G. and H. Nevill.

1871. *Pisidium clarkeanum*, G. and H. Nevill, *Fourn. As. Soc. Bengal* XL, p. 9, pl. i, figs. 4, 4a-d.
 1915. *Pisidium clarkeanum*, Preston, *op. cit.*, p. 225.

The original description of the species by G. and H. Nevill, as was pointed out by Theobald,¹ is inaccurate in that the authors have wrongly described the posterior side as longer instead of the anterior; their figures, however, show the posterior side as the shorter of the two.

In the Manipur collection there is a single specimen of this species collected by the Survey Party at Potsengbam near the edge of the Loktak Lake. I assign this single specimen to this species with confidence as I have compared it with the types, which are in the collection of the Indian Museum.

Pisidium hydaspicola, Theobald.

1878. *Pisidium hydaspicola*, Theobald, *Fourn. As. Soc. Bengal* XLVII, p. 147.
 1915. *Pisidium hydaspicola*, Preston, *op. cit.*, p. 225, fig. 27.

The species was originally described from Shupion in Kashmir, but there is a specimen of it from Bhagalpur, Bihar, and Mr. S. L. Hora also collected many specimens in a stream near the Yaribuk Bungalow and also from small streams on the road to Shugui from Wai-khong in the Manipur Valley.

Most of the specimens are very small. Of those in spirit some are gravid. An account of their anatomy will be published along with the revision of the genus.

¹ *Fourn. As. Soc. Bengal*, XLV, pt. ii, p. 188 (1876).