

PART III.—SYSTEMATIC.

By N. ANNANDALE.

The smooth-shelled dark-banded *Viviparæ* of India and Burma have given difficulty to all conchologists who have discussed them in a comprehensive spirit. This is because the shells are both variable individually and plastic in relation to environment. Local races are also liable to become differentiated, and we find a number of forms that appear at first sight to be specifically distinct but are actually linked together, as becomes evident where a sufficient number of specimens are examined, by innumerable intermediate types. Nevill in his unfinished *Catalogue of Mollusca in the Indian Museum* (1877), of which the only fragment published dealt with the Ampullaridae and Viviparidae, and in his later but also unfinished *Hand List of Mollusca in the Indian Museum* (1885), included most of those forms, with several others, as varieties and subvarieties under the name *Paludina bengalensis*. So far as the species found in India proper are concerned, I believe that his judgment was in the main just, but the forms he assigned in 1885 to *cingulata* (from Assam) and *polygramona*, von Martens, I regard as specifically distinct.

Under the specific name *Vivipara bengalensis* I include all the Indian forms of the genus with dark-banded shells, except the *Viviparæ oxytropides*, undescribed species from Manipur and Preston's *Vivipara nagaensis*, the last of which I have not seen. Of *V bengalensis* I recognise the following forms:—

Race <i>bengalensis</i> (Lamarck).	Race <i>colairensis</i> , nov.
Race <i>mandiensis</i> , Kobelt.	Phase <i>annandalei</i> , Kobelt.
Race <i>nepalensis</i> , Kobelt.	Phase <i>halophila</i> , Kobelt.
Race <i>balteata</i> (Benson).	Phase <i>incrassata</i> , nov.
Race <i>doliaris</i> (Gould).	Phase <i>pachydolicha</i> , Annandale.
Race <i>eburnea</i> , nov.	

***Vivipara bengalensis* (Lamarck).**1822. *Paludina bengalensis*, Lamarck, *Anim. s. Vert.* VI (2), p. 174.1920. *Vivipara bengalensis*, Annandale, *Rec. Ind. Mus.* XIX, p. 113.

The shell is ovate as a whole, sharply acuminate and with a relatively large subcircular or almost rhomboidal mouth, which is never very oblique. The upper part of the shell is slightly conoidal rather than strictly conical. There are $5\frac{1}{2}$ to $6\frac{1}{2}$ whorls, the suture is narrowly impressed and the whorls are somewhat but never very greatly swollen. The spire is relatively large, usually a little shorter than, but occasionally longer than the body-whorl. Its whorls increase in size evenly and gradually. The body-whorl is slightly oblique and always considerably broader than high, as seen in dorsal view. In this view it expands but slightly towards the

outer margin. The umbilicus is narrowly perforate or completely closed, rarely more open, the columella is strongly arched, with a narrow margin and by no means prominent, the outer lip is almost semicircular, sharp, thin and joined to the columellar margin above as a rule merely by a thin, glary deposit. In the adult shell the sculpture consists of fine longitudinal ridges, which are convex outwards and on the body-whorl sometimes take the form of fine irregular ribs or varices. Only traces of spiral sculpture can as a rule be distinguished on adult shells, but the young shell bears rows of very fine punctae, representing the bases of minute chaetae. The colouration varies considerably, but is always some shade of greenish-olivaceous, marked with dark spiral bands. These are as a rule narrow, but broader bands alternate with still narrower, often paler linear ones of the nature of 'shadow stripes.' The bands are occasionally rendered obsolescent, though rarely or never quite obsolete, either by a general deposit of dark pigment or by an incomplete albinism. The fully developed mouth usually has a narrow black rim.

The operculum is moderately thin and of a deep brownish colour. The external surface is concave as a whole. The outer margin is strongly curved, the inner margin slightly sinuate and the posterior extremity bluntly pointed. The muscular scar is moderately large and prominent, much deeper in colour than the rest of the operculum.

In all races two types of shell can be found. They may be called the normal type and the elongate. In the former the shell is considerably more globose, broader in proportion to its height, with a larger mouth and a shorter spire than in the other. The difference is not sexual, but apparently dimorphic. In most races the normal type is much the commoner, but in the phase *annandalei* the proportionate numbers of the two are reversed, and this is also so in the race *balteata*. In the race *colairensis* the normal type is about as elongate as the elongate type in the *forma typica*, but shells of a still more elongate type are also found occasionally.

In the *forma typica* and in the race *mandiensis* a third type of shell is sometimes found. It may be called the gigantic type, for its characters are great size, more swollen whorls, broader umbilicus and more projecting mouth. Sometimes, especially in large marshes, this type shows a tendency to predominate and almost assumes the rank of a phase.

Yet a fourth type occurs, much more rarely than the others, namely, the canaliculate, in which the outline is extremely broad and the surface outside the suture deeply impressed. Single shells of this type have been found in the *forma typica* and in the dark form of the race *eburnea*.

The elongate type of shell was called *Paludina elongata* by Swainson, the gigantic *P. gigantea* by Reeve and the canaliculate *P. bengalensis* var. *canaliculata* by Nevill, but I have avoided the use of these latinized names, for as a rule they apparently represent mere aberrations.

Soft parts.—As yet we know too little about the details of the comparative anatomy of the Viviparidae to say with certainty what characters in the soft parts are of specific importance, but the following four points may be noted wherein a definite anatomical difference exists between *V vivipara* and other species for which information is available :—

1. The marginal processes of the mouth are moderately well developed, less so than in *V oxytropis*, but more so than in the adult of *V dissimilis* and *V vivipara*. Three are much larger than the others.

2. The testis consists of a single lobe, not of two subequal lobes as in *V vivipara* or of a large primary lobe with an ill-developed second lobe as in *V dissimilis*.

3. The male tentacle is less differentiated than in *V vivipara*, but not less so than in *V dissimilis* and other Indian species examined.

4. The right pleural ganglion is almost completely fused with the right cerebral ganglion, whereas in *V vivipara* there is a short but distinct commissure.

Radula.—The radula is chiefly noteworthy for the following points :—

1. The teeth are moderately large and stout and have their denticulation well but not immoderately prominent.

2. The central is relatively large and considerably broader than long. Its distal margin is distinctly concave. The lobe in the middle of its cutting edge is quadrate, much broader than deep and relatively large. It has on each side of it at least five triangular denticulations, which are sharply pointed and decrease in size gradually from within outwards.

3. The two laterals and the marginal on each side are relatively broad and not very much longer than the central. Their denticulations are comparatively coarse and on the laterals closely resemble those on the central. On the marginal they are much finer and there are over twenty. The upper extremity of the edge of this tooth is usually expanded to form a small triangular process.

The foregoing description and observations are intended to apply to the species as a whole. I will describe separately the various races that occur in different parts of the Indian Empire, and then the phases, whose peculiarities are probably due to some physical factor in their environment acting directly on the individual, rather than to geographical isolation of the race.

The anatomy of the Viviparidae, so far as it has been studied, is strikingly uniform in most respects and little or no recognisable difference has been found in the different forms of *V bengalensis* so far as the radulae and soft parts are concerned. In the radular teeth slight racial peculiarities might perhaps be found, but they are so ill marked that it would be misleading to lay stress upon them.

The different local races of *V bengalensis* have the following distribution. The *forma typica* is peculiar to the lower Ganges

valley. Westwards it is replaced, apparently quite gradually, by *mandienseis* and southwards by *eburnea*. The race *nepalenseis* occupies the base and lower valleys of the Eastern Himalayas from Nepal to the east of Assam, but in the plains of Assam is gradually replaced by *balteata*, which in its turn gives way to *doliaris* in the valleys of Burma. In no instance is it possible to draw a precise line, either structural or geographical, between the different races.

The form that I have called race *colairensis* differs from the others here recognised as races, in that it has been found only in one locality. A large number of individuals were, however, examined and the racial characters seem to be remarkably distinct.

In a sense two (*incrassata* and *pachydolicha*) of the four phases here recognised, are modifications of the local race *eburnea* rather than of the species as a whole, but in the other two (*annandalei* and *halophila*) the phase-characters mask the racial ones and the phase is found in the territory of more than one race.

For these reasons I have carefully avoided a specious appearance of precision in defining the diagnostic characters of races and phases. I have also refrained from giving measurements of individual shells. These I have found most misleading in diagnosis, the differences in form depending not so much on point to point measurements as on the curvature and inclination of the outlines. Such differences can be properly demonstrated only by good figures. Unless it is otherwise stated, I have examined large numbers of specimens of each race and phase from several or many localities.

Race *bengalensis* (Lamarck).

(Plate I, figs. 1-3.)

1822. *Paludina bengalensis*, Lamarck, *Anim. s. Vert.* VI (2), p. 174.
 1822. *Paludina elongata*, Swainson, *Zool. Ill.* Ser. I, II, pl. xcviij.
 top.
 1841. *Paludina bengalensis*, Delessert, *Rec. de Coquilles*, pl. 31, figs.
 2a, 2b.
 1852. *Paludina bengalensis*, Küster, in Martin and Chemnitz's *Conch.*
Cab., *Paludina* I, p. 17, pl. 3, figs. 15, 16.
 1862. *Paludina bengalensis* and *P. gigantea*, Reeve, *Con. Icon.*, pl. ii,
 figs. 5a, 5b, and 7.
 1876. *Paludina bengalensis*, and *P. bengalensis* var. *gigantea*, Hanley
 and Theobald, *Con. Indica*, pl. lxxvi, figs. 8, 9, 10 and pl.
 lxxvii, fig. 5.
 1877. *Paludina bengalensis*, (Typical sect. in part) Nevill, *Cat. Moll.*
Ind. Mus., pp. 26-28.
 1885. *Paludina bengalensis* (in part), with subvar. *phaeostoma*, *elong-*
ata, *gigantea* and *canaliculata*, Nevill, *Hand List Moll.*
Ind. Mus., II, pp. 20, 21.
 1909. *Vivipara bengalensis*, Kobelt, in Martin and Chemnitz's, *Conch.*
Cab., *Paludina*, II, p. 271, pl. lv, figs. 1-4.

I regard the race found in the lower Ganges valley as the *forma typica* of the species. The typical shell of this race is about $1\frac{2}{3}$ times as high as broad and the spire and body-whorl as seen in dorsal view are about equally high. The whorls are rather tumid and the body-whorl is evenly convex in profile, not

biangulate. The mouth of the shell is sub-circular and has a narrow black margin when complete. It is nearly as high as the spire and very little oblique. The umbilicus is narrow. The colouration is never very brilliant. The ground colour is greenish and opaque. The dark bands are variable and irregular, but the alternating of broad and narrow bands can always be seen if the shell is clean. The bands are hardly incrassated. The interior of the shell is white.

The elongate type of shell occurs occasionally with the typical one. In it the height is about $1\frac{1}{2}$ times the maximum diameter. Its mouth is relatively small. The gigantic type is rarer than the elongate one, but occasionally occurs almost as a distinct phase. It is, however, also found with the typical form, apparently as an aberration.

Nevill has given the name subvar. *canaliculata* to a curious shell from Raniganj in Bengal. This specimen, which is the only one of the kind I have seen in this race, has a somewhat turbinate form and a broad, deeply impressed suture. It must be regarded as a mere abnormality.

This race is usually found in large ponds, marshes and backwaters with a properly aquatic vegetation. Where the vegetation is scanty the shells are usually dwarfed.

Race *mandiensis*, Kobelt.

(Plate I, figs. 4 and 10.)

1909. *Vivipara bengalensis*, var. *mandiensis*, Kobelt, *op. cit.*, p. 414, pl. lxxvii, figs. 8, 9.

This race is so like the *forma typica* that I have kept it distinct with some hesitation and only after ascertaining that the differences persist with fair constancy over a large territory. These differences, small as they are, are well shown on plate I. The spire is rather more conical and a little narrower than in the *forma typica*, the aperture not quite so broad, but more projecting, the umbilicus broader. There is great variation in colour, probably due to the nature of the water in which the animal lives. The shells in the type-series are pale, but have the alternating broad and narrow spiral bands well developed. Shells from Ambala in the plains of the Punjab are very similar. Specimens from shallow ponds in Lahore have the shell pale and translucent like opal glass, the periostracum extremely thin and evanescent and the dark markings often almost obsolete. In such specimens the animal is also very pale. Shells from the island of Bombay, on the other hand, are unusually brilliant in colouration, the ground-colour being bright olive-green and the bands well defined, dark and regular.

Type-series. No. M5081/1 Z.S.I

Geographical range.—The type-series is said to be from Mandi, a small native state high up in the Kangra valley in the Western

Himalayas, but the fauna of this district is mainly Palæarctic and the occurrence of *V bengalensis* needs confirmation. The specimens examined by Kobelt, moreover, agree precisely with those from the plains of the northern Punjab. The range of the race certainly extends from Allahabad at the junction of the Jumna with the Ganges to the northern limits of the plains of the Punjab on the one hand and to the shores of the Arabian Sea at Bombay on the other. It may be described as the common race of north-western India.

Both the "elongate" and the "gigantic" type of shell occur in this race occasionally, but the "normal" type is very much more common than either.

I have found this race in the Punjab in small ponds that in winter were extremely shallow and completely devoid of phanerogamic vegetation. In such environment the mollusc buries itself in the mud as the water dries up.

Race *nepalensis*, Kobelt.

(Plate I, fig. 7.)

1909. *Vivipara bengalensis*, var. *nepalensis*, Kobelt, *op. cit.*, p. 44, pl. xxlvii, fig. 10.

This race is rather more distinct from the *forma typica* than the preceding one, but many shells occur that would be difficult to assign to one race or the other and as a whole *nepalensis* merges so gradually into the still more distinct Assamese form *balteata* that it is impossible to draw a precise line between them. The shells are of moderate size, as a rule a little smaller than those of *bengalensis*. The whorls are more contracted and not so convex in outline, distinctly flattened as a rule outside the suture; the aperture is smaller, narrower and more pointed above and the umbilicus still narrower. The body-whorl often shows a tendency to become biangulate and the dark bands are sometimes incrasated. The colours are usually rather deep, but dull, and the bands are well developed.

The "normal" type of shell is much the commonest, but the "elongate" type occurs occasionally.

Type-series. No. M5080/1 Z.S.I.

Geographical Range.—The range extends from the Nepal valley along the base of the Eastern Himalayas as far east as Siliguri, below Darjiling. At or near this point the race merges into the Assamese race *balteata*. Specimens from Gauhati on the Brahmaputra, however, belong to it rather than to the latter. They are much more brightly coloured than specimens from Nepal.

I found the race common in ponds with submerged and floating vegetation at Gauhati.

Race *balteata* (Benson).

(Plate I, fig. 8.)

1836. *Paludina bengalensis*, var. *balteata*, Benson, *Journ. As. Soc Beng.* pt. 2, p. 745.
 1909. *Vivipara (bengalensis* var.) *balteata*, Kobelt, *op. cit.*, p. 415, pl. lxxvii, figs, 11-12.

Were all the shells of this race like the one figured by Kobelt, there would be little doubt as to the propriety of regarding it as specifically distinct; but his figure represents an extreme type, which, though common, is by no means universal in the race. My own figure (pl. I, fig. 3) represents a shell that goes almost to the opposite extreme. Both types are present in several series examined from Sylhet and the eastern parts of the Brahmaputra valley. It will be noticed that Kobelt's figure represents a small shell of the "elongate" type, mine a larger one of the "normal" type.

Most shells resemble the former. They rarely exceed 20 mm. in height and are narrow in proportion. The whorls are somewhat contracted, the aperture ovoid and the umbilicus closed. The dark bands are well developed and sometimes all of them are very narrow. They are frequently thickened and prominent. Shells of the "normal" type are often larger, with a very large sub-circular aperture. Their body-whorl is frequently almost biangulate, and the dark bands alternate in width. Intermediates between the two types are not uncommon. In both types, the shell is very thin and quite translucent when fresh. Specimens can often be found so similar to some of those of the Burmese race *doliaris* that they can hardly be distinguished from them. Others closely resemble Peninsular shells of the phase *annandalei*.

Geographical Range.—The headquarters of this race is the Sylhet valley in southern Assam, but it also occurs in the eastern part of the valley of the Brahmaputra. It is absent from Manipur. There are specimens in the Indian Museum labelled Siliguri but this is probably a mistake for Silcuri in Cachar, where Benson originally obtained specimens.

I am informed that this race is often found in flooded rice-fields.

Race *doliaris* (Gould).

(Plate I, fig. 9.)

1843. *Paludina doliaris*, Gould, *Proc. Bost. Soc. Nat. Hist.* I, p. 144
 1869. *Paludina digona*, Blanford, *Proc. Zool. Soc. London.*, p. 445.
 1876. *Paludina digona*, Hanley and Theobald, *op. cit.*, pl. cxv, fig. 7.

The most characteristic feature of this race is the one described in Blanford's name *digona*. The biangulate outline of the body-whorl is due to the presence of two spiral ridges which are merely dark bands thickened, but this feature is not equally developed in all individuals and in some is almost absent. In typical specimens the aperture is exceptionally large and wide, the columellar edge prominent, and the umbilicus rather broad;

but these characteristics are inconstant, especially in shells of the "elongate" type, which are found not uncommonly. In both this and the "normal" type, however, the shell is relatively broader than in the corresponding types in the *forma typica*, and the upper surface of the whorls is more or less broadly and obliquely flattened; the dark bands, which have the typical arrangement, are as a rule slightly incrassated and the aperture is subangulate, at any rate to a slight degree, at its outer and lower extremity. The size is usually larger than that of *balteata* but a little smaller than that of the *forma typica*.

In some respects the three eastern races (*nepalensis*, *balteata* and *doliaris*) represent a developmental series and would seem to indicate that there has been a tendency for the species to develop along certain lines as it proceeds eastwards, notably in the assumption of dark spiral bands of a prominent character and the special development of two of these bands as keels. A similar line of development can also be traced, but less completely, in the Peninsular phases of the species.

Geographical Range.—The race *doliaris* has its headquarters in the valley of the Irrawadi, down which its range extends at any rate from Bhamo to the delta. It is also found on the lower Siltang and probably on the lower Salween.

Race *eburnea*, nov.

(Plate II, figs. 1-2.)

In this race the shell is as a rule slightly narrower than in the *forma typica* and its aperture smaller; the body-whorl is also less enlarged and does not project outwards to the same extent in dorsal view. The whorls are narrow but distinctly flattened outside the suture and the body-whorl sometimes shows a tendency to become biangulate. The longitudinal striae are very fine and as a rule more regular than in *bengalensis* (s.s.), and strong traces of spiral sculpture can nearly always be detected with the aid of a good hand-lens. The aperture of the shell is slightly pyriform and the umbilicus is very narrow if not completely closed. The shell-substance when fresh has an ivory-like appearance. The outer surface is lightly tinged with yellowish olive and the spiral bands are never very dark. Sometimes they are obsolete, but traces of them can usually be found at any rate on the upper whorls and the alternating broad and narrow bands are often quite clear. Sometimes the dark bands coalesce on the body-whorl. The aperture never has a black rim.

Elongate shells are not uncommon and individuals intermediate between this type and the normal one occur more frequently than in the *forma typica*.

The animal in this race is pale olivaceous and has a peculiar translucent appearance, but the yellow spots characteristic of all races are never obsolete.

Type-series. No. M11960/2 *Z.S.I* (from the Keligiri reservoir Nellore district, Madras).

Geographical Range.—This is the race commonly found in the large reservoirs of the Madras Presidency and the central parts of India. It occurs in abundance as far north as Sambalpur in the interior of Orissa and has been collected occasionally in the south central parts of the Ganges valley. Specimens from the northern parts of its range are nearer the *forma typica* than those from the eastern districts of Madras. Nevill states (*Cat. Moll. Ind. Mus.* p. 27) that the spiral bands are sometimes absent in specimens from near Calcutta, but such specimens are mere albinistic aberrations and do not resemble *eburnea* in other respects.

The race is usually found in perennial bodies of still water. It reaches its maximum development among algae growing on stones.

I include provisionally in this race a small series of specimens from a large pond in the town of Godaveri in the eastern part of Madras. The shells are similar in shape but have the suture more impressed. In one specimen, indeed, it is canaliculate, and so deep that it forms an actual break in the shell at certain points, where the soft parts are exposed; but this shell was evidently diseased. The pigmentation of the shell is very dense, the outer surface being blackish brown with only traces of the spiral bands, while the interior is deep blue. The animal was also very dark.

These specimens were found amongst dense masses of the Water Hyacinth and *Pistia stratiotes*, so congested that many of the plants were rotting. Their peculiarities may be due to this fact.

Race *colairensis*, nov.

(Plate I, figs. 5-6.)

This race is one of the most distinct with which I am acquainted. It is remarkable for the elongate form of the shell and its relatively small aperture, which is almost circular. These features are noteworthy both in the normal and the elongate type, which occurs rarely with the former. The shell is of very large size, but thin and somewhat translucent. The pigmentation is rather deep, but dull. The alternating broad and narrow bands are distinct. The sculpture resembles that of the *forma typica*.

Type-series. No. M11961/2 *Z.S.I*.

Geographical Range.—I know this race only from a single pond at the village of Sriparptipada on the edge of the swamps that skirt the Colair Lake in the Kistna district of Madras. Specimens from the lake itself belong to the race *eburnea*.

Habits.—The pond in which my type-series was obtained was deep and contained abundant water although the district was

suffering from a very serious drought at the time of my visit (September, 1918). It had an abundant and healthy vegetation of submerged weeds and plants with floating leaves (*Limnanthemum* and water-lilies) were also abundant and healthy. The molluscs were taken among the leaves in great profusion. Their habitat was of a type more common in Lower Bengal than in Madras.

This exhausts the number of true races with which I am acquainted and we may now turn to the four well-marked phases of the species.

Phase *annandalei*, Kobelt.

(Plate II, figs. 5-8.)

1908. *Vivipara annandalei*, Kobelt, *Nachr. Malak. Ges.* LX, p. 161.
 1909. *Vivipara annandalei*, Kobelt, in Martini and Chemnitz, *Conch. Cat.* 1, 21 (2), p. 296, pl. 57, figs. 11, 12.

Kobelt refers to this form as "*eine kritische form.*" I was prepared to accept it as distinct until I had become acquainted with its habits and had ascertained the fact that in some ponds (*e.g.* the tank in the Museum compound, Calcutta) it graded insensibly into the typical form of *V bengalensis*, or rather into a small but not otherwise peculiar phase thereof. Kobelt's description and figures were based on somewhat exceptional specimens of relatively large size and proportionately broad shell. Such individuals occur occasionally but are by no means typical of the phase. On pl. II four shells are shown. Fig. 5 represents one of Kobelt's type-series, which is from Vizagapatam in the north-east of Madras. The other three (figs. 6-8) are more typical. The shells examined by Kobelt were, moreover, old specimens and had lost the translucency characteristic of the phase.

The shell is always very thin and light and usually small. The more elongate type is the commoner of the two that occur, but the type-series chances to belong to the other. Apart from the thinness and translucency of the shell, the most characteristic features are the gradual increase in size of the whorls, the shallowness of the suture, and particularly the shape of the aperture, which is distinctly subrhomboidal and subangulate at its anterior extremity. The dark bands are sometimes a little incrassated. Some shells of the phase come very near to some of the Assamese race *balteata*. The animal is usually very pale in colour, but occasionally almost as dark as that of the *forma typica*. I have noticed that in living specimens kept in an aquarium it gradually becomes darker.

This phase is found in the territory both of the *forma typica* and of the race *eburnea*, but I can find no difference between specimens from Calcutta and those from Hyderabad, Deccan. It is commoner in the vicinity of both cities and almost always occurs in pools of rather foul water used for domestic purposes.

Phase **halophila**, Kobelt.

(Plate II, figs. 9, 10.)

1908. *Vivipara annandalei halophila*, Kobelt, *op. cit.*, p. 162.1909. *Vivipara annandalei halophila*, Kobelt, *tom. cit.*, p. 297, pl. 59, figs. 17-20.

The type series of this phase was noted by Nevill as 'a short angulate form, almost indistinguishable from some of the Burmese var. *doliaris*.' It resembles *annandalei* very much as *doliaris* does *balteata*, but is certainly not a local race. The type-series was from the Punjab Salt Range, but I have also examined series from Calcutta and Burdwan in Bengal. The shell has a distorted appearance and is usually eroded at the tip. Its sculpture is coarse and irregular, the dark bands are usually incrassated and the body-whorl frequently sub-biangulate. The aperture resembles that of the shell of *annandalei*, but is usually larger and broader.

In calling this form *halophila*, Kobelt referred to the name of the locality of the type-series, but it is by no means improbable that the phase does live in water of abnormal chemical composition. Unfortunately I have never found it living myself.

Phase **incrassata**, nov.

(Plate II, figs. 3, 4.)

Shells of this phase differ from those of the race *eburnea* in being very thick and opaque and in having as a rule coarse irregular varices on the body-whorl. They are often almost devoid of pigment. Sometimes the umbilicus is more open than usual. I have examined a good series from Poona in western and from the Kurnool district in southern India. Unfortunately I know nothing of its habitat, but it resembles *eburnea* so closely in all but the thickness and sculpture of the shell that it can hardly be more than a phase of that race.

Phase **pachydolicha**, Annandale.1921. *Vivipara bengalensis* phase *pachydolicha*, Annandale, *Rec. Geol. Surv. Ind.*, L.I, p. 367, pl. xi, figs. 5-7.

I assign to this phase certain large elongate shells in which the umbilicus is more open than usual, and the mouth small and oval. The whorls are swollen and the sculpture impressed, with the upper surface of the whorls broadly and obliquely, but somewhat obscurely flattened, just outside it. There are numerous distinct minutely sinuate, spiral striae on the surface, and the longitudinal striae are coarse and irregular. The epidermis is a dark olivaceous brown in colour with numerous longitudinal black streaks. The spiral bands are narrow and obscure.

I have seen only two fresh specimens of this phase, but there is a series of fine subfossil shells in the collection of the Geological Survey of India.

The fresh shells were found on the sea-shore at Puri in Orissa near small pools of fresh water in the almost dry bed of a stream, the mouth of which was temporarily blocked. The subfossil specimens are from the alluvium of the Narbadda.

I should have regarded this phase as specifically distinct, were it not for the fact that some specimens of the phase *incrasata* approach it closely. It is probably another modification of the race *eburnea*.