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REVISION OF THE INDIAN AMPULLARIIDAE.

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(Plates XIII—XV.)

This paper is a revision of the Indian snails of the family Ampullariidae or apple-snails as these molluscs are popularly called. Burmese and Ceylonese species are also included amongst the Indian species.

The paper is one of the series on the Indian freshwater molluscs which was started by the late Dr. Annandale. Two papers of this series dealing with *Vivipara bengalensis*¹ and the Indian Limnaeidae² have already appeared.

Amongst the Indian species I have recognized two genera of this family, *Pila* Bolten for the common forms found in the plains and *Turbinicola* Annandale and Prashad for the hill-stream species. Detailed descriptions with fairly complete synonymies of all the species are given, and photographs of all the species, except those which have recently been figured and described, are also published.

I have to express here my great indebtedness to Mr. G. C. Robson (British Museum, Natural History, London), Dr. F. Haas (Senckenberg Museum, Frankfurt A. Main), Dr. J. Thiele (Berlin Museum), Dr. G. Mermod (Musée d'Histoire Naturelle, Genève) and Dr. E. Lamy (Muséum d'Histoire Naturelle, Paris) for the facilities given me during my tour in 1922 for the examination of the collections of Ampullariidae under their charge. The illustrations of this memoir have been prepared with their usual skill by the artists of the Zoological Survey of India under my supervision and my thanks are due to them for their great help.

Pila Bolten.

- 1797. *Pomus*, *Mus. Calonnianum*, p. 58.
- 1798. *Pila*, Bolten, *Mus. Boltenianum*, p. 145 (in part).
- 1799. *Ampullaria* (in part), Lamarck, *Prodrome*, p. 76.
- 1817. *Conchylium* (in part), Cuvier, *Regne Anim.* II p. 426.
- 1821. *Ampullaria*, Sowerby, *Genera* I, pl. clxxxiv.
- 1828. *Pachystoma*, Guilding, *Zool. Journ.* III, p. 536.
- 1840. *Pachylabra*, Swainson, *Malacol.* p. 339.
- 1847. *Pomus*, Gray, *Proc. Zool. Soc. London*, p. 148.
- 1854. *Ampullaria*, H. & A. Adams, *Gen. Rec. Moll.* I, p. 345.
- 1859. *Ampullaria*, Chenu, *Man. Conchyliol.* p. 313.
- 1883. *Ampullaria*, Tryon, *Struct. and Syst. Conch.* II, p. 276.

¹ Annandale & Sewell, *Rec. Ind. Mus.* XXII, p. 215 (1921).

² Annandale & Rao, *Rec. Ind. Mus.* XXVII, pp. 137-189 (1925).

1885. *Pachylabra*, Fischer, *Man. Conchylol.* p. 757.
 1904. *Pila*, Dall, *Journ. Conchol.* XI, p. 53.
 1910. *Pila* (subgenus), Sowerby, *Proc. Malacol. Soc. London*, IX, p. 56.
 1912. *Pachylabra*, Kobelt, Martini & Chemn., *Conch. Cab.* (n. f.) Ampullariidae, p. 44.
 1914. *Pila*, Preston, *Faun. Brit. Ind. Freshw. Moll.* p. 96.
 1921. *Pachylabra*, Annandale & Prashad, *Rec. Ind. Mus.* XXII, p. 7.

In the paper cited above Dall has fully discussed his reasons for discarding the *Mus. Calonnianum* name *Pomus* and adopting Bolten's generic name *Pila*. Dr. Annandale and I had doubts about the propriety of adopting the Boltenian names and so had adopted with Kobelt Swainson's name *Pachylabra*. Since, however, Bolten's names are now accepted as valid by most European and American workers, I have thought it best to adopt the name *Pila* in preference to *Pachylabra* for the Asiatic Ampullariidae with a calcareous operculum.

A detailed account of the structural peculiarities of the shells of this genus will be found in the paper by Annandale and myself cited above and a complete account of the anatomy of the common Bengal species *P. globosa* will be published shortly.

The genus is widely distributed in Ceylon, India, Burma, Siam, Malay Peninsula, Borneo, Sumatra, Java, the Philippines and French Indo-China and probably extends into China. No living species of the genus are found in the Punjab or Sindh, but beautifully preserved fossil opercula of a species, which I have described elsewhere under the name *Pachylabra prisca*, were recently obtained from Poonch within the boundaries of the Punjab. No Ampullariids are known from Persia, Mesopotamia, Arabia or Asia Minor.

In India, Burma and Ceylon I have been able to recognize 8 species and 6 varieties. One of the species is described as new, while a fair number of species have been included in the synonymy of previously described species. The synonymies included in this paper are based on the results of my examination of the rich collections in the various European museums and private collections in addition to the very large collections of the Zoological Survey of India in the Indian Museum, Calcutta.

A few notes on the distribution of the various species may also be included here. *P. globosa* with the two varieties *incrassatula* and *minor*, *P. virens* and *P. nevilliana* are distributed in India proper excluding Punjab and Sindh where no living species of Ampullariidae are found at the present day. *P. theobaldi*, *P. conica* with the vars. *compacta* and *gracilis* are found in Burma and *P. layardi* with var. *cinera*, *P. dolioides* with the var. *wocwardi* and *P. robsoni* are the species common in Ceylon.

***Pila globosa* (Swainson).**

(Plate XIII, figs. 1-7.)

1822. *Ampullaria rugosa*, Sowerby (*nec* Lamarck), *Genera Recent and Fossil Shells*, I, pl. clxxxiv.
 1822. *Ampullaria globosa* and *A. corrugata*, Swainson, *Zool. Illustrations* ser. 1, Vol. II, pl. cxix, Vol. III, pl. cxx.
 1838. *Ampullaria corrugata*, Lamarck, *Hist. Nat. Anim. sans Verteb.* (2nd Edu. by Deshayes & H. Milne-Edwards) VIII, p. 543.
 1851. *Ampullaria globosa* and *A. corrugata*, Philippi in Martini & Chemn., *Conch. Cab. Ampullaria*, p. 8, pl. i, fig. 3; p. 7, pl. i, fig. 1.

1856. *Ampullaria globosa* and *A. encaustica*, Reeve, *Conch. Icon. X, Ampullaria*, pl. x, figs. 46, 47 ; pl. xvi, fig. 76.
1876. *Ampullaria globosa* with vars. *sphaerica* and *fasciata* (*nec* Lamarck) and *A. corrugata*, Hanley and Theobald, *Conch. Ind.* pp. xvii, 46, pl. cxiii, figs. 2-5.
1877. *Ampullaria globosa* with var. *corrugata*, Nevill, *Cat. Moll. Ind. Mus.* Fasc. E, pp. 1, 2.
1885. *Ampullaria globosa* and vars. *corrugata*, *longispira* and subvars. (without names) from Assam and loc. ?, Nevill, *Hand-List Moll. Ind. Mus.* II, pp. 1, 2.
1910. *Ampullaria (Pila) globosa* with vars. *corrugata*, *encaustica*, *longispira* and *sphaerica*, Sowerby, *Proc. Malacol. Soc. London IX*, pp. 58, 59.
1912. *Pachylabra globosa* with var. *encaustica*, Kobelt in Martini & Chemn., *Conch. Cab. (n. f.) Ampullariidae*, p. 72, pl. xxiv, figs. 1, 2 ; p. 95, pl. xli, fig. 1.
1915. *Pila globosa* with vars. *sphaerica*, *fasciata* (Hanley & Theobald *nec* Lamarck), and *P. corrugata* with var. *longispira*, Preston, *Faun. Brit. Ind. Freshw. Moll.* pp. 97, 98.
1923. *Pachylabra globosa*, Prashad, *Journ. As. Soc. Bengal (n. s.) XVII*, p. 586.

The shell of this species is large, of moderate thickness and usually globose ; in some specimens, however, the spire is abnormally long and exerted resulting in the outline becoming somewhat ovate. Normally the total height of the shell is more than the maximum diameter, but in some cases the specimens are more globose than high. There are $6\frac{1}{2}$ whorls ; the apex is obtuse and in practically all shells the first two to three whorls are eroded ; done of the whorls, with the exception of the large body-whorl, are greatly swollen. The upper surface of all the whorls is somewhat obliquely flattened, but they are never angulate or carinate. Normally the suture is slightly impressed but in specimens with an exerted spire it becomes much deeper and appears canaliculate. The spire is usually depressed and less than $\frac{1}{3}$ of the total height, but in specimens with an exerted spire it is a little more than $\frac{1}{3}$ of the total height. The whorls increase in size regularly up to the body-whorl, which suddenly swells up ; it is broad and slightly oblique, appearing broadly cordate in dorsal view and much broader than high, being deepest near the mouth end. The mouth of the shell is large, lunate-oblong, and about $1\frac{1}{2}$ times as high as broad, and its main axis forms an acute angle with that of the shell. The peristome is continuous and the callus well developed in adult shells ; the lips are sharp but slightly retroverted and bear a slightly raised ridge about a quarter of an inch below the margin for the fitting of the operculum. The umbilicus is broadly perforate, but somewhat covered over by the retroverted inner lip of the mouth.

The shells are either smooth or have slightly raised, arched ridges corresponding to the lines of growth, or with the greater part of the body-whorl malleated. In the last case the surface has shallow squarish to rectangular pits giving it a corrugated or malleated appearance of the type described and figured for shells called *corrugata*, Swainson.

The external colour, which is usually uniform, is some shade of lemon-yellow, but much darker shells of a brownish or even black colour are sometimes found. Transverse colour bands of a light brown shade are sometimes to be made out in the case of young shells. The inner surface is white with irregular spiral transverse bands of a brownish or orange colour near the margin. The periphery of the mouth often shows an orange band lining it, but this may sometimes be absent.

The operculum of *P. globosa*, as in the case of the other members of the genus, is a calcareous, concentric patelliform plate. In this species the outline of the operculum corre-

sponds to that of the mouth, being somewhat lunate-oblong. Its outer margin is convex, regularly arched, curving on gradually to the anterior margin and quite suddenly descending to a point at the junction of the posterior with the inner margin. The inner margin is nearly straight in its anterior half, but further back becomes arched, making the margin as a whole concave. The nucleus is only visible on the inner surface and is situated about the middle at a distance of about $\frac{1}{4}$ of the breadth from the inner margin. A number of rings of growth are to be seen in the lemon-yellow chitinous covering on the outer surface of the operculum. On the inner surface the boss for the attachment of the opercular muscle is distinguished by its being excavated from the rest of the surface by a shallow groove and being slightly raised. It is of a creamy colour in this region being covered over by very minute irregular vermiculations for the attachment of the muscle fibres. The rest of the inner surface of the operculum is some shade of shining gray.

Measurements (in millimetres).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Height	59	70	67	59	57	58	50	57	51	49	69	66	68	58	58	59	56	62	58	59
Maximum diameter	60	66	66	57	56	54	48	51	49	46	63	64	72	56	56	58	51	59	55	56
Height of mouth (oblique)	48	54	51	44	41	45	38	42	38	35	47	51	55	45	43	46	43	46	43	42
Maximum diameter of mouth	30	32	33	26	25	29	27	28	24	24	33	34	35	27	28	29	26	28	28	26

Specimen No. 1 from Calcutta is reproduced on plate XIII as fig. 1; specimen No. 2 from Port Canning is of the *corrugata* type and is reproduced as fig. 6, pl. XIII; specimen No. 3 from Allahabad is reproduced as fig. 3; specimen No. 5 from Gopalpur is reproduced on same plate as fig. 5; specimens 6 and 7 are from Sambalpur, they have a malleated surface with a canaliculate suture and a depressed spire, one of these is reproduced as fig. 4; specimen 8 is from Ranchi, Orissa; specimens 9, 10 are from Central India and are intermediate between the *corrugata* and *globosa* types; specimen 11 is from Benares and is the type of Nevill's *longispira*; it is reproduced as fig. 7; specimens 12-17 are from the Calcutta tanks; specimens 18-20 are from Assam and are intermediates between the *corrugata* and *globosa* types.

P. globosa is the common Indian apple-snail. It ranges from Bombay, Rajputana, Central Provinces and Orissa to Bengal and outskirts of Assam on the one hand and through Bihar to the United Provinces of Agra and Oudh. So far as I am aware, it does not occur in the Punjab, Sindh, Madras and Burma. In the Punjab and Sindh no living Ampullariid is found at the present day, while in Madras and Burma the species is replaced by *virens*, *conica* and *theobaldi*.

Remarks.—As will be clear from the synonymy given at the beginning, Sowerby was wrong in figuring a shell of this species under the name *Ampullaria rugosa* Lam., which is a synonym of *Ampullaria urceus* (Müller)—an American species with a horny operculum. Swainson was the first to give it the name *globosa* but later described shells with a malleated surface under the name *corrugata*. Reeve described shells under the names *globosa* and *encaustica*, recognizing *corrugata* as only a variety of the former; his *bilineata* (*loc. cit.* fig. 110) of unknown habitat also appears to be based on young shells of this species. Hanley and Theobald (*loc. cit.*), probably from Lamarck's note as to the locality of his species *A. fasciata*¹ "dans les rivières de l'Indie," were led to consider the form from Moradabad, United Provinces, with a large shell and with distinct reddish narrow bands on a greenish background, as *fasciata* Lam. Lamarck's name *fasciata* is, however, a

¹ Lamarck, *Hist. Nat. Anim. sans Verteb.* VI (2), p. 177 (1822).

very doubtful one, and I am inclined to agree with Reeve that it is only a synonym of *P. ampullacea* (Linn.), which is cited by Lamarck himself as the species he means. His locality, rivers of India, is certainly wrong. Nevill's ideas about this species seem to have been correct in the main except in that he included *carinata* (= *virens* of the present paper) with *layardi* as a variety of this species. I have little doubt that *virens* and *layardi*, though allied to *globosa*, are both distinct species.

Ampullaria globosa was recorded by Morelet,¹ and on his authority by Fischer and Dautzenberg,² from the marshes of the Menam near Bangkok, Siam, but this, as Annandale³ has shown, was due to Morelet having confused the characteristic Bangkok species, which Annandale named *P. angelica*, with Swainson's *globosa*.

I also give photographs (Figs. 10 and 11) of the two shells which were called "subvar. *sinistrosa*, nov." by Nevill.⁴ One of these (Fig. 10) was collected by Anderson from the Royal Botanical Gardens, Calcutta, and the other (Fig. 11) labelled "Mauritus" is from the old collections of the Asiatic Society of Bengal. Both specimens are sinistral abnormalities of the typical *P. globosa* and I do not believe that it is right to give them a separate name, even of a subvarietal rank.

var. **incrassatula** Nevill.

(Plate XIII, figs. 9-11.)

1877. *Ampullaria globosa* var. *incrassatula*, Nevill, *Cat. Moll. Ind. Mus.* Fasc. E, p. 4.

1885. *Ampullaria globosa* var. *incrassatula*, Nevill, *Hand-List Moll. Ind. Mus.* p. 2.

In a recent paper⁵ I expressed an opinion that Nevill's varieties *incrassatula* and *minor* were only phases of the common *P. globosa* and could not be considered as distinct. Since then, however, I have examined larger series of specimens from the type-localities and am inclined to consider these two forms as distinct varieties. Both forms, however, appear to be depauperated types occurring in special localities only.

Nevill gave only a short description of this form and I add a few notes to amplify his account.

The shell is somewhat subglobose, small and thick, much thicker than that of the typical form. The spire is more produced and slightly exserted. There are 5-5½ whorls; the apex is acute and the nepionic shell is easily distinguishable by its colour. The suture is only slightly impressed and is neither angulate nor carinate. The whorls are only moderately swollen and are evenly rounded above. The mouth is somewhat ovoidal, being nearly ⅔ as broad as high, and its main axis forms a very acute angle with the main axis of the shell. The peristome is continuous, only slightly retroverted anteriorly and not at all thickened. The columellar callus is narrow and with the rest of the peristome, according to Nevill, white in fresh specimens. The umbilicus is very narrow and nearly covered over by the callus. The shells are of a uniform lemon-yellowish colour without any traces of bands and show faint vertical ridges corresponding to the lines of growth.

¹ Morelet, *Ser. Conchyliol.* IV, p. 289 (1875).

² Fischer & Dautzenberg, *Mission Pavie* III, p. 425 (1904).

³ Annandale, *Journ. Nat. Hist. Soc. Siam* IV, p. 5 (1920).

⁴ Nevill, *Hand-List Moll. Ind. Mus.* II, p. 2 (1885).

⁵ Prashad, *Journ. As. Soc. Bengal* (n. s.) XVIII, p. 581 (1920).

The operculum of this variety differs from that of the typical form in being very thick and many layered.

Measurements (in millimetres).

	1	2	3	4	5	6
Height.	31	30	29	30	32	27
Maximum breadth	27	25	25	26	28	22
Height of mouth (oblique)	21	21.5	21	21	22	19
Maximum diameter of mouth	14	14	13.5	14.5	16	14

Type-specimen.—No. 2399 (Indian Museum, Calcutta).

Remarks.—Nevill based this variety on shells obtained from a tank near Calcutta and some specimens from a paddy swamp near Dum-Dum. I have seen the former series and a fair number of fresh shells from some tanks near Calcutta. All the specimens are remarkably constant and it appears doubtful whether they should not be separated as a distinct species. It is probably the form referred to as a " dwarfed var. not rare about Calcutta, measures only 1.20 by 1.07 " by Theobald.¹

var. **minor** Nevill.

(Plate XIII, fig. 8.)

1877. *Ampullaria globosa* var. *minor*, Nevill, *Cat. Moll. Ind. Mus.* Fasc. E, p. 4.

1886. *Ampullaria globosa* var. *minor*, Nevill, *Hand-List Moll. Ind. Mus.* II, p. 2.

As I have already stated (*antea* p. 73) I considered this variety also to be a phase of *P. globosa*, but I am now of opinion that Nevill was right in considering it a distinct variety.

This variety is to be distinguished by its very thin shell, widely expanded columella margin of a chestnut colour, more produced spire and anteriorly directed mouth-opening, and by the distinct colour bands both on the outer surface of the shell and inside the mouth.

Measurements (in millimetres).

	<i>Type</i>		
Height.	36	33	28
Maximum diameter	. 29	28	25
Height of mouth (oblique)	. 25	23	20
Maximum diameter of mouth	17	16	13

Type-specimen.—No. 2445 (Indian Museum, Calcutta).

Remarks.—This variety was based on a series of specimens collected near Dum-Dum, Calcutta. The specimens are remarkably constant and, as Nevill said, it is " the most aberrant " of Indian forms. The relationships of the variety were well defined by Nevill as being " intermediate between *A. globosa* and *A. maura*," but it is as closely allied to *P. conica*.

¹ Theobald, *Journ. As. Soc. Bengal*, XXVII, p. 321 (1858).

***Pila virens* (Lam.).**

(Plate XIV, figs. 1-3.)

1822. *Ampullaria virens*, Lamarck, *Hist. Nat. Anim. sans Verteb.* VI (2), p. 179.
1829. *Ampullaria carinata*, Swainson (*nec* Lamarck), *Zool. Illus.* ser. ii, pl. 9.
1838. *Ampullaria virens*, Lamarck, *Hist. Nat. Anim. sans Verteb.* (2nd Edn. by Deshayes and H. Milne-Edwards), VIII, p. 536.
1841. *Ampullaria virens*, Delessert, *Rec. Coq. Lamarck*, pl. xxxi, figs. a-c.
1851. *Ampullaria carinata*, Philippi in Martini & Chemn., *Conch.-Cab.* (ed. Kuster), *Ampullaria*, p. 8, pl. i, fig. 2.
1852. *Ampullaria paludinoidea* (Philippi *nec* Crist. & Jan.), *A. malabarica*, *A. virens* and *A. pallens*, *id.*, *ib.*, pp. 27, 29, 30, 32, pls. vii, figs. 4, 8, pl. viii, figs. 2, 4.
1856. *Ampullaria maura*, *A. carinata*, *A. malabarica*, *A. paludinoidea* var. and *A. largillierti* (Reeve *nec* Philippi), Reeve, *Conch. Icon.* X, *Ampullaria*, pls. xiii, figs. 57, 58, xv, fig. 67, xviii, fig. 86, xxiii, fig. 109.
1876. *Ampullaria carinata* and *A. malabarica*, Hanley & Theobald, *Conch. Ind.* pp. xvii, 46, pl. cxiv, figs. 1, 2.
1877. *Ampullaria globosa* var. *carinata* (in part) and *A. maura*, Nevill, *Cat. Moll. Ind. Mus.* Fasc. E, pp. 3, 5.
1885. *Ampullaria globosa* subsp. *carinata*, var. *malabarica*, subvar. *virens* and *A. maura*, Nevill, *Hand-List Moll. Ind. Mus.* II, pp. 3, 4.
1910. *Ampullaria virens* (in part), Sowerby, *Proc. Malacol. Soc. London* IX, p. 61.
1912. *Pachylabra maura*, *P. largillierti* var. (Kobelt *nec* Philippi) and *P. paludinoidea* (in part), Kobelt in Martini & Chemn., *Conch. Cab.* (*n. f.*), *Ampullariidae*, pp. 87, 59, 102, pls. xxxv, fig. 2, xxxiii, fig. 9, xl, fig. 6, xliii, fig. 3.
1915. *Pila carinata*, *P. malabarica* and *P. maura*, Preston, *Faun. Brit. Ind. Freshw. Moll.* pp. 98, 99.
1921. *Pachylabra maura*, Annandale (in part), *Rec. Ind. Mus.* XXII, p. 567, fig. 8 (Radular teeth).
1923. *Pachylabra virens*, *P. largillierti* var., *P. paludinoidea*, Prashad, *Journ. As. Soc. Bengal* (n. s.) XVIII, pp. 589, 586, 590.

The shell is rather medium sized, globose, with the maximum diameter usually slightly less than the height of the shell. There are $5\frac{1}{2}$ -6 whorls. The apex is obtuse and in most cases the first 3 whorls are eroded. The whorls are only moderately swollen; they are all nearly horizontal above and are separated from the adjacent whorls by a deep furrow resulting in a distinct carination of the whorls on the outside. The suture is deeply impressed and may be described as canaliculate. The spire is somewhat conical and is about $\frac{1}{4}$ of the total height of the shell. The whorls, owing to the deep canaliculate suture, appear to increase in size irregularly. The body-whorl is somewhat oblique in dorsal view; it is much broader than high. The mouth is elongate ovoidal, broadest a little below the middle and the margin is of an orange-yellow colour, it is about $1\frac{1}{2}$ times as high as broad. The peristome is quite continuous and the callus is well developed; the lips are distinctly retroverted and have a prominent ridge for the fitting of the operculum. The umbilicus is somewhat narrow and is partly covered over by the retroverted inner lip.

The shells appear nearly smooth, but have distinct and slightly raised, curved ridges corresponding to the lines of growth. Usually the shells are uniform, shining olive-brown,

but in some of the shells the lines of growth appear much darker and alternate with lighter intermediate vertical areas. There are no transverse bands. The margin of the mouth is orange-yellow and internally the shells show distinct chocolate coloured transverse bands.

The species varies greatly in having the spire more or less produced and somewhat exerted (corresponding to *malabarica*) or otherwise, with a canaliculated suture more or less marked, with a sharp natural angulation of the outer lip (as in *carinata*) or a flat infrasutural ledge (as in *malabarica*) with the umbilicus open or covered by the callus. The colour of the shells also varies from light yellowish olive to dark brown or chocolate.

Measurements (in millimetres).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total height	32	45	46	50	40	23	44	31	39	34	51	45	46	52	41
Maximum diameter	28	40	43	43	38	20	40	29	34	30	49	47	43	43	37
Oblique height of mouth	23	33	34	38	32	18	31	24	30	27	38	37	36	39	34
Maximum diameter of mouth	14	22	25	27	21	11	22	18	19	18	26	22	22	36	20

No. 1 is Reeve's *malabarica* from Madras; No. 2 is Hanley & Theobald's shell figured in *Conch.-Ind.* as *malabarica* from Malabar; No. 3 is the type-shell of Reeve's *maura* from India; Nos. 4, 5, 6 are from Bombay; No. 7 is from Goa; Nos. 8, 9 from Madras; No. 10 is from Pondicherry; Nos. 11, 12, 13 are specimens labelled *virens* in the British Museum, without locality; No. 14 is from Bengal without definite locality and No. 15 is from Assam.

This species has a very wide range in Peninsular India and extends through Orissa and Bengal to Assam. In the south I have seen specimens from below Pondicherry and it probably extends still further south.

Remarks.—Lamarck's types of this species, consisting of a tablet with 4 shells fixed to it, is preserved in the Geneva Museum, Switzerland. No locality is mentioned on the tablet. Of the four shells three are *virens* while the fourth is a *conica*-type of shell. All the three shells are orange-yellow in colour without any transverse bands, but with distinct brownish bands inside the mouth. The shells are markedly umbilicate and the carination of the mouth is also distinctly seen. The spire is less pointed than is shown in Delessert's figure. The sculpture consists of vertical ridges and some shells are malleated on the body-whorl.

I have also examined the type of *maura* in the British Museum, specimens identified probably by Philippi as *malabarica* in the Berlin Museum, and large series of specimens indiscriminately labelled as *carinata*, *malabarica* or *maura* in various institutions, and I am of opinion that all of them are the same as Lamarck's *virens*. The species has a very wide distribution and though specimens from such widely separated localities as Bombay, Madras and Assam appear to be different, forms filling up the gaps are found in large series from intermediate areas and it is not possible to separate specimens into different species or even varieties.

Reeve's specimen of *largillierti* figured on plate XXIII, fig. 109 of *Conch. Icon.* is not *largillierti*, but is, as was stated by Sowerby, a specimen of *P. virens*. The locality Madagascar on the tablet is apparently a mistake.

Pila nevilliana (Annandale and Prashad).

1921. *Pachylabra nevilliana*, Annandale & Prashad, *Rec. Ind. Mus.* XXII, p. 11, figs. 1, 2.

I have nothing to add to our recent account of the species beyond the fact that no fresh specimens have been obtained so far, and that the species is doubtfully to be placed next to *P. virens* (Lam.).

Pila olea (Reeve).

(Plate XIV, fig. 4.)

1856. *Ampullaria olea*, Reeve, *Conch. Icon. X, Ampullaria*, pl. xxi, fig. 102.
 1876. *Ampullaria olea*, Hanley & Theobald, *Conch. Ind. (Syst. List)*, p. xvii (without description or figures, reference to pl. cxiv, figs. 8, 9 wrongly included).
 1885. *Ampullaria aperta* var. ? *Ampullaria olea*, Nevill, *Hand-List Moll. Ind. Mus.* II, p. 4.
 1910. *Ampullaria olea*, Sowerby, *Proc. Malacol. Soc. London IX*, p. 6.
 1915. *Pila olea*, Preston, *Faun. Brit. Ind. Freshw. Moll.* p. 102.

This species was described by Reeve from shells out of the 'Mus. Cuming' collection without any definite locality. Sowerby gave the locality as Penang and Tongking, but this is apparently incorrect. Nevill had provisionally referred some shells from Cachar, Assam, to this species, but included it as a variety of *aperta*. I have carefully examined the original shells of Nevill and Reeve's specimens and I am of opinion that the form is nearly allied to *P. virens* and is probably a variety of it. For want of sufficient material, however, I propose to leave it distinct for the present.

Reeve's description of the species is sufficiently complete and is given below :—

“Shell subglobose, scarcely umbilicated, spire rather short, whorls rounded, longitudinally striated; shining olive, encircled with two distinct narrow blackish-red bands; aperture pyriformly ovate.”

Young shells are olive in colour with a number of transverse bands of a reddish or chocolate colour. The only adult shell is somewhat brownish with rather faint bands.

Measurements (in millimetres).

Height	. . . . .	31	23	21
Maximum diameter	. . . . .	29	21	10
Height of mouth (oblique)	. . . . .	25	18	16
Maximum diameter of mouth	. . . . .	17	12	12

The only specimens in addition to the types in the British Museum, which I have seen, are 3 shells from Cachar, Assam, in the Indian Museum and which were provisionally referred to this species by Nevill.

Pila theobaldi (Hanley).

(Plate XV, fig. 3.)

1875. *Ampullaria Theobaldi*, Hanley, *Proc. Zool. Soc. London*, p. 608.
 1876. *Ampullaria Theobaldi*, Hanley & Theobald, *Conch. Ind.*, pp. xvii, 47, pl. cxv, fig. 2.
 1877. *Ampullaria maura* var. *theobaldi*, Nevill, *Cat. Moll. Ind. Mus.* Fasc. E, p. 6.
 1885. *Ampullaria maura* var. *theobaldi*, Nevill, *Hand-List Moll. Ind. Mus.* II, p. 4.
 1889. *Ampullaria Theobaldi*, Tapparone Canefri, *Ann. Mus. Civ. Stor. Nat. Genova* (ser. ii) VII, p. 630.
 1901. *Ampullaria winkleyi*, Pilsbry, *Proc. Acad. Nat. Sci. Philadelphia*, LIII, p. 189, pl. v, figs. 2, 3.
 1910. *Ampullaria theobaldi* and *A. winkleyi*, Sowerby, *Proc. Malacol. Soc. London IX*, pp. 61, 62.
 1912. *Pachylabra theobaldi*, Kobelt in Martini & Chemn., *Conch. Cab. (n. f.) Ampullariidae*, p. 86, pl. xxxv, fig. 1.
 1915. *Pila theobaldi* and *P. winkleyi*, Preston, *Faun. Brit. Ind. Freshw. Moll.* pp. 99, 103.
 1923. *Pachylabra theobaldi*, Prashad, *Journ. As. Soc. Bengal (n. s.) XVIII*, p. 589.

The species was fully described by Hanley, and Pilsbry has also given a detailed description of what he considered to be a new species. The following notes, based on an examination of a large series of shells of all ages, are given to supplement these descriptions.

The shells vary to some extent in the height of the spire; in young shells it is fairly prominent and produced, but in full-grown shells it is often greatly eroded and owing to the greatly swollen body-whorl appears depressed. The suture is moderately impressed in half-grown shells but not deeply canaliculate as in the adult specimens; in young shell the whorls next to the suture appear somewhat flattened but in the adult shell with a deep suture the whorls even in this area are very convex. Young shells are only narrowly umbilicate but in adult shells the umbilicus is very broad and deep. The surface of young shells appears nearly smooth to the naked eye, and only very low vertical spiral ridges can be distinguished with a lens, but in a full-grown specimen the ridges become very marked and prominent; the surface of the shell further becomes corrugated or pitted with squarish depressions. The outline of the mouth does not change with age, but the outer lip which is quite sharp and straight in young shells becomes thick and reflected outwards; the anterior margin of the aperture is also greatly reflected. Young specimens are yellowish-olive, while full-grown shells are shining olive-brown to brown with scarcely any spiral bands.

Measurements (in millimetres).

	1	2	3	4	5	6
Height.	86	53	53	51	44	40
Maximum diameter	83	51	52	54	46	40
Height of mouth (oblique)	67	41	42	40	34	31
Maximum diameter of mouth	40	25	28	27	24	21

Locality.—Type-shells were collected at Bhamo in Burma by Theobald. Pilsbry's type-series of *winkleyi* was collected at Henzada, Burma. In the Indian Museum the species is represented by a large series of shells from round Bhamo.

Remarks.—Nevill considered this species to be only a variety of the Assamese form *maura* (= *virens*) basing his conclusions on an examination of young shells only. Kobelt, however, treated the species as distinct. Preston could not trace the description of the species by Hanley and provided a new description from Hanley's figure; he also did not examine the type and co-type, both of which were in the British Museum collections. Pilsbry described half-grown specimens from Henzada, Burma, under the name *winkleyi*. I have, through the kindness of Dr. Pilsbry, received one of the co-types of his species and am now able to confirm my previous conjecture that his species was only based on half-grown shells of *theobaldi*.

P. theobaldi is the largest of the Indo-Burmese species of apple-snails growing to over 85 mm. in total height. It differs from the nearly allied *P. virens*, of which Nevill made it a variety, in being much larger, the whorls much more globose, the suture more impressed and the very open umbilicus. This species appears to be confined to Burma only.

It may be noted here that the specimen from Talé Sap, Siam, referred to as *P. winkleyi* by Annandale (*Journ. Nat. Hist. Soc. Siam* IV, p. 457 (1920), is only a greatly eroded young shell of *P. turbinis*.

Pila conica (GRAY).

(Plate XV, figs. 4-8).

1828. *Ampullaria conica*, Gray, *Wood's Index Test. Suppl.* pl. vii, fig. 22.
 1849. *Ampullaria scutata*, Mousson, *Moll. Java*, p. 60, pl. vii, fig. 2.
 1851. *Ampullaria scutata*, Philippi, Martini & Chemn., *Conch., Cab.* (ed. Kuster) *Ampullaria*, p. 9, pl. i, figs. 4, 5, 6.
 1854. *Ampullaria conica*, Hanley, *Conch. Miscell.* pl. iii, fig. 13.
 1856. *Ampullaria conica*, Reeve, *Conch. Icon.* X, pl. ii, fig. 10.
 1857. *Ampullaria scutata*, v. Martens, *Malakozool. Blatt.* p. 186.
 1877. *Ampullaria conica* near type form and var. *orientalis*, and *A. gracilis* (Nevill nec Lea), Nevill, *Cat. Moll. Ind. Mus.* Fasc. E, pp. 7, 9, 10, 11.
 1885. *Ampullaria conica* and var. *orientalis* and *A. gracilis* (Nevill nec Lea), Nevill, *Hand-List Moll. Ind. Mus.*, I, from pp. 5, 7.
 1897. *Ampullaria scutata*, v. Martens, *Max Weber's Zool. Ergeb. Neiderl. Ost.-Ind.* IV, p. 18.
 1898. *Ampullaria scutata*, P. & F. Sarasin, *Moll. Celebes*, I, p. 60.
 1903. *Ampullaria conica* and ? *A. gracilis* (Blanford nec Lea), Blanford, *Proc. Malacol. Soc. London* V, p. 281.
 1910. *Ampullaria conica* and vars. *scutata*, *orientalis*, Sowerby, *Proc. Malacol. Soc. London* X, pp. 57, 58.
 1912. *Pachylabra conica*, Kobelt, Martini & Chemn., *Conch. Cab. (n. f.) Ampullariidae*, p. 93, pl. xl, fig. 1.
 1913. *Ampullaria scutata*, Schepmann, *Proc. Malacol. Soc. London*, X, p. 236.
 1915. *Pila conica* and var. *orientalis*, Preston, *Faun. Brit. Ind. Freshw. Moll.* pp. 100, 101.
 1920. *Pachylabra conica* and *P. gracilis* (Annandale nec Lea), Annandale, *Journ. Nat. Hist. Soc. Siam*, IV, p. 9, pl. i, fig. 3, pl. ii, fig. 2 and p. 11, pl. i, fig. 4.
 1921. *Pachylabra conica*, Prashad, *Rec. Ind. Mus.* XXII, p. 477.
 1923. *Pachylabra conica*, Prashad, *Journ. As. Soc. Bengal (n. s.)* XVIII, p. 589.

This species was figured by Gray in the Supplement to Wood's Index from a specimen belonging to the collections of the British Museum. When working in the British Museum in 1922 I could not find this specimen anywhere in the British Museum collections, but I came across another specimen from Gray's own collections marked " *Helix conica Wood Supl. pl. 7 fi. 22* " and in another line below " *Ampullaria* " in Gray's own hand. This specimen agrees fully with the figure in Wood's Supplement and the later full-sized figures of the type-shell in Hanley's work. I have, therefore, accepted this shell as the idio-type of Gray's *conica*.

When dealing with Sumatran molluscs in my paper cited above I was not able to deal with the species in detail and did not recognize that the shell described by Annandale as *P. gracilis* (Lea) was also a young shell of this species and not true *gracilis*. Annandale based his description of *gracilis* on a Siamese shell in the Indian Museum collections received as *A. gracilis* from Morelet. This shell had already been referred to by Nevill also. Unfortunately the measurements given are incorrect and this apparently misled Annandale in considering this shell as probably belonging to Lea's species. Lea's *gracilis*, as is shown later, is apparently the same as what was described by Nevill under the name *expansa*.

I have nothing to add to the description of this species by Annandale in the paper cited above beyond noting that the species is very variable both as regards shape and colour.

Young shells are usually olivaceous green with faint brownish spiral bands ; these, however, fade away with age, the shells become much thicker and of a deep-brown colour and only brownish spiral bands are visible inside the mouth opening.

P. conica has a very wide distribution. It occurs in Burma, Siam, Sumatra, Java and probably extends up to China. The last locality needs confirmation in spite of the fact that there are specimens in the Indian Museum received from Morelet and Baron F. von Richthofen labelled China and Canton respectively.

var. **compacta** (Reeve).

(Plate XV, figs. 9, 10.)

1854. *Ampullaria conica* var. (*orientalis*), Hanley, *Conch. Miscell.* pl. ii, fig. 8.
 1856. *Ampullaria compacta*, Reeve, *Conch. Icon.* X, *Ampullaria*, pl. xiv, fig. 62, pl. xv, fig. 71.
 1876. *Ampullaria paludinooides* var., Hanley & Theobald (*nec* Philippi), *Conch. Ind.* pp. xvii, 47, pl. cxiv, figs. 6, 7.
 1877. *Ampullaria conica* var. *compacta*, Nevill, *Cat. Moll. Ind. Mus.* Fasc. E, p. 10.
 1885. *Ampullaria conica* var. *compacta*, Nevill, *Hand-List Moll. Ind. Mus.* II, p. 5.
 1910. *Ampullaria compacta*, Sowerby, *Proc. Malacol. Soc. London* IX, p. 57.
 1912. *Pachylabra compacta*, Kobelt in Martini & Chemn., *Conch. Cab. (n. f.) Ampullariidae*, p. 100, pl. xlii, figs. 3-9.
 1912. *Pachylabra paludinooides*, Kobelt in part (*nec* Philippi), *ib.*, p. 102, pl. xliii, fig. 3.
 1918. *Pachylabra winkleyi*, Annandale (*nec* Pilsbry), *Rec. Ind. Mus.* XIV, p. 138, pl. xii, fig. 10.
 1921. *Pachylabra conica* var. *compacta*, Annandale, *Journ. Fed. Malay States Mus.* X, p. 195.
 1923. *Pachylabra conica* var. *compacta*, Prashad, *Journ. As. Soc. Bengal (n. s.)* XVIII p. 590.

As I have remarked in my recent paper, I agree with Nevill in considering this as only a variety of *P. conica*. The young shells are impossible to distinguish, but the adults are much larger with a much thicker and stouter shell with strong vertical striations, sometimes making the shell quite malleated. The columellar callus is much broader and the mouth more ovoid. The shells are also much darker in colour with faint transverse colour-bands.

Reeve's type-specimens are labelled "Malacca," but all the other shells which I have seen are from Burma and the variety appears to be true Burmese.

Measurements (in millimetres).

Total Height	46	41	42	32
Maximum diameter . . .	42	37	36	29
Oblique height of mouth	35	33	31	27
Maximum diameter of mouth .	25	23	21	16

var. **gracilis** (Lea).

(Plate XV, fig. 11.)

1856. *Ampullaria gracilis*, Lea, *Proc. Acad. Nat. Sci. Philadelphia*, VII, p. 10.
 1856. *Ampullaria bilineata*, Reeve, *Conch. Icon.* X, *Ampullaria*, pl. xxiii, fig. 110.
 1867. *Ampullaria gracilis*, Lea, *Observ. Unio etc.* XI, p. 70, pl. xxii, fig. 1.
 1876. *Ampullaria paludinooides*, Hanley & Theobald (*nec* Philippi, *non* Crist. & Jan.), *Conch. Ind.* pp. xvii, 47, pl. cxiv, fig. 5.

1877. *Ampullaria conica* var. *expansa*, Nevill, *Cat. Moll. Ind. Mus.* Fasc. E, p. 9.
 1885. *Ampullaria conica* var. *expansa*, Nevill, *Hand-List Moll. Ind. Mus.* II, p. 5.
 1889. *Ampullaria conica*, Gray, var. *expansa*, Tapparone Canefri, *Ann. Mus. Civ. Stor. Nat. Genova* (ser. 2) VII, p. 360.
 1899. *Ampullaria expansa*, von Martens, *Arch. Naturges.* Bd. I, p. 34.
 1910. *Ampullaria bilineata*, *A. ampullacea* (in part) and *A. gracilis*, Sowerby, *Proc. Malacol. Soc. London*, IX, pp. 56, 57, 59.
 1912. *Pachylabra bilineata* and *P. paludinooides* (Kobelt nec Philippi), Kobelt, Martini & Chemn., *Conch. Cab. (n. f.)*, *Ampullariidae*, p. 96, pl. xli, fig. 3 and p. 102, pl. xliii, fig. 2.
 1915. *Pilla conica* var. *expansa*, Preston, *Faun. Brit. Ind. Freshw. Moll.* p. 100.
 1921. *Pachylabra gracilis*, Annandale, *Journ. Fed. Malay States Mus.* X, p. 195.
 1923. *Pachylabra conica* var. *expansa*, Prashad, *Journ. As. Soc. Bengal (n. s.)* XVIII, p. 590.

I have carefully compared Lea's description and figures of *gracilis* with Nevill's types of his var. *expansa* and can find no reason for keeping the two distinct. Reeve's *bilineata*, of which I have examined the types, is certainly the same. Von Martens considered Nevill's *expansa* as being a distinct species and not a variety of *conica*, but as a result of examination of a large series of specimens, including the ones identified by von Martens, I am of opinion that it must be relegated as a variety of *conica*. Of the other authors' names referred to above I have examined the specimen which was figured as *A. paludinooides* by Hanley and Theobald, and also other shells labelled as such from Theobald's collection; all these shells also are the same as Nevill's *expansa*. Lea's name which is the older must, however, be adopted for it.

Pila layardi (Reeve).

(Plate XIV, fig. 5.)

1856. *Ampullaria layardi*, Reeve, *Conch. Icon.* X, *Ampullaria*, pl. vi, fig. 27 and pl. viii, fig. 40.
 1876. *Ampullaria layardi*, Hanley & Theobald, *Conch. Ind.* pp. xvii, 47; pl. cxiv, fig. 4.
 1877. *Ampullaria globosa* var. *carinata*, Nevill, *Cat. Moll. Ind. Mus.* Fasc. E, p. 3.
 1885. *Ampullaria globosa* var. *layardi*, Nevill, *Hand-List Moll. Ind. Mus.* II, p. 3.
 1910. *Ampullaria virens* var. *layardi*, Sowerby, *Proc. Malacol. Soc. London*, IX, p. 62.
 1912. *Pachylabra layardi*, Kobelt in Martini & Chemn., *Conch. Cab. (n. f.) Ampullariidae*, p. 73, pl. xxxiv, figs. 3, 4.
 1915. *Pila layardi*, Preston, *Faun. Brit. Ind. Freshw. Moll.* p. 99.
 1923. *Pachylabra layardi*, Prashad, *Journ. As. Soc. Bengal (n. s.)* XVIII, p. 587.

The original description by Reeve is fairly complete and I have little to add to it. The species is closely allied to *P. virens* (Lam.), but the suture is never so deeply canaliculate and the shoulder on the body-whorl is consequently less marked and much less angulate. The shell is less stout, lighter in colour with more traces of bands on the body-whorls, with the sculpture less prominent, the whorls slightly more tumid and the mouth more oblique and slightly broader in proportions.

P. layardi has a much smaller shell than *P. globosa* and the animal (*vide* Nevill 1877, p. 3, footnote) is of a different colour. The shells vary exactly as in *P. globosa* and *P. virens* in having the spire more or less produced, the mouth more or less expanded and the shell-surface smooth or somewhat malleated. The shells are usually light olive to olive-brown in colour.

The operculum is similar to that of *P. globosa* but the inner margin is slightly more concave.

This species is stated by Nevill to be as common in Ceylon as *P. globosa* is in Bengal. In the Indian Museum there are only a few shells sent by E. L. Layard and some collected by G. Nevill. The collection in the British Museum, London, contains a very large series presented by various collectors including Reeve's type of the species.

Measurements (in millimetres).

	1	2	3	4	5	6	7
Total Height	49	48	42	39	44	38.5	40
Maximum diameter	47.2	51	39	37	40	35	38
Oblique height of mouth	34.8	37	31	31	33	28	30.5
Maximum diameter of mouth	27.1	24.2	20	20.2	23	18.5	20

No. 1 is Reeve's type-specimen of the species ; Nos. 2, 3 are from Colombo Lakes and specimens 4-7 are from the Indian Museum collection labelled Ceylon.

Remarks.—*Pachylabra layardi* was originally considered by Nevill to be the same as var. *carinata* (= *virens* Lam.) of *P. globosa*, but later was separated as a distinct variety. Kobelt and Preston considered it to be a distinct species while Sowerby placed it with *virens* as a variety. I have examined a large series of shells including types of *virens* and *layardi* and am of opinion that though allied to *virens* it should be considered as a distinct species.

var. **cinerea** (Reeve).

(Plate XIV, fig. 6.)

1856. *Ampullaria cinerea*, Reeve, *Conch. Icon. X, Ampullaria*, pl. xx, fig. 94.
 1858. *Ampullaria tischbeini*, Dohrn, *Proc. Zool. Soc. London*, p. 134.
 1876. *Ampullaria cinerea* and *A. tischbeini*, Hanley & Theobald, *Conch. Ind.* pp. xvii, 46, pls. cxiii, fig. 1 and cxiv, fig. 3.
 1910. *Ampullaria globosa* var. *cinerea*, *A. virens* var. *Tischbeini* and *A. alucinans*, Sowerby, *Proc. Malacol. Soc. London*, IX, pp. 58, 62, 63, fig. in text.
 1912. *Pachylabra cinerea*, *P. tischbeini* and *P. alucinans*, Kobelt in Martini & Chemn., *Conch. Cab. (n. f.) Ampullariidæ*, pp. 89, 100, 104, pl. xxxv, fig. 9 xlii, figs. 1, 2, xliii, fig. 8.
 1915. *Pila cinerea*, *P. tischbeini* and *P. alucinans*, Preston, *Faun. Brit. Ind. Freshw. Moll.* pp. 101, 102, 103.
 1923. *Pachylabra layardi* var. *cinerea*, Prashad, *Journ. As. Soc. Bengal (n. s.) XVIII*, p. 587.

Reeve's description of *cinerea* is fairly complete and I have very little to add to it beyond noting the variation as to the suture and spire, as also in colouration. The suture in young shells is fairly impressed but is not canaliculate, with the growth of the shell, however, this character becomes very marked. As in most other species of the genus both short and long spired forms are found in this species also. The type-shell is of a dark ashy colour with a few faint darker bands. Mostly the shells are dark olive with obscure bands of a darker shade under the epidermis in some specimens. Bands of a dark chestnut colour are often present on the inner surface of the shell.

Measurements (in millimetres).

	1	2	3	4	5	6
Total height	39	53	25	33	46	58
Maximum diameter	35	48	22	31	42	56
Oblique height of mouth	29	40	18.8	25	33	44
Maximum diameter of mouth	19	27	12	17	22	27

No. 1 is Reeve's type of *cinerea*; No. 2 is the shell figured as *cinerea* in *Conch. Ind.*; No. 3 is the type of *alucinans* Sowerby; No. 4 is one of Dohrn's type-series of *tischbeini* and Nos. 5, 6 are from Ceylon in the Indian Museum.

Remarks.—Reeve's type-specimen of *cinerea* in the British Museum is a half-grown shell, while the shell figured by Hanley and Theobald, which I have also seen, is a much larger specimen. Larger shells are present in the collections of the British Museum and in the Indian Museum. Sowerby's type shell of *alucinans* in the British Museum is only a young of *cinerea*. That Sowerby himself did not know his new species *alucinans* became apparent on examining a specimen which was sent to Kobelt by Sowerby as *Pila alucinans* from Ceylon. This specimen is a young thick-shelled form of a dark brownish colour, not at all banded as the type of *P. alucinans* is, with vertical striae; the shell as a whole is much higher than broad with an elongate spire, the umbilicus more perforate and not fully covered by the rather narrow columellar border. This shell, except for being of about the same size as the type-shell of *alucinans*, has nothing in common with it. It is only a young specimen of *P. conica*, probably of the var. *gracilis* (Lea).

Dohrn's type-series of *A. tischbeini* consists of three shells out of the 'Mus. Cuming' collection. One of these shells is the typical *layardi*, while the other two are the same species. Of these the type-shell was figured by Hanley and Theobald. It is a little abnormal as regards its spire which is very much produced, otherwise it is quite like the shells of the var. *cinerea*. Specimens with varying lengths of the spire are, as has been noted already, present in this variety, and the specimens in the collections of the British Museum form a regular series between the types of *cinerea* and *tischbeini*.

It is undoubtedly a variety of the common Ceylonese species *layardi* being distinguished by its thinner shell, the less canaliculate suture, more perforated suture and different sculpture. In younger shells the colour bands on the shells are also more distinct.

***Pila dolioides* (Reeve).**

(Plate XIV, fig. 7.)

1856. *Ampullaria dolioides*, *Ampullaria canaliculata* (Reeve nec Lam.) and *A. moesta*, Reeve, *Conch. Icon.* X, *Ampullaria*, pls. xvi, figs. 75, a, b, xvii, fig. 79, xx, fig. 92.
1876. *Ampullaria moesta*, Hanley & Theobald, *Conch. Ind.* pp. xvii and 47, pl. cxv, fig. 6.
1877. *Ampullaria dolioides*, Nevill, *Cat. Moll. Ind. Mus.* Fasc. E., p. 12.
1885. *Ampullaria dolioides*, Nevill, *Hand-List Moll. Ind. Mus.* II, p. 7.
1909. *Ampullaria* (s. s.) *dolioides*, Sowerby, *Proc. Malacol. Soc. London*, VIII, p. 348.
1910. *Ampullaria moesta*, Sowerby, *Op. cit.* IX, p. 60.
1912. *Pachylabra dolioides* and *P. moesta*, Kobelt in Martini & Chemn., *Conch. Cab. (n. f.) Ampullariidae*, pp. 74, 75, pl. xxxiv, figs. 5, 6, 8.
1915. *Pila dolioides* and *P. moesta*, Preston, *Faun. Brit. Ind. Freshw.-Moll.* p. 101.
1923. *P. dolioides*, Prashad, *Journ. As. Soc. Bengal* (n. s.) XVIII, p. 588.

Reeve's English description of *dolioides* is as follows: "Shell ovate, thin, ventricose, narrowly umbilicated, spire short, sharp, whorls convex, shining, impressed at the sutures, last whorl largely swollen and expanded; ash-olive, obscurely red-banded, bands linear, irregular; aperture very large, open, columellar lip reflected.

Hab.—Bombay.

An elegantly convoluted species, of light semitransparent substance, the last whorl being unusually larger than the rest, and openly expanded."

The following notes may be added to the above :—

The shell of this species is comparatively large, ventricose with an elongate spire and more or less acuminate apex. The suture is fairly impressed and somewhat canaliculate. The aperture is very large and expanded. The shell is narrowly perforate and in adult individuals the reflected umbilicus almost completely covers the perforation. Specimens vary as to the length of the spire, and both long and short spired forms are found in the same localities. Young individuals are paler in colour than full-grown specimens, which are usually olive-brown with distinct, dark, transverse bands of a darker colour encircling the shells.

Measurements (in millimetres):

Total height	46	39	25	29
Maximum diameter	41	36	22	27
Oblique height of mouth	36	31	19	23
Maximum diameter of mouth	24	21	12	16

Remarks.—Reeve's type-shell of *dolioides* from the 'Mus. Cuming' collection in the British Museum is labelled Bombay. On the same tablet there are two other shells, one like the type is *dolioides*, while the other is a South American shell. Apparently this led Hanley and Theobald to suggest in the systematic list in *Conchologia Indica* that the species is South American. Sowerby (*loc. cit.*) was also misled by the same shell and included the species in *Ampullaria* s. s. with La Plata, etc., as its habitat. Nevill, however, had collected a shell in Ceylon which agreed with Reeve's figure of *dolioides* and was of opinion that the species was Ceylonese. Kobelt agreed with Nevill's conclusions. In the unnamed collections of the Indian Museum, Calcutta, and in the British Museum (Natural History), London, I found a fair number of specimens from Ceylon which are identical with the type-shell. There can be no doubt, therefore, that the species is a true Ceylon form. So far as I know it does not occur anywhere in South India.

Reeve's *moesta*, of which I have examined the type, is only a half-grown shell of *dolioides*.

In the synonymy I have included *canaliculata* (Reeve *nec* Lam.). This conclusion is based on an examination of the specimen so labelled by Reeve and figured in *Conchologia Iconica*. The specimens are from 'Mus. Cuming' collection and are stated to have been received from Baron Hugel with the locality "Cashmere", (Kashmir). I have personally collected extensively in Kashmir and have also examined various large collections from that area, but have never come across any specimens of an Ampullariid from Kashmir or even the Punjab. Only fossil opercula of a species which I have described elsewhere¹ as

¹ Prashad, *Rec. Geol. Surv. Ind.* (in press).

Pachylabra prisca are known from Poonch in the Punjab. The specimens of Reeve's *canaliculata* were considered by Sowerby to be shells of the Zanzibar form *speciosa*. As I have satisfied myself, however, they are only shells of the Ceylonese *dolioides*.

Morelet's remark ¹ that *A. moesta* of Reeve appears to be only a variety of *A. borneensis* Phil. is, in view of what has been stated above, certainly incorrect. The species has no relationship with *P. conica* of which *borneensis* is only a form.

var. **woodwardi** (Dohrn).⁷

1858. *Ampullaria woodwardi*, Dohrn, *Proc. Zool. Soc. London*, p. 134.

1876. *Ampullaria woodwardi*, Hanley & Theobald, *Conch. Ind.* pp. xvii and 47, pl. cxv, fig. 5.

1910. *Ampullaria woodwardi*, Sowerby, *Proc. Malacol. Soc. London IX*, p. 62.

1912. *Pachylabra woodwardi*, Kobelt in Martini & Chemn., *Conch. Cab. (n. f.) Ampullariidae*, p. 105, pl. xliii, fig. 9.

1915. *Pila woodwardi*, Preston, *Faun. Brit. Ind. Freshw.-Moll.* p. 102.

1923. *Pachylabra dolioides* var. *woodwardi*, Prashad, *Journ. As. Soc. Bengal (n. s.) XVIII*, p. 588.

Dohrn described this species from two specimens in the 'Mus. Cuming' collection, but as I remarked recently, in my paper cited above, I could only find one of these in the British Museum when working there in 1922. This specimen is a young shell with the apex very much eroded. This unique shell is, as noted already, very like the young shells of *dolioides*, but owing to the more perforate nature of the shell, the loosely wound whorls, the darker colouration and differences in proportions, I propose considering it as a distinct variety.

Pila robsoni sp. nov.

(Plate XIV, figs. 8, 9.)

1877. *Ampullaria moesta*, Nevill (*nec.* Reeve), *Cat. Moll. Ind. Mus. Fasc. E*, p. 12.

1885. *Ampullaria moesta*, Nevill, *Hand-List Moll. Ind. Mus. II*, p. 7.

Nevill in his first work provisionally identified 4 specimens which he had himself collected near Balapiti, Ceylon, as probably belonging to Reeve's *moesta*. He, however, noted that "they do not agree very well with figures in *Conch. Indica* and Reeve's *Monog.*, the whole shell apparently being more angular, imperforate, and of a brown colour." I have carefully compared these specimens with Reeve's types of *moesta* (= *dolioides* *vide* p. 84) and I am of opinion that they represent an undescribed species. This species I describe below under the name *P. robsoni* in recognition of the very great help I received from Mr. G. C. Robson of the British Museum (Natural History), London, while I was working there in 1922.

The shell of this species is of medium size, globose and of moderate thickness. The total length in the type-specimen with the worn apex is only a little more than the maximum diameter. The spire is depressed but not flattened at the base. There are $4\frac{1}{2}$ whorls and the spire, though somewhat eroded in all specimens, is acuminate and, owing to the swollen whorls, has towards the base a globose appearance; it is only slightly exerted. The upper

¹ Morelet, *Ser. Conchyliol.* IV, p. 290 (1875).

surface of all the whorls is convex and the body-whorl alone is slightly carinate. The suture is deeply impressed and in the body-whorl becomes distinctly carinate. The body-whorl is broad and somewhat heart-shaped in dorsal view. The mouth of the shell is large and is $1\frac{1}{2}$ times as high as broad. The main axis of the mouth forms a very acute angle with the main axis of the shell. The peristome is continuous, but the inner lip above the callus is very thin and in some places appears to be incomplete; the outer lip is thin and sharp and only the anterior margin of the peristome is slightly everted. The umbilicus is quite closed being covered over by the narrow but strongly developed callus.

The external surface is shining but not highly polished. It is sculptured with longitudinal strong striae which are very distinct near the suture.

The colour is olivaceous with brownish to black spiral bands alternating with narrow lighter areas all over the surface of the body-whorl. In young shells the bands are fewer and the lighter background is more prominent.

The operculum is thin but heavy. Its outline is somewhat pyriform, the outer margin being strongly convex and the upper part of the inner margin somewhat concave. The external surface is markedly concave and the lines of growth are distinctly visible. The muscular scar is elongate and roughly corresponds in outline to that of the operculum. Its smooth area is prominent owing to a bluish colour, while the transversely sculptured area round it is broad.

Measurements (in millimetres).

	<i>Type.</i>			
Height.	34	22	19	18
Maximum diameter	31	20	17	15
Height of mouth	26	17	15	13
Maximum diameter of mouth	17	11	10	8

Types.—In the collection of the Zoological Survey of India (Indian Museum), No. 2414.

The species is represented by 3 young and one adult shell collected by G. Nevill near Balapiti, Ceylon.

Remarks.—The species resembles *P. dolioides* in shape, but is easily distinguished by its closed umbilicus.

Genus **TURBINICOLA** Annandale & Prashad.

1921. *Turbinicola*, Annandale & Prashad, *Rec. Ind. Mus.* XXII, p. 9.

1923. *Turbinicola*, Prashad, *Journ. As. Soc. Bengal* (n. s.), XVIII, p. 591.

In the paper cited this genus was described by Annandale and myself for the hill-stream Ampullarid of the Western Ghat species of Bombay Presidency. Since then I have come to the conclusion that a Burmese hill-stream species with similar peculiarities of shell should also be included in this genus.

The shell-characters and the radula of the genus are fully described in the paper cited above.

The animal of this genus resembles that of the genus *Pila* except in the following respects.—(i) The two nuchal lobes or the pseud-epipodia are of the same size and no siphon

is formed by the left lobe. (ii) The lung is comparatively much more capacious, more richly supplied with blood vessels and with its upper wall rather thin. The opening of the lung is also situated more anteriorly and is very much larger than in the genus *Pila*. (iii) The epitaenia is much better developed, forming a much higher ridge and more efficiently separates the branchial from the pulmonary part of the pallial cavity. (iv) The gill filaments are not so large and the gill does not appear to be used for aquatic respiration to the same extent as in the genus *Pila*. (v) The osphradium is less highly organized. (vi) The penis and its sac are much larger and the seminal groove is much deeper than in the genus *Pila*; and (vii) the radular teeth are very different.

The genus appears to have evolved on the same lines as the South American Ampullariid genus *Asolene* D'Orbigny.¹ The operculum of the American genus is described by Kobelt as horny,² while that of the Indian genus is calcareous. The difference in the structure of the operculum is the same as that between the genera *Ampullaria* and *Pila*. Practically nothing is known about the animal of the genus *Asolene*, beyond the fact that no respiratory siphon is formed by the animals for breathing. The same is the case in the Indian species *T. saxea*, the anatomy and habits of which are known.

Turbinicola saxea (Reeve).

(Plate XIV, figs. 10–12.)

1856. *Ampullaria saxea* and *Ampullaria nux*, Reeve, *Conch. Icon.* X, *Ampullaria*, pls. xxii, fig. 108, xxviii, figs. 132 a, b.
1876. *Ampullaria nux*, Hanley & Theobald, *Conch. Ind.* pl. cxv, fig. 1.
1877. *Ampullaria nux* (typical), Nevill, *Cat. Moll. Ind. Mus.* Fasc. E., p. 5.
1885. *Ampullaria nux*, *id.*, *Hand-list Moll. Ind. Mus.* II, p. 3.
1910. *Ampullaria saxea* and var. *nux*, Sowerby, *Proc. Malacol. Soc. London*, IX, p. 61.
1912. *Pachylabra nux* and *P. saxea*, Kobelt, Martini & Chemn., *Conch. Cab. (n. f.)*, *Ampullariidae*, pp. 82, 89, pls. xxxvii, figs. 5, 6; xxxv, fig. 7.
1915. *Pila nux*, Preston, *Faun. Brit. Ind. Freshw. Moll.* p. 99.
1918. *Ampullaria nux*, Annandale & Prashad, *Rec. Ind. Mus.* XVI, p. 149, pl. v, fig. 8.
1921. *Turbinicola nux*, *ib.*, *id.*, XXII, p. 9.
1923. *Turbinicola saxea*, Prashad, *Journ. As. Soc. Bengal* (n. s.) XVIII, p. 591.

In the paper cited above I recently pointed out that as a result of my examination of the Reevian types in the British Museum, London, an unfortunate change has been rendered necessary in the name of this hill-stream Ampullarid of the Bombay Presidency. The type-series of *saxea* and *nux* each consist of three shells mounted on tablets and form part of the 'Mus. Cuming' collection. Reeve apparently mixed up the two species when describing these shells and his figures of the two species, poor as they are, are both of the hill-stream Ampullarid of the Bombay Presidency. Sowerby, in the paper cited above, casually hinted that the two species were probably synonymous or at most *nux* may be considered as a variety of *saxea*. As a result of a careful examination of the types and other specimens in the British Museum and other collections I am of opinion that the type-series

¹ D'Orbigny, *Voy. Amer. Mer.* p. 364 (1837).

² Kobelt, Martini & Chemn., *Conch. Cab. (n. f.) Ampullariidae*, p. 203 (1913).

of the two species are certainly specimens of the same species, and, since *saxea* has page priority over *nux*, the latter name must be dropped. It may also be noted here that *saxea* of Hanley and Theobald is the Burmese species *T. aperta*. According to Reeve the provenance of the type-series of *saxea* was unknown, but the type-tablet has the label "Bombay" in a later and unknown handwriting. The types of *nux* are labelled "Bombay". Another tablet out of the 'Mus. Cuming' collection in the B. M. is labelled "Borneo," but this is certainly a wrong locality like so many other Cumingian localities. Other specimens in the B. M. are labelled Bhor Bhat, Western India; Western Ghats; Bombay and India without definite localities. The exact distribution of the species, as was noted by Annandale and myself in the paper cited above, is the small hill streams round Khandalla and Igatpuri in the Western Ghats, Bombay Presidency, at altitudes between 2,500 and 3,000 feet.

Reeve's description of the species is not quite complete but a detailed description will be found in the paper by Dr. Annandale and myself cited above. Owing to all the specimens then at our disposal having a greatly eroded apex we were unable to say anything about the apex, but since then I have collected large series of fresh shells. In these the embryonic shell forming a bluntly pointed apex is beautifully preserved, being of a dark-brownish to blackish colour and showing out remarkably against the yellow olivaceous colour of the shell.

The figures of this species in both *Conch. Iconica* and *Conch. Indica* are very poor. The shell is comparatively longer, less globose, with a less broader mouth and the outer lip sharp and not thickened as is shown in the figures.

A few remarks about the biology of this species would not be out of place here. *T. saxea* is confined to hill-streams. It is only found during and for sometime after the rains, while there is water in the more or less perennial hill-streams. Animals of this species are only found along the banks of the streams or on rocks which are projecting above the surface of the streams and do not frequent deeper waters. The animals were observed to stick in such a way that the anterior part of the shell with the siphonal area was above the water-level. Specimens thrown into the deeper parts always crawled to the banks of the streams. The same was observed in the case of specimens kept in aquaria in the laboratory. The animals always crawled to above the water-level and preferred aerial to aquatic respiration.

The eggs of the species resemble those of the members of the genus *Pila* and are laid in one or two layered thick clusters. The clusters are attached to stones outside the water and the eggs are nearly 5 mm. in diameter. At Khandalla many clusters of eggs with fully formed young animals in them were found in the month of June, 1923. The egg-covering is calcareous.

Turbinicola aperta (Phil.).

(Plate XV, figs. 1, 2.)

1849. *Ampullaria aperta*, Philippi, *Zeitschr. Malakozool.* VI, p. 18.
 1851. *Ampullaria aperta*, Philippi in Martini & Chemn., *Conch. Cab.* (ed. Kuster) *Ampullaria*, p. 14, pl. iii, fig. 5.
 1876. *Ampullaria saxea* (nec Reeve) and *A. saxea* var., Hanley & Theobald, *Conch. Ind.* pp. xvii, 47, pl. cxv, figs. 3, 4.
 1877. *Ampullaria aperta* Nevill, *Cat. Moll. Ind. Mus.* Fasc. E. p. 6.
 1885. *Ampullaria aperta*, Nevill, *Hand-List Moll. Ind. Mus.* II, p. 4.
 1910. *Ampullaria aperta*, Sowerby, *Proc. Malacol. Soc. London*, IX, p. 57.

Owing to the absence of fresh examples with soft parts I have, after a great deal of hesitation, decided to include this species on shell characters only in the genus *Turbinicola*. The shell is certainly larger and more globose than in *T. saxea*, but the species, like *T. saxea*, is an inhabitant of hill-streams. The erosion of the spire and the body-whorl as seen in the shells from Akyab appear to have been brought about by a rocky bottom in a rapid-running stream. The columella is similar to that of *T. saxea*, being very narrow and the umbilicus is similarly closed or rimate. The species may be redescribed as follows :—

The shell is of medium size, globose-ovate, somewhat swollen and very solid. The height of the shell is slightly more than the maximum diameter, but in specimens with an eroded apex the shells are as high as or a little higher than broad. There are 6—6½ whorls—the apex is acute, often eroded, but the brownish protoconch is always distinctly visible. The spire is more than ⅓ of the total height and is greatly exerted. The suture is only feebly impressed, but the part of the whorls next to the suture is distinctly flattened producing a distinct shoulder-shaped appearance even though the suture is not canaliculate. The whorls are all swollen and increase in size suddenly. The columella is narrow but strongly developed. The shells are rimate, the umbilicus being almost completely covered over by the columellar callus. The mouth is broadly ovate, the peristome being continuous and the lips slightly retroverted.

The shells are usually smooth but in some specimens fine vertical ridges can be distinguished on the body-whorl.

Specimens vary greatly in colour, some of them are of a uniform olive-brown, others are light olive-brown with transverse bands of a deep-brown encircling the body-whorl.

The operculum, which corresponds in outline to that of the mouth, resembles that of *T. saxea* in being very concave on the outer side and in having a large boss on the inner surface for the attachment of the muscles.

Measurements (in millimetres).

	1	2	3	4	5	6	7
Total height	35	34	32	25	35	30	25
Maximum diameter	31	30	27	25	30	27	22
Oblique height of mouth	25	25	22	19	24	21	19
Maximum diameter of mouth	19	18	17	14	17	14	13

Specimens Nos. 1-4 are from Akyab, the spire of specimen No. 4 is greatly eroded ; Nos. 5, 6 are from Pegu and No. 7 is from Bassein.

The species is characteristically Burmese and all the specimens which I have examined are from hill-streams.

Remarks.—“*Ampullaria aperta*” was described by Philippi from a specimen of unknown habitat. It was, however, rightly identified by Nevill as being the Burmese species which Hanley and Theobald had called *saxea*. As I have stated (*antea* p. 88) the names *saxea* and *nux* of Reeve's *Conch. Icon.* are synonyms and as *saxea* has page priority over *nux*, the species from Western Ghats which had hitherto been known as *nux* must be designated as *saxea*. It is of interest to note that *T. aperta* and *T. saxea* are the only two Ampullarids which are found in hill-streams.

EXPLANATION OF PLATE XIII.

All the figures are reproduced from direct untouched photographs of shells.

Pila globosa (Swainson).

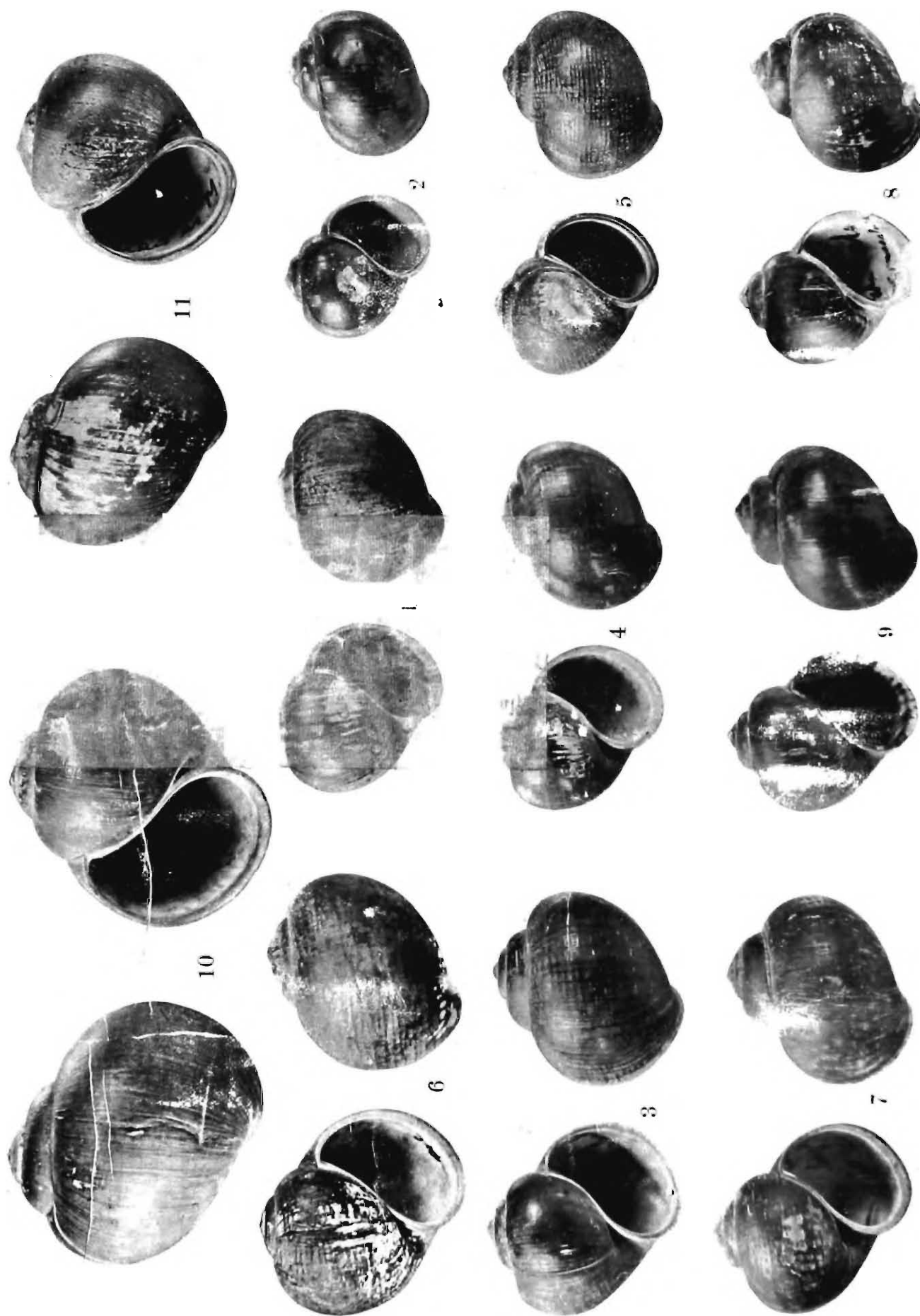
- FIG. 1.—Upper and lower views of a shell from Calcutta. $\times \frac{1}{2}$.
FIG. 2.—Upper and lower views of a shell from Pilibhit, Central India. $\times \frac{1}{2}$.
FIG. 3.—Upper and lower views of a shell from Allahabad, United Provinces. $\times \frac{1}{2}$.
FIG. 4.—Upper and lower views of a shell from Sambalpur, Orissa. $\times \frac{1}{2}$.
FIG. 5.—Upper and lower views of a shell from Gopalpur, Orissa. $\times \frac{1}{2}$.
FIG. 6.—Upper and lower views of a shell from Port Canning, Bengal. $\times \frac{1}{2}$.
FIG. 7.—Upper and lower views of the type-shell of var. *longispira* Nevill from Benares. $\times \frac{1}{2}$.

var. *minor* Nevill.

- FIG. 8.—Upper and lower views of the type-shell from Dum Dum, Bengal. Natural size.

var. *incrassatula* Nevill.

- FIG. 9.—Upper and lower views of the type-shell from Calcutta. Natural size.
FIGS. 10, 11.—Upper and lower views of two sinistral shells of *P. globosa* labelled var. *sinistrosa* by M.
Natural size.



INDIAN AMPULLARIIDAE.

All the figures are reproduced from the original photographs.

Pila virens (Lamarck)

FIGS. 1, 2.—Upper and lower views of two shells from Madras. Natural size.

FIG. 3.—Upper and lower views of a sinistral shell labelled *var. sinistralis* by Dall. Natural size.

Pila (Reeve).

a. 4.—Upper and lower views of a shell from [unclear] Natural size.

FIG. 5.—Upper and lower views of a shell from [unclear] Natural size.

Pila hayardii (Reeve).

FIG. 6.—Upper and lower views of a shell from [unclear] Natural size.

Pila dolosus (Reeve)

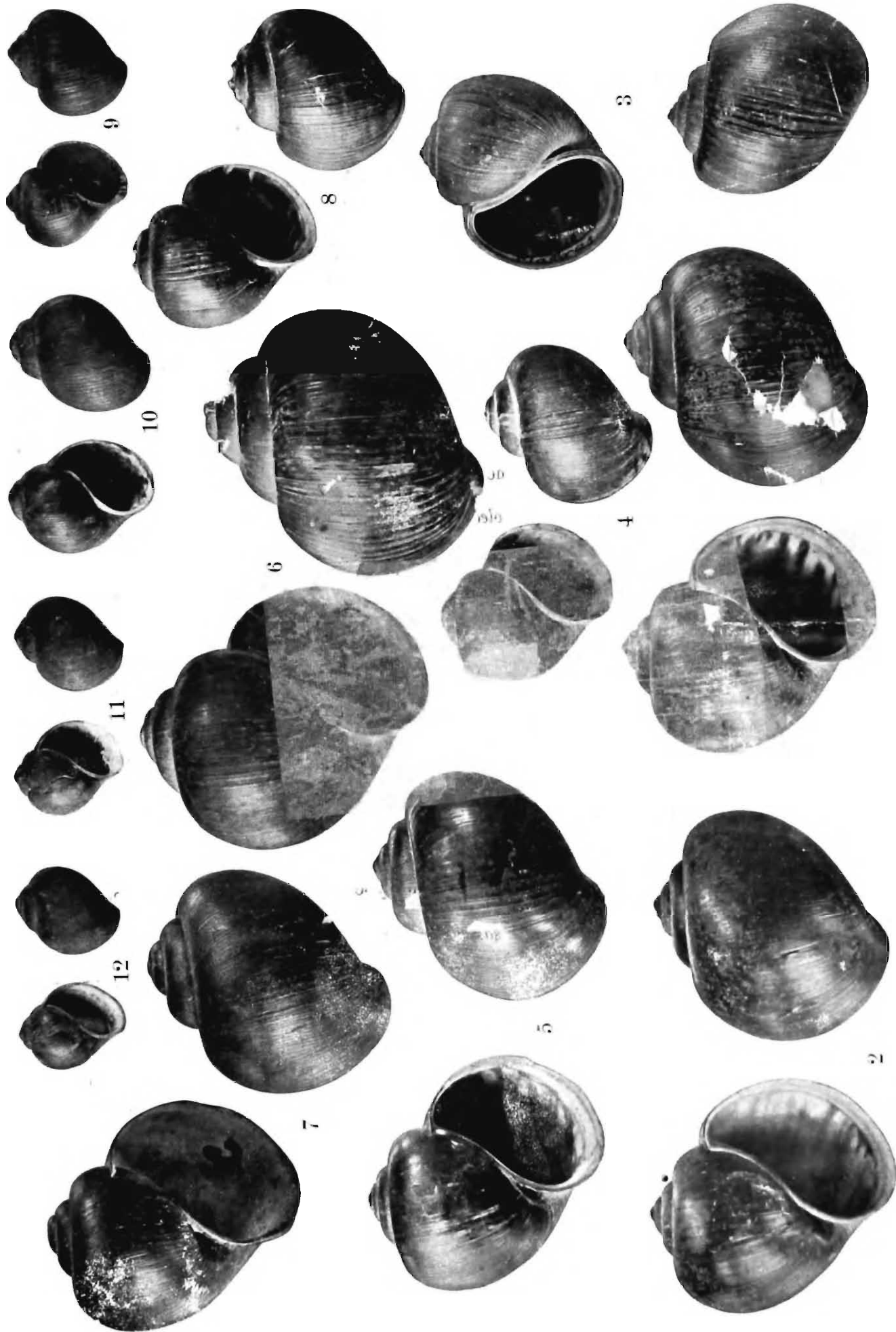
FIG. 7.—Upper and lower views of a shell from Ceylon. Natural size.

isoni, sp. nov.

FIGS. 8, 9.—Upper and lower views of two shells out of the lot from Balapiti, Ceylon. Natural size.

Turbinicola *rea* (Reeve).

FIGS. 10-12.—Upper and lower views of the shells from Khandalla, Bombay Presidency.



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H. C. Maudslayi photo.

EXPLANATION OF PLATE XV.

All the figures are reproduced from direct untouched photographs of shells.

Turbinicola aperta (Philippi).

FIGS. 1, 2.—Upper and lower views of two shells from Pegu, Burma. Natural size.

Pila theobaldi (Hanley).

FIG. 3.—Upper and lower views of cotype of the species from Moulmein, Burma. $\times \frac{1}{2}$.

Pila conica (Gray).

FIG. 4.—Upper and lower views of a specimen from Rangoon, Burma. Natural size.

FIG. 5.—Upper and lower views of a shell from Bassein, Burma. Natural size.

FIG. 6.—Upper and lower views of a shell from Siam. This specimen was figured and described by Annandale as *P. gracilis* Lea. Natural size.

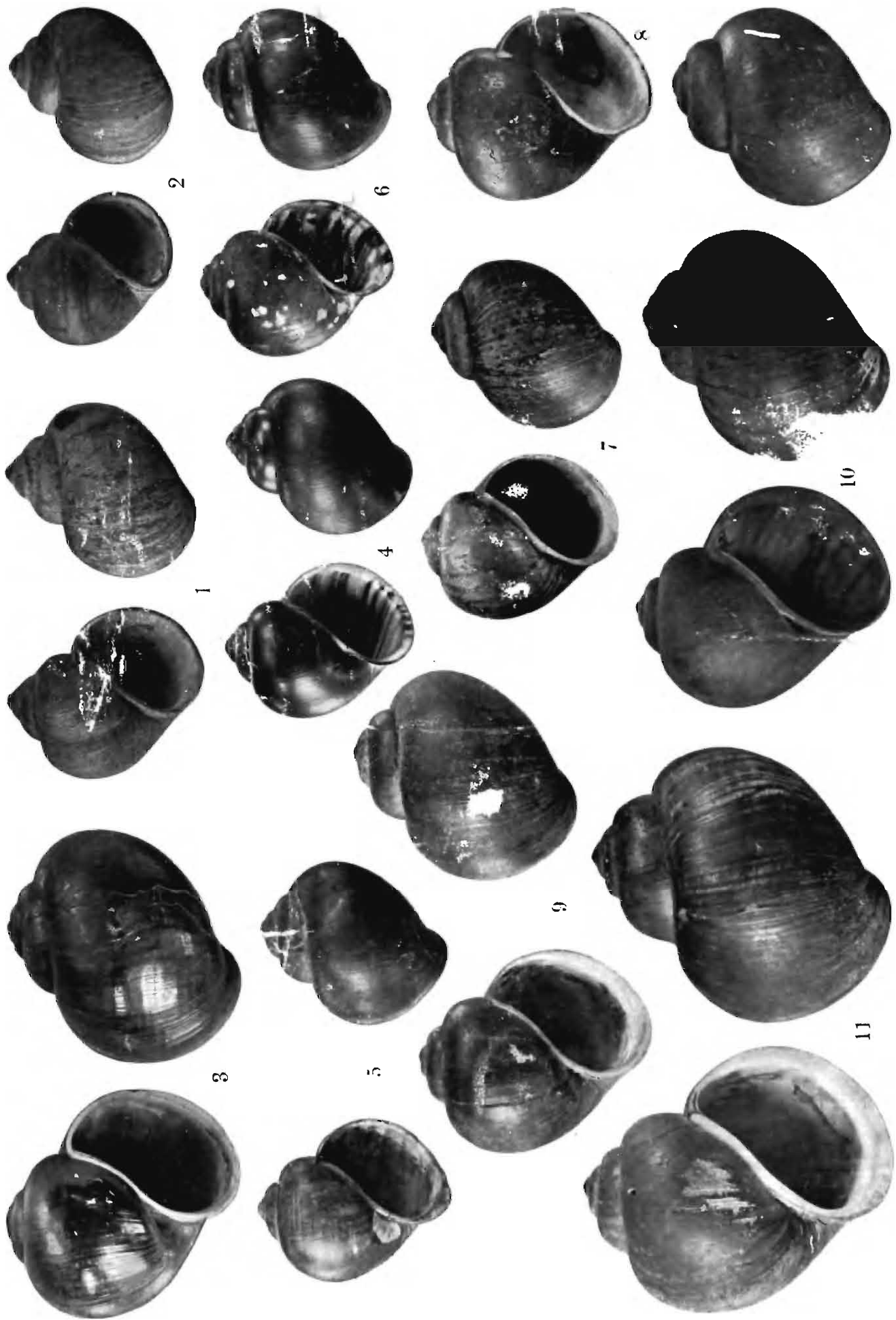
FIGS. 7, 8.—Upper and lower views of two specimens stated to be from China. Natural size.

Pila conica compacta (Reeve).

FIGS. 9, 10.—Upper and lower views of two shells from Mandalay.

Pila conica var. *gracilis* (Lea).

FIG. 11.—Upper and lower views of an adult shell from Pegu. The shell figured is the type of *expansa* Nevill. Natural size.



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