

## No. II—THE INDIAN GENERA OF VIVIPARIDAE.

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Until recently all the Indian species of this family have been placed in the genus *Vivipara*, Montfort; but in 1918<sup>1</sup> I separated certain forms from Upper Burma and the Shan States under the name *Taia*, while still more recently<sup>2</sup> I have described three fossil or subfossil subgenera of this genus from the same country. In the present paper I give reasons for regarding one of these (*Temnotaia*) as generically distinct and put on record the occurrence of a living species in Upper Burma. An examination of the animal of Benson's *Paludina lecythis* proves that it and its allies must also be separated from *Vivipara*. I propose for them the new generic name *Lecythoconcha*.

*Key to the Indian Genera of Viviparidae.*

1. Columellar callus of shell broad and plate-like.
  - A. Sculpture usually consisting of prominent nodular, squamose or spinulose spiral ridges and of coarse longitudinal striae. Operculum with an internal scar of oval or ovate outline and without a rounded boss in the centre of the scar. Mantle of adult with a rather feeble sphincter muscle and a smooth or lobular margin ... .. *Taia*.
  - B. Shell smooth or with incised spiral lines. Operculum as in *Taia*. Soft parts and radula unknown ... .. *Temnotaia*.
2. Columellar callus not plate-like. Sculpture minute or including smooth spiral ridges.
  - A. Shell of small or moderate size, conical or conoidal. Operculum as in *Taia*. Mantle with the sphincter muscle moderately developed and prominent; its margin bearing in the young well-developed digitiform processes, which persist in the adult of some species ... .. *Vivipara*.
  - B. Shell large and globose. Operculum with a well-defined funnel-shaped pit on the external surface corresponding to a smooth, prominent rounded boss in the centre of the internal muscular scar, which is ring-shaped and poorly developed. Mantle sphincter very strong and prominent; mantle itself greatly thickened and highly muscular, bearing three digitiform processes in the young, smooth in the adult ... .. *Lecythoconcha*.

An examination of the mantle in these genera shows that it provides good generic characters. In all it is highly vascular, but in *Taia* and *Vivipara* it is thin and has a comparatively feeble musculature, while in *Lecythoconcha* it is much thickened and has both longitudinal and transverse muscles very strongly developed. In all three genera the transverse muscles are congregated on the outer surface a short distance above the margin. It is probable that all the Oriental species of the family have digitiform pro-

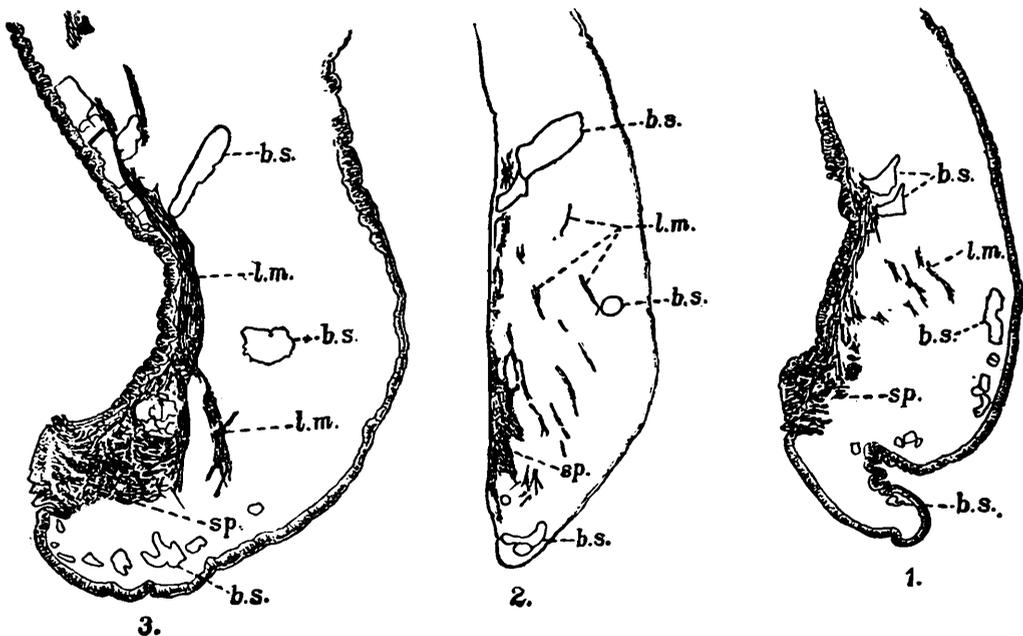
<sup>1</sup> *Rec. Ind. Mus.*, XIV, p. 123 (1918).

<sup>2</sup> *Rec. Geol. Surv. Ind.*, L, p. 231 (1919).

cesses<sup>1</sup> on the extreme edge of the mantle in the young. In those species in which the shell of the adult possesses smooth spiral ridges of a dark colour (notably *Vivipara oxytropis*) the processes persist in the adult, but in those that have smooth unicolourous shells they become small and inconspicuous or disappear altogether. In *Taia*, in which the spiral ridges are never quite smooth, but as a rule nodular, squamose, or even spinulose, there are no such processes in the adult, and they are also absent in the somewhat similar Chinese genus *Margarya*, but apparently temporary lobes of the mantle-edge can be thrust into the small concavity at the base of each nodule, scale or spine. I hope to elaborate this point on another occasion.

### Genus *Vivipara*, Montfort.

This genus is so well known that it is unnecessary to give a full description. The Indian species fall naturally into four



Vertical sections through the mantle-edge of Indian Viviparidae.

1. *Vivipara oxytropis*. 2. *Taia intha*. 3. *Lecythoconcha lecythis*.  
b.s. blood-space; l.m. longitudinal muscle; sp. transverse sphincter.

groups, which may be named after the type-species of each as follows:--

**VIVIPARAE BENGALENSES.** The shell is normally of moderate size, occasionally large, as a rule thin but thickened in certain phases. The whorls of the spire are not greatly swollen and the suture is not deeply impressed. The outline is ovate, but varies considerably. Spiral bands darker than the rest of the shell are always present, though sometimes obsolescent. They are never very numerous and vary considerably in breadth. In some forms these bands become thickened to form ridges and there is often a

<sup>1</sup> I can find no reference to these processes in the European forms. Erlanger (*Morph. Jahrb.*, XVII, pl. xxii: 1891), and other authors figure the edge of the mantle in the fully formed embryo as smooth.

tendency for the outline of the body to become biangulate owing to two of them assuming the form of carinae. Corresponding to these bands there are on the edge of the mantle an equal number of small digitiform processes. The operculum is thin, sharp round the periphery and with the internal muscular scar moderately developed. The radular teeth are normal. Their denticulations are by no means large and the central lobular process of the free edge of the central tooth is broad and quadrate or triangular.

I believe that all described Indian forms<sup>1</sup> of this group can be comprised in the single species *Vivipara bengalensis* (Lamarck), of which several distinct races and phases can be distinguished. Major Sewell and I hope to describe it in detail shortly. It is found in all parts of the plains of the Indian Empire at which there is perennial still water.

**VIVIPARAE OXYTROPIDES.** The shell is large or small, thin, acuminate and more or less distinctly biconical. The whorls of the spire are not at all swollen and the suture is less impressed than in *V bengalensis*. Dark spiral bands are present. They are always more or less thickened, at any rate in the young, and in the typical species form prominent ridges in the adult. The peripheral band forms a prominent keel, separating the shell into two regions. The region below it is obliquely flattened on the ventral surface. The operculum and radula resemble those of *V bengalensis*, but in the typical species the marginal processes of the mantle are much larger in the adult.

Only one species of this group has as yet received a name, viz. *V oxytropis* (Benson), but another, smaller and less specialized species, awaits description. The former is apparently endemic in the Manipur valley, while the latter occurs in the plains of the eastern part of Assam.

**VIVIPARAE DISSIMILES.** The shell is always small, rather high and narrow, never very sharply acuminate, moderately thin or thick, with the whorls of the spire swollen and the suture deeply impressed. There are no dark spiral bands or prominent spiral ridges, but a minute spiral sculpture of punctured lines can often be detected. There is often a broad but rather obscure pale transverse bar on the body-whorl. The operculum is thicker than in the other three sections and the muscular scar better developed. Round the periphery of the operculum there is often a thickened spongy ridge. The edge of the mantle is smooth in the adult. The central lobe of the central tooth of the radula is rounded.

Most of the forms that belong to this group are classified by Nevill<sup>2</sup> as varieties of *V dissimilis* (Müller), but I think that he has included several species. Pilsbry<sup>3</sup> regards the characters of the operculum as subgeneric and has given the subgeneric name

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<sup>1</sup> *V. nagaensis*, Preston may be distinct, but I have not seen the species. I have another (undescribed) from Manipur.

<sup>2</sup> Nevill, *Hand List Moll. Ind. Mus.*, II, pp. 27-30 (1885).

<sup>3</sup> Pilsbry, *Proc. Ac. Nat. Sci. Philadelphia*, LIII, p. 188 (1901).

*Idiopoma* to a Burmese species, *V. henriadensis*. These characters, however, are adaptive and are not found either in all species of the group, or even in all individuals of the species in which they are present. They are connected with the habit of aestivation in drying mud, the Viviparæ dissimiles being found mainly in bodies of water liable to desiccation. The species are widely distributed in the plains of Peninsular and North-Western India and in the drier regions of Burma.

VIVIPARÆ SINDICAE. Shells of this group are distinguished by their very pale colour, by the absence of distinct spiral bands and by the thinness of the operculum, in which the muscular scar is very feebly developed. Nothing is known of the anatomy.

The only Indian species is *V. sindica* (Nevill) from Sind, but another occurs in Seistan. Kobelt has caused great confusion in the *Conch. Cab.* by basing his description<sup>1</sup> and figures of this form on the type-series of Nevill's *Paludina dissimilis sindica*, which I regard as a distinct species, and conversely describing and figuring specimens from Seistan as *sindica*. His *hilmendensis* is, therefore, an absolute synonym of *sindica* (Nevill). I propose for the Seistan species the name *V. helmandica*.

#### Genus *Lecythoconcha*, nov.

*The shell* is of large, sometimes of relatively gigantic size, but never very thick, it is smooth or with obscure and never very prominent sculpture and always translucent when fresh; it is globose in form, with broad swollen whorls, and often bears a striking superficial resemblance to that of *Pachylabra* (Ampullariidae). The colour is uniform or nearly so, as a rule rather bright olive green, often with irregular blackish longitudinal lines. The aperture is large and patent, subcircular or broadly ovate. The columellar fold is not strongly developed, the umbilicus narrowly perforate and the outer lip thin.

*The operculum* is large, thin, horny, stiff and brittle. Externally it is marked with fine but prominent concentric ridges and bears a deep, funnel-shaped pit in a subcentral position. On the internal surface this pit is represented by a smooth, prominent rounded boss, which is surrounded by a smooth or minutely granular area representing the muscular scar.

*The animal* differs from that of *Vivipara* in the greatly thickened and very muscular free edge of the mantle, the sphincter muscle running along it is very prominent and unusually well developed. There are three marginal processes in the young, but none in the adult.

*The radula* is identical with that of *Vivipara*.

*Type-species.* *Paludina lecythis*, Benson.

*Geographical Range.* The range of the genus probably extends from Manipur (and possibly Sylhet) in the west through

<sup>1</sup> This description was originally published in *Nachr. Malak. Ges.* LX, p. 161 (1908).

Upper Burma and across China to the Philippines, Formosa and Japan, but I am not sure as to the generic identity of some of the Far Eastern species.<sup>1</sup> The only one of those of which I have been able to examine the soft parts is *Vivipara chinensis* (Gray) from Yunnan. This species, from which I regard *L. lecythis* as specifically distinct, agrees in the structure of the mantle and operculum with the type-species of the new genus.

All the Asiatic genera of the Viviparidae are closely similar in anatomy, but the structure of the mantle-edge and its sphincter is characteristic.

#### Genus *Taia*, Annandale.

1918. *Taia*, Annandale, *Rec. Ind. Mus.*, XIV, pp. 123, 160.

1919. *Taia*, *id.*, *Rec. Geol. Surv. Ind.*, L, p. 231.

I have already discussed this genus in the papers cited and here need only give my reasons for regarding the subfossil *Temnotaia incisa* as generically distinct. In the key on page 111 I have pointed out the distinctive characters of the mantle.

#### *Temnotaia*, Annandale (1919).

1919. *Temnotaia* (subgenus of *Taia*), Annandale, *Rec. Geol. Surv., Ind.* L, p. 231.

The discovery of a recent specimen<sup>2</sup> of *Temnotaia* in the old collection of the Indian Museum renders it advisable to enlarge the original description slightly and to separate the species generically from *Taia*.

The shells of the genus thus proposed are rather narrowly ovate, externally smooth and without prominent spiral sculpture but bearing rather coarse longitudinal striae and either microscopic spiral striae or well-defined incised lines. There are 5½ to 6½ whorls, and the spire is exserted and acuminate. The mouth of the shell is ovate, with the outer lip thin and not at all expanded and the columellar margin flattened, plate-like and polished, resembling that of *Taia*. In the only fresh specimen examined there are no dark spiral bands and the external surface is highly polished. The operculum is thin and resembles that of *Taia*. Nothing is known of the radula or soft parts.

Only two species have as yet been discovered, namely *T. incisa* (Annandale), found in an apparently subfossil condition in the Chindwin watershed, and *T. bhamoensis* (Nevill) from north-eastern Burma. The genus may thus be regarded as characteristic of the fauna of Upper Burma. It is apparently related to the Indo-Chinese *Chlorostracia*, Mabile, but the shell is much less globose and the mouth narrower.

<sup>1</sup> For one, the common species in Lake Biwa, Japan, I am proposing a new genus in a paper to be published in the *Journal of the Asiatic Society of Bengal*.

<sup>2</sup> This specimen is labelled as the type-specimen of Nevill's *Paludina dissimilis*, subvar. *bhamoensis*, but the resemblance to the Viviparæ dissimilis is quite superficial and the structure of the mouth entirely different.