XLIX MOLLUSCA, IX.

By LT.-COLONEL H. H. GODWIN-AUSTEN, *F.R.S.*

I commenced the study of the Genera *Glessula*, *Plectotropis*, *Hapalus*, *Clausilia*, etc., now many years ago, when (associated with William Blanford) the first Molluscan volume of the "Fauna of British India" was in preparation.

With considerable trouble specimens preserved in spirit have been got together and the animals examined. The final results I hope to bring out in "Land and Freshwater Mollusca of India," Vol. III, but the war has greatly delayed publication.[1]

As Helices of the section generally known as *Plectotropis* have been received from the Abor Hills and Eastern Assam, I take this opportunity of making known some of the results, which include the description of a new species from Sikhim, another from the Burrail Range; what is known of *P. huttoni* of the N.-W. Himalaya and of *P. radleyi* of Ceylon; and of a large species allied to *Helix catostoma*, as these are of much interest from the generic point of view. Although this will increase the pages of the "Zoological Results of the Abor Expedition," it will, I trust, add to their value.

Much of what I now communicate would have appeared in Vol. II (1914) of the "Fauna of British India," on which I commenced work in 1912 with Mr. G. K. Gude, vide Preface to that volume. This requires, if only in justice to myself, some explanation. I gave up the task in 1913, for the following reasons. It entailed constant visits to town, and much trouble, as well as correspondence which took up so much time when at my age I did not feel equal to it and when also I had a great deal of other work to do. I tried hard with the Editor, with the India Office, and printers but could not obtain the printed sheets in galley form as they had been supplied by the printers to Dr. W. T. Blanford, at the time I was engaged completing and bringing out Vol. I. Those who have ever been engaged on work of this nature will understand how important this is in the final arrangement of the sheets, especially when perhaps at the last moment the receipt of material from India might upset all previous conclusions as to the generic position of a species.

Having been able to bring together from various sources and to examine a considerable amount of material, I am induced to venture on some changes in classification following p. 200 of the

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[1] Should I be unable to publish these results the manuscript will be placed with the described species in the drawers of the Blanford and Godwin-Austen collections in the Shell Gallery of the British Museum (Natural History).

"Manual of Conchology" under *Eulota*. In this excellent work of Mr. H. A. Pilsbry, 2nd Series (Pulmonata), p. 208, under section *Plectotropis*, commenting on Prof. Wiegmann's work and figures of *P. sumatrana* and *P. rotatoria*, Pilsbry very truly says: "Until adult examples are examined I do not venture to "transfer this species especially since a vast majority of the "forms of both groups are still anatomically unknown, and their "systematic position consequently is only arbitrarily fixed by "slight and obscure shell features." Thus *Thysonota* (p. 207) may be removed, vide *L. and F. W Moll. India* (1907), p. 189, which no doubt Mr. Pilsbry has already done.

In this section of the Helicidae, there is a general similarity in the radula, vide *Man. Conch.* pl. 65, fig. 14 (*Plectopylis vulvivaga*), and pl. 65, fig. 3 (*Eulotella similaris*), but great differences are found in the generative organs, and the dart-sac is a conspicuous feature, vide pl. 66, figs. 33, 34 for the first, and pl. 66, fig. 20 for the second.

Among the long list of species of the section *Plectotropis* given by Pilsbry, I note the following from India and Burma and Borneo.

akoutongensis, Theob. Pegu.
emensus, G.A. Burma. *P.Z.S.* 1888, p 242.
mitanensis, G.A. Tenasserim. *A.M.N.H.* 1869, p. 108.
grumulus, G.A. Borneo. *P.Z.S.* 1891, p. 43, pl. v, fig. 2.
pudica, G.A. Labuan. *P.Z.S.* 1891, p. 43, pl. ii, figs. 7, 7*a*.
huttoni, Pfr. N.-W. Himalaya. *Symb. Hist. Helic.* 1842, p. 82.
=*orbicula*, Hutt. *J.A.S.B.* 1838, p. 271.
v. *savadiensis*, Nev. Sawady, Upper Burma. *Hand-list*, p. 73, 1878. Type in Indian Museum.
clarus, G.A. Burma. *P.Z.S.* 1888, p. 242.
catostoma, W. Blf. *P.Z.S.* 1869, p. 447.
oldhami, Bens. Burma. *A.M.N H.* 1859, p. 185.
tapeina, Bens. Khasi Hills. *J.A.S.B.* 1836, p. 352.
rotatoria, Busch. Java.

Of these I have examined the animal of *P. huttoni* and am able to give a description of it, and some other species from Sikhim and the Eastern Frontier

Many years ago I had noticed how very much the shell of this species differed from very similar looking species from other parts of India and Burma, species which had received very casual attention and had come to be considered alike. I compared all I had, and provisionally named those species I considered distinct. More recently, to obtain some idea of the generic position, I have paid attention to the anatomy of the animals of those I had in spirit, and been able to continue the work, thus verifying their distinctness.

William Theobald in his "Catalogue of the Land and Fresh-water Shells of British India" (1876) was the first to give this species a very wide distribution; he records "Himalayas, Simla to Sikkim; Nilghiri Hills; Iravadi Valley."

In the most recent publication "The Fauna of British India," Vol. II, Mollusca, p. 211, 1914, the range of *H. huttoni* is to say the least very remarkable, it is apparently copied from Nevill's "Hand List" of 1878, then 36 years old and thus with no further advance in our knowledge. These habitats are India (Simla and Landour); Darjiling; Kashmir; Naga Hills; Dafla Hills; Shevroy Hills; Burma, Upper Salween Valley; Puppa Hills near Ava; China; and Ponsee, Yunnan. With the exception of Kashmir, I fortunately have examples of most of these.

Family ZONITIDAE.

Sivella castra, Bs.

(Text-fig. 1).

Locality.—Sikhim.

Animal. The visceral sac is white, with black splashes at regular intervals as far back as the commencement of the liver

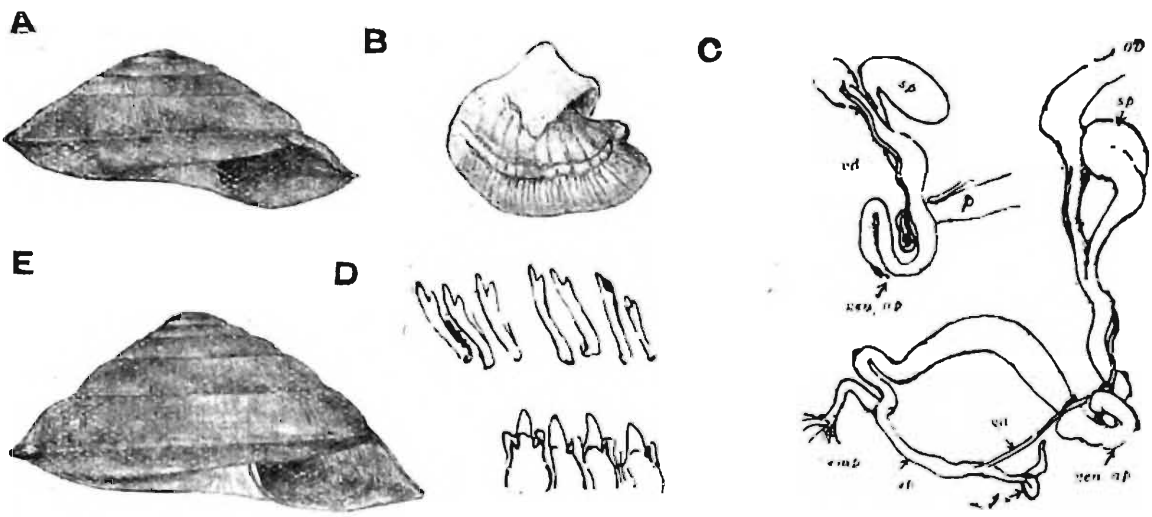

FIG. 1.—*Sivella castra*, Bs.

A.—Shell, × 4. Abor Hills.
B.—Extremity of foot of animal to show the mucous gland, × 9.
C.—Generative organs, × 9.
D.—Teeth of the radula from different parts of the row, × 800.
E.—Shell, × 4. Rarhichu, Sikhim.

lobes, and thus it resembles the animal of *Rahula*. The extremity of the foot has a small lobe above the small slit of the mucous gland (text-fig. 1, B), the peripodial margin is very broad with two grooves above well defined. The genitalia (text-fig. 1, C) were well got out, the penis (*p*) consists of a long sheath, the retractor muscle strong and short at the end, a long epiphallus (*ep*) follows and where the vas deferens joins there is a well-developed flagellum. The spermatheca (*sp*) rises about half way up the free oviduct and has a globose termination. This does not agree with Stoliczka's figure, plate ii, fig. 7, *J.A.S.B.* 1873, described on p. 21, and

there is no flagellum shown and the spermatheca rises at the generative aperture.

Stoliczka, however, does not give the habitat of the animal he dissected, but as the paper is on the land shells of Penang Island, *castra* from that place was at the time he wrote before him, thus the difference. It is very doubtful if typical *castra* from Sikhim is the same, and has such an extended range.

In the radula (text-fig. 1, D) the central and admedian teeth are small, the latter having a small cusp on the outer side, the marginals are slightly longer, narrow and bicuspid.

Formula ? ? 1.9.1.9.1. ? , there may be about 20 to 25 marginals, but they were so crowded together I could not count them. Jaw not seen.

I have no hesitation in removing this species from the Family Trochomorphidae to the Zonitidae. Pilsbry defines the anatomical characters of the former "without a mucous gland," "spermatheca on a short duct," the opposite is found in *castra* from the Eastern Himalaya, besides which there is a flagellum in the penis. I have figured (*Proceedings Malacological Society*, vol. i, pt. 6, 1895, p. 281, pl. xix) the generative organs of *Videna trilineatus* of Great Nicobar, *bicolor* of Borneo, and *conicoides*; it will be seen they differ altogether from *Sivella castra*.

Sivella castra var. **kobonensis**, nov.

Locality.—Kobo, Abor Hills. No. 6013, Ind. Mus. (*S. W Kemp*).

Shell very depressedly pyramidal, flat on base, keel sharp, sculpture irregular rather distant transverse folds, fewer on base, where rather close concentric striae are conspicuous, colour umber brown, spire moderately high, sides flat, apex rounded, suture linear. Whorls 5, very flat, regularly increasing, aperture oblique, quadrate, peristome thin, columellar margin suboblique.

Size: major diameter 8·9, alt. axis 3·25 mm.

Only two specimens were received and one is small compared with the Dafla Hill form, the nearest locality on the west, it is flatter on the side of the spire and rather more tumid below the keel, but not nearly so flat on the base as in *Sivella castra* of Sikhim. More specimens are required and in a fuller stage of growth to show the variation.

Family HELICIDAE.

Landouria, gen. nov.

Type: H. huttoni, Pfr.

A dart-sac with accessory glands is not present. The penis is short with short epiphallus, flagellum and vas deferens, the spermatheca swollen at the base of a thin duct terminating in a globose sac.

Jaw with many plates. Radula with simple median teeth, a side cusp or ectocone coming in, the marginal have the mesocone lengthened and finally in the outermost marginals this becomes bifid and the ectocone also.

Shell small orbiculate, about 10 mm. in major diameter, openly umbilicate. Whorls closely wound.

This genus includes also *damsangensis* of Sikhim, *hengdanensis* of North Cachar, *aborensis* of the Abor country and *radleyi* of Ceylon (by dissection).

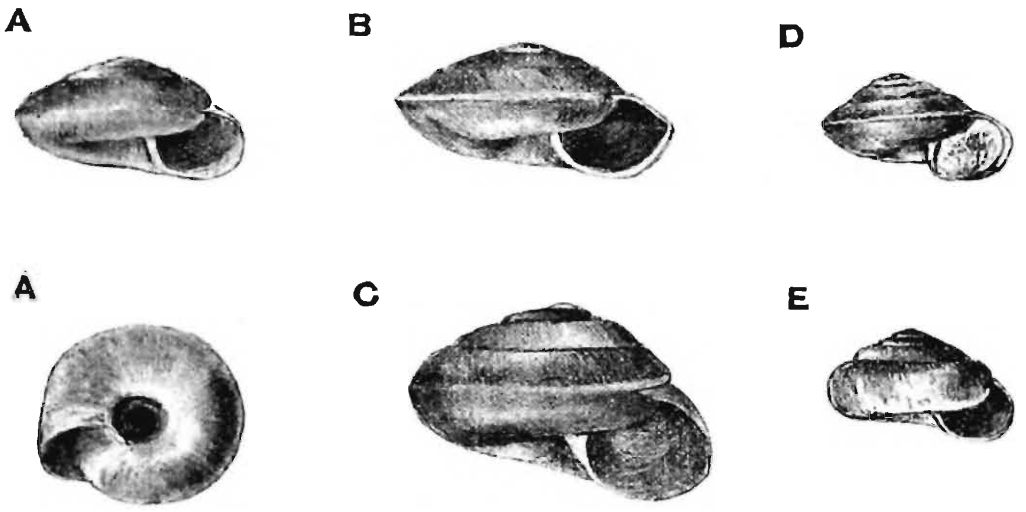

FIG. 2 A.—*Landouria huttoni* (Pfr.), × 2·2.
,, 2 A'.— ,, ,, basal side, × 2·2.
,, 2 B.— ,, *damsangensis*, n. sp., × 2·2.
,, 2 C.— ,, *aborensis*, n. sp., × 4.
,, 2 D.— ,, ,, × 2·2.
,, 2 E.— ,, *hengdanensis*, n. sp., × 2·2.

Landouria huttoni (Pfr.).

(Text figs. 2 A, A' and text-fig. 3).

Helix huttoni, Pfr., *Symb.* II, p. 82.
Helix orbicula, Hutton, *Jour. A.S.B.* VII, p. 217.

Habitat.—Himalaya near Simla, Mahasu (*Hutton*); Landour (*Benson*).

I take this species first, having seen the animal.

Description: "Testa orbiculato-convexa, fuscescente, epider-"mide scabra; anfractibus sex convexiusculis; periphaeria sub-"angulate; umbilico profundo latiusculo; peritremate subrotun-"dato, acuto. Diam. 0·4 (B.)."

From Mussoorie, N.-W Himalaya. I give the following description of a specimen found there by myself.

Shell perspectively umbilicated, orbiculate, slightly convex, sculpture in the young shell, the epidermis when wetted appears rough and spotted, spots in relief and irregular, colour pale corneous; whorls 6, slightly convex, the last angulate and scarcely descending. Aperture oblique, roundly lunate; peristome simple,

columellar margin slightly reflected. Major diameter 10·0, alt. axis 3·5 mm.

Original description: "T. umbilicata, orbiculato-convexiuscula, sub-diaphana, pallide cornea, epidermide scabra induta, aufr. 6, convexiuscula, ultimus angulatus, antice vix descendeus; umbilicus latiusculus, perspectivus; apertura obliqua, lunato-rotundata, perist simplex marginibus."

Among some shells collected alive by my brother-in-law Major S. W. Robinson, R.A., were a few immature examples of this species. The animal has the visceral sac white, with a green tinge, crossed and splashed distantly with black and a few intervening spots of same colour towards the apex. From one I have been able to extract the jaw and radula, but not in so perfect a state as I could wish, still the number of the central and admedian teeth on broad plates can be counted and comparison made with species from other and distant localities, this character shows far more decided and more reliable variation than is to be found in the shells. The radula (text-fig. 3) of *H. huttoni* is a very beautiful

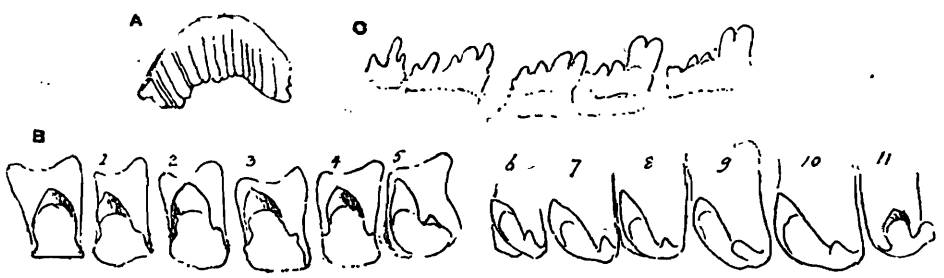

Fig. 3.—*Landouria huttoni* (Pfr.)

A.—Jaw, × 30.
B.—Teeth of the radula, from the central to the 11th.
C.— ,, the outermost marginals, much enlarged.

one. The first four admedian teeth are short and broad, have no cusp on the outer side, only a sort of flange or shoulder, with the 5th tooth the mesocone becomes longer and narrower and an ectocone is present which continues to the 11th tooth, the plates still being broad, these then begin to get narrower with the ectocone bicuspid, and at about the 14th tooth the mesocone becomes bicuspid also.

The jaw (text-fig. 3, A) was slightly broken on one side, but some 15 or 16 narrow plates could be counted.

Since Hutton and Benson dealt with *Helix huttoni* some 80 years ago, coming down to more recent times it has been placed in *Fruticola* by Theobald 1876, in *Plectotropis* by Nevill 1878, Pilsbry 1895, Gude 1914.

In "Die Preussische Expedition nach Ost-Asien", p. 267, Von Martens records *H. orbicula*, Hutton, from Zollinger in Java, this I expect will prove to be another species, the shell no doubt is very close in form, but if the animal could be seen it is not likely to be the same as the Landour species.

The following species is one of which I had the animal in spirits. It is No. 82. *Helix* (*Plectotropis*) *huttoni*, Pfr., Nevill's Hand List (1878), p. 73, from Darjeeling (F. Stoliczka and Col. G. Mainwaring). Quoted by Mr. G. K. Gude in the *Fauna of British India*, vol. II (1914), p. 211, under same title.

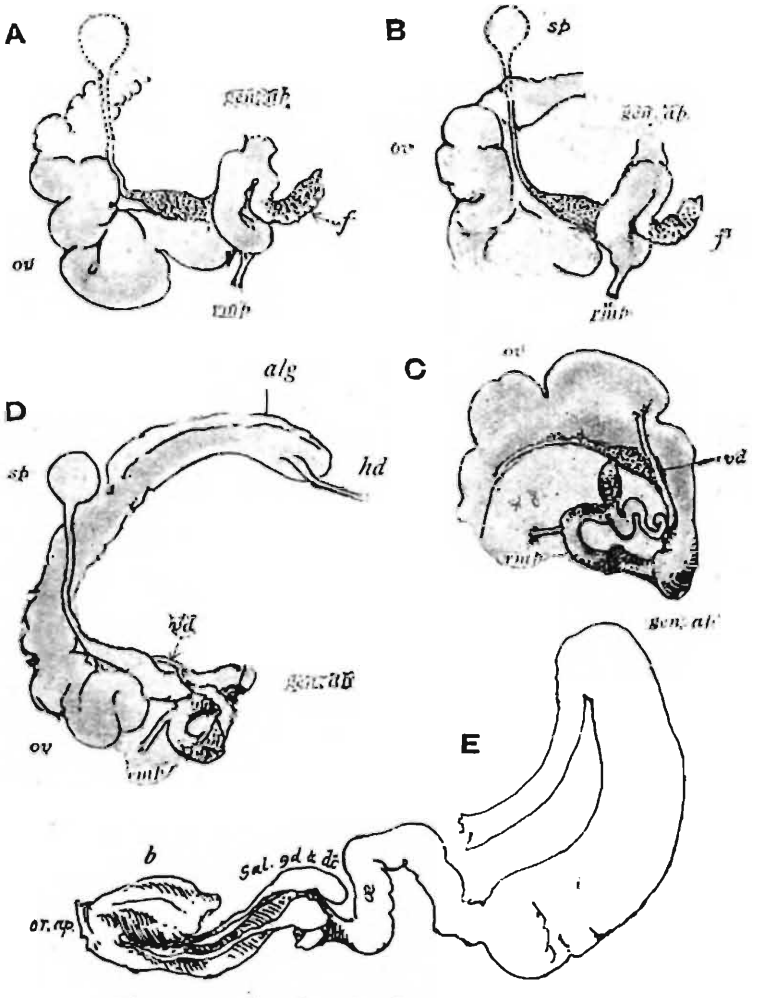

FIG. 4.—*Landouria damsangensis*, n. sp.

A.—Portion of generative organs, 1st specimen dissected, × 7.
B.— ,, ,, 3rd specimen dissected, × 7.
C.— ,, ,,
D.— ,, ,, 2nd specimen dissected, × 7.
E.—Buccal mass, salivary glands and intestine, × 7.

Landouria damsangensis, n. sp.

(Text-figs. 2 B and text-figs. 4 and 5 D).

Locality.—Damsang, Sikhim.

Shell widely and perspectively umbilicate, flatly orbiculate, well keeled; colour ruddy brown. Spire low, apex rounded, sides flatly convex, suture shallow. Whorls 6, closely wound, sides flat; aperture oblique, semi-lunate, peristome slightly thickened. Columellar subvertical not thickened, slightly dilated.

Largest sp.	major diameter	13·0,	alt. axis	5·5 mm.
Ordinary size	,,	10·0	,,	4·8 ,,

Animal. In the spirit specimens the very much darker colour of the visceral sac, much speckled and mottled throughout at once showed this to be a different species to the first I dissected from the Naga Hills. The mantle edge has a broad band of black. The visceral sac as far back as the region of the heart is blue black with a narrow pale ochre band on the line of the rectum, which on closer inspection is made up of closely set double V-shaped markings.

In the generative organs (text-fig. 4, A, B, C, D), the penis is very small in comparison to the length of the free oviduct and albumen gland. It is bent on itself where the short retractor muscle is given off, the epiphallus is short up to where a short thick ovoid sac, which represents the flagellum, occurs, the vas deferens joins this at its base, takes a few twists and continues to the oviduct. The spermatheca is a long thin duct with a fairly large globose termination (fig. 4, D), which is generally broken off in the process of dissection. The salivary glands were well seen with the buccal mass, two separate masses on long fine ducts (fig. 4, E).

The jaw (text-fig. 5, D) is composed of some 24 plates closely set together. Radula formula 15.1.15.

The 16th tooth is bicuspid and the next four are similar.

Landouria hengdanensis, n. sp.

(Text-figs. 2 E and text-fig. 5 A, B, C).

Locality.—Hengdan Peak, Burrail Range, on the North Cachar and Munipur Frontier (*Godwin-Austen*).

Shell globosely conic, very flat on the base, openly umbilicated, sculpture smooth, fine lines of growth, indistinct spiral striation near the umbilicus; colour pale brown. Spire rather high, sides slightly convex, suture shallow. Whorls 5, the last rounded, sides slightly convex, aperture semilunate, columellar margin oblique.

Size: major diameter 10·0, alt. axis 4·5 mm.

This shell is more openly umbilicated than *H. huttoni*.

Animal. The branchial sac is very long, pale ochre, a dark line borders the mantle edge, and on the line of the rectum there are 8 or 9 conspicuous spots of black. The generative organs were not in a state to see very much, or to figure.

The jaw is highly arched with about 24 close set plates. The central teeth are simple and straight sided, at the 6th tooth a small cusp begins to show and continues to the 17th, becoming larger, at the 18th the mesocone is bifid and this is the shape with an outer single cusp up to the margin, where three or four of the outermost laterals have double cusps on the outer side of the bifid mesocone.

Radula formula 14.12.1.12.14 or 26.1.26.

Other species of the genus are numerous on the North-East Frontier of India and Burma, but space does not admit of their introduction in this contribution. They have been described and figured and await publication in "Land and Freshwater Mollusca of India." To give an idea of the range of this new genus, I include the following Ceylon species.

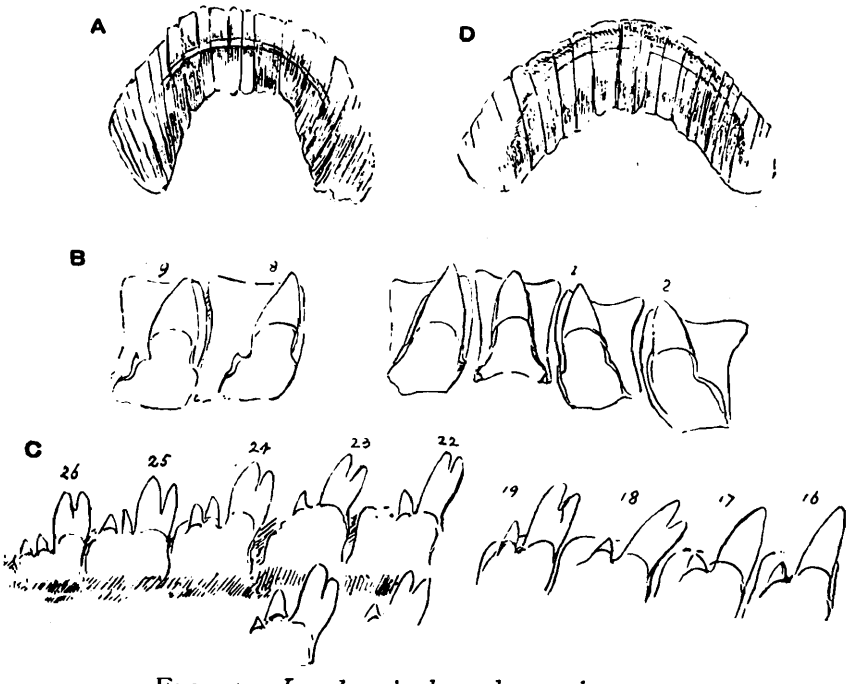

FIG. 5.—*Landouria hengdanensis*, n. sp.
A.—Jaw, × 40.
B.—Centre and admedian teeth } × 630.
C.—Laterals and outermost teeth. }
D.—*L. damsangensis*, n. sp. Jaw, × 40.

Landouria radleyi, Jousseaume.

(Text-fig. 6).

Memoirs Soc. Zool. France, VII, pp. 284, 285, pl. iv, fig. 6 (1894).
Helix huttoni var. *radleyi*, Sykes, *Proc. Malac. Soc. London*, III, p. 161 (1898), as var. of *huttoni*, Pfr.; G. K. Gude, *Faun. Br. India, Mollusca*, II, p. 212 (1914).

Locality.—Harputtalle, Ceylon, 4,000 feet.

These shells were sent to me by Mr. O. Collett, who did so much to advance our knowledge of Ceylon land mollusca and sent home many valuable species preserved in spirit. Malacology suffered great loss in his early death, his labour now enables me to give the following description:—

Animal. Two were extracted from the shells, of course not complete, but enough to show important characters. The foot (text-fig. 6, A) is short and pointed at the extremity with a very indistinct pale line above the peripodial margin. In one specimen this was seen to be broken up by close grooves running upwards

from the margin, in the other there was no indication of this, due no doubt to destruction of surface in the alcohol.

The generative orifice was very conspicuous, a vertical slit with a pale border. Head and neck pale grey with a rugous surface, the rugosities having a single dark spot. The mouth (text-fig. 6, B), as viewed from the front, is seen to have thick crescentric sides, somewhat projecting and pale in colour than the surrounding integuments. The visceral sac is very closely and finely streaked black giving it a dark tinge.

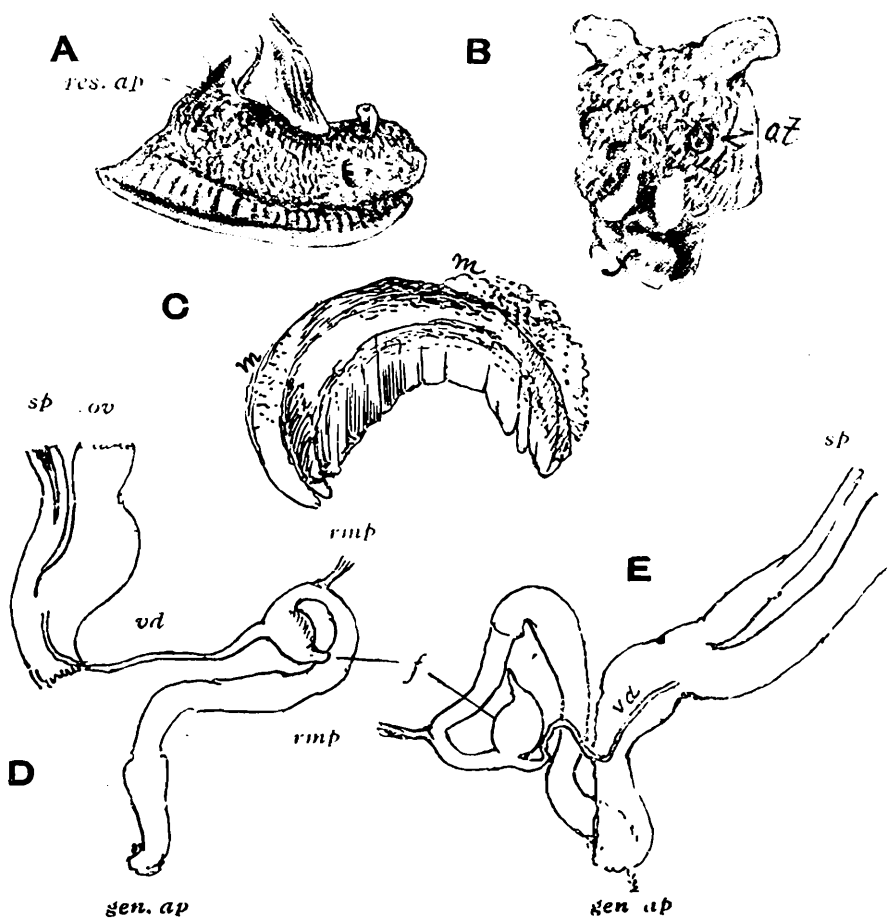

FIG. 6.—*Landouria radleyi*, Jousseaume.
A.—Anterior part of animal, × 4·5.
B.—Head as viewed from the front, × 8.
C.—Jaw, × 30.
D.—Part of generative organs, × 8.
E.— ,, ,, ,, × 8.

Generative organs. The penis (text-fig. 6, D, E) is a long tube bent where the short retractor muscle is given off, a very short epiphallus, followed by an oval-shaped flagellum which terminates in a short distinct point, at the base of this ovate sac the vas deferens joins it. The lower portion of the spermatheca was seen, but the terminal (probably globose) was broken. So far the genitalia agrees with that of *H. damsangensis* of Sikhim and they are co-generic, which is of interest to record. The radula was extracted, the formula being 15.15.1.15.15 or 30.1.30. The teeth correspond in form with those I have figured of *hengdanensis* from

the Burrail Range (text-fig. 5, B, C). The jaw (text-fig. 6, C) is well arched and made up of some 12 broadish plates.

Landouria aborensis, n. sp.

(Text-fig. 2 C, D).

Locality.—Kobo, Abor Hills (*Captain G. F. T Oakes, R. E.* and 5918, *S. W Kemp*).

Shell narrowly and perspectively umbilicated, globosely conoid, bluntly keeled; sculpture close irregular striae of growth; colour umber brown in fresh shells; spire depressedly conoid, apex rounded; suture linear. Whorls 5, flatly convex, aperture roundly lunate, subvertical.

Size: major diameter 8·4, alt. axis 3·8 mm.

The shells differ much in height of spire, one specimen out of five sent me is much higher than the type and measures 8×4·8 mm. The two specimens in spirit collected by Mr. S. W. Kemp at Kobo are small only 8×4, one of these has been dissected, and is described below, the other shell is figured.

The animal is white with some transverse bars behind the mantle-edge. Male organ as in *L. damsangensis* (text-fig. 4, A, B, C), the rest of the genitalia was not in a state to see much and I did not like to destroy the shell of the only other specimen.

The radula was obtained, the formula being 12.9.1.9.12 or 21.1.21. The teeth are similar in shape to those of *L. hengdanensis* from the Burrail Range (text-fig. 5, B, C).

Mikiria, gen. nov.

Type: M diyungensis, G.-A., n. sp.

Named from the Mikir tribe, inhabiting the hills of the Nowgong District, Assam.

The penis is very long from the generative aperture to the retractor muscle. Epiphallus short, no flagellum, vas deferens long, spermatheca bulbous with a retractor muscle.

Shell similar to but larger than in *Landouria*, about 15 mm. in major diameter.

Mikiria diyungensis, n. sp.

(Text-fig. 7.)

Locality.—Diyung Valley, Singpho Hills (*M T Ogle*).

Shell perspectively umbilicated to the apex, conoid, base flat keeled on the periphery, thin, covered with an epidermis; sculpture irregular rather close transverse folds of growth; colour pale ochraceous; spire moderately high, conic, apex blunt; suture moderately impressed. Whorls 6, closely wound, the last only very slightly descending below the keel; aperture lunate; peristome very slightly thickened and reflected.

Size: major diameter 16·0, alt. axis 7·0 mm.

The largest major diameter 16·25.

This species, looking at it from above, recalls and is very closely allied to *H. catostoma*, W. Blf., of the same valley the Diyung in the Naga Hills. It is larger than that species, is higher in the spire, is not nearly so openly umbilicated and the aperture distinguishes it at once, it is also very close to *tapeina* from Teria Ghat.

Animal. The foot is not divided below, there is no peripodial groove or border to the margin and the extremity of the foot is

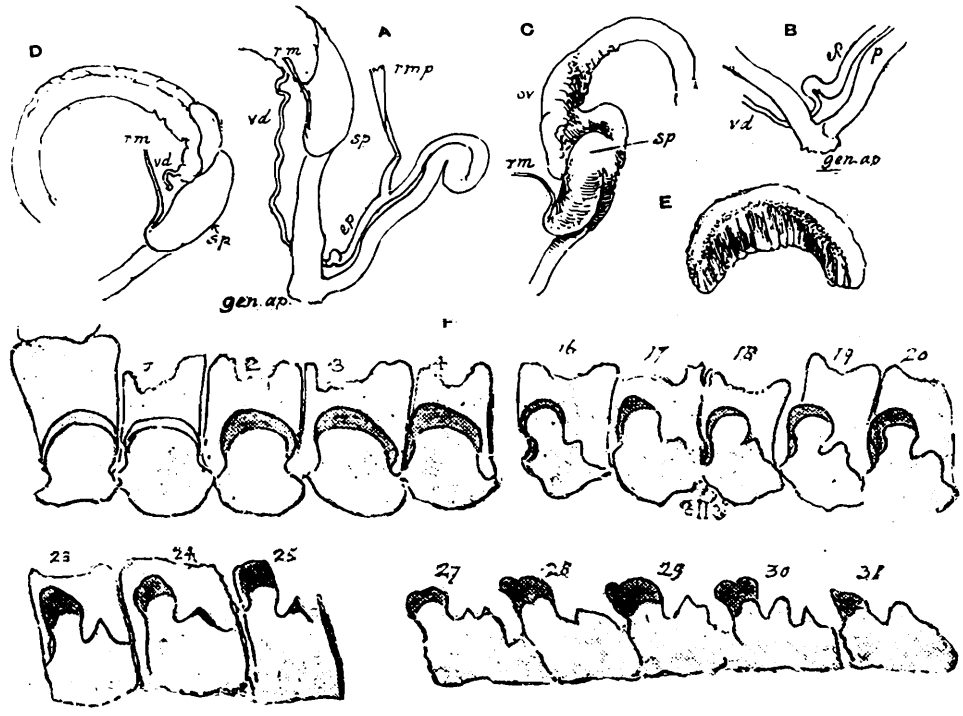

FIG. 7.—*Mikiria diyungensis*, n. sp.

A.—Portion of the generative organs, × 2.
C.— ,, showing the spermatheca, × 2.
B.— ,, to show enlargement of the vas deferens, × 2.
D.— ,, oviduct and vas deferens, × 2.
E.—Jaw, × 15.
F.—Teeth of the radula at different parts of the row, very largely magnified.

ep. epiphallus, *gen. ap.* generative aperture, *ov.* oviduct, *p.* penis, *rm.* retractor muscle, *rmp.* retractor muscle of penis, *sp.* spermatheca, *vd.* vas deferens.

rounded in the spirit specimen. The visceral sac is sparsely mottled with black on the branchial cavity, closer and in larger streaks near the mantle margin and line of the rectum. A triangular small right dorsal lobe, the left reflected over the peristome, single elongate and narrow posteriorly.

From the form of the shell so openly and closely wound, the principal retractor muscles extend far back nearly to the apex and the visceral sac is very long, every organ of the animal is thus drawn out and closely packed within it. The kidney takes this form from above the heart in an anterior direction and is situated between it and the line of the rectum.

Genitalia. The shaft of the penis (fig. 7, A) is very long, attenuate, sharply folded and bent on itself; the retractor muscle is given off on the side, as it lies folded up; the epiphallus (*ep*) is a thinner tube with a small enlargement or sharp bend, indicating where the spermatophore is developed and here the vas deferens joins it, its position being close and opposite to the male generative aperture and junction of the free oviduct.

This free oviduct is very long, and just below the commencement of the vas deferens there is a short solid bulbous spermatheca (fig. 7, D and C) with quite a strong retractor muscle, which extends a long way backwards. The walls of this sac are very thick and on the inside surface have many parallel fine wavy raised ridges. The oviduct and prostate are much drawn out and so is the albumen gland, all lie parallel to the muscles from the buccal mass and eye tentacles, and last of all lying between two of these the hermaphrodite duct may be followed towards the apex of the shell.

The jaw (fig. 7, E) is very solid with about 16-18 smooth, parallel plates.

The radula (fig. 7, F) was extracted nearly complete. The centre tooth and admedians up to the 13th are short, blunt and rounded, on ample somewhat elongate plates, becoming more pointed externally. At the 14th a slight shoulder is apparent which gradually enlarges into a basal cusp, while the mesocone has also lengthened at the 23rd and 25th tooth. Another change then takes place, both points become double as in the 27th and 30th; these outermost teeth are very irregular in their outline and being very thin are often broken.

Helix catostoma, W Blf.

An extract from my field-book may be of interest here, now that I am describing a species so closely allied. Shell subconoidal, openly umbilicated, whorls 7, close wound, covered with an epidermis having a rough surface as if hairs had been shaved off it. The aperture turns suddenly down close behind the peristome and is slightly reflected at the margin.

The animal is a true *Helix* with no gland, foot painted behind. Body of a pale pink grey, under surface and margin of the foot of a green tint. Tentacles short, dark coloured. Wooded hills east of the Kopili River, particularly abundant in the Diyung Valley.

The absence of a dart-sac with accessory organs in all the preceding Indian species of this group of the Mollusca, combined with other characters, appears quite sufficient to separate them generically from species inhabiting Europe (*Eulota*), and China and Japan (*Plectotropis*) including *Œgista* in which some have been placed—notably *catostoma*. This removes both these genera from the Indian region. I am induced also from a knowledge of the animals of six species to divide the Indian, for they fall into two very well-marked sections, shown not only by the shell but in the internal anatomy, as represented by *H huttoni* of the N.-W

Himalaya and *H. damsangensis* of Sikhim on one side, and *diyungensis* of Assam a very close ally of *H. catostoma* on the other. In these three species there is not a sign of a dart-sac, but the genitalia however show marked differences. In *H. damsangensis* the spermatheca is very long, with a globose termination carrying no retractor muscle, and is bound to the oviduct. In the larger Assam species (*diyungensis*) the same organ is solid, bulbous, almost sessile, with a remarkably strong and lengthened retractor muscle. The penis again of these two species could hardly be more unlike. Compare text-fig. 4 C with text-fig. 7 A, in the first there is a well-developed flagellum, in the second there is none at all, while the retractor muscles are different in form and position.

In the formula of the respective radulas very considerable diversity is found, the greatest departure being in that of *diyungensis*, the total number being far the highest.

Landouria	*huttoni*	8	10	1	10	8	or	18	1	18
	damsangensis	10	9	1	9	10	,,	19	1	19
	hengdanensis	17	9	1	9	17	,,	26	1	26
	aborensis	12	9	1	9	12	,,	21	1	21
	dawnaensis	11	2.9	1	9	2 11	,,	22	1	22
	radleyi	15	15	1	15	15	,,	30	1	30
Mikiria	*diyungensis*	20.8.	13	1	13	8 20	,,	41	1	41

In the "*Records of the Indian Museum,*" Vol. VIII, Part VIII (1915), p. 537, Mr. H. B. Preston describes and figures *Plectotropis austeni*, as from Upper Rotung, Abor Hills (*S. W Kemp*) I have seen nothing so large as 12 mm. major diameter from that part or of such a high spired form. *L. aborensis* which I describe is only 8 mm. in major diameter. It is not stated how many specimens were sent home nor is the museum number given or I could with this have traced it to the tube it was in. The locality requires verification —*Clausilia insignis* is recorded in this same contribution from Kobo. In the interest of geographical distribution I must allude to this for it certainly came from the Dawna Hills, and I have it among species sent at the same time from the Amherst District of Burma. *Sarika concepta* is also stated to be from Kobo, it was I feel certain in the Dawna collection. Unfortunately shells from the Abor Hills and Dawna Hills were packed in the same box. Mr. Preston was with me at the time it was unpacked, when 3 or 4 glass tubes were found broken in transit, the scattered shells were picked out as carefully as possible, but some mixing of specimens was certain to result.

Trachia ? delibrata, Benson, var. **fasciata,** G.-A.

Locality.—Kobo (*S. W Kemp*).

Shell with five bands below the broader supra-peripheral band and one very fine one above that.

Size: major diameter 21, minor 17, alt. axis 7½ mm.

This species is placed in *Chloritis* by Mr. Gude (*Faun. Br. India*, p. 172), its generic position is very unsettled, I leave it with doubt where Stoliczka placed it, he describes under *delibrata* the animal of a Moulmein shell in *J.A.S.B.*, 1871, p. 225. The shell Benson described came from Bengal, and it is the animal of this which now requires examination. The generic position of *delibrata* would then be better understood particularly if other closely allied species were dissected and compared with it.

Trochomorphoides acris, (Bs.), var.

Locality.—Abor Hills (*Captain G. F. T Oakes, R.E.*)

Shell narrowly umbilicated, trochiform, flat on base, sharply keeled; sculpture oblique fine striation, transverse; colour bleeched. Spire high, conoid, sides distinctly concave, apex blunt, suture linear. Whorls 7, flat; aperture very oblique, narrowly ovate; peristome expanded and slightly reflected below; columellar margin oblique.

Size: major diameter 11·0, alt. axis 9·0 mm.

Two specimens were received, one young and broken, the other fortunately fully grown. The slight convexity of the side of the spire distinguishes this from *T acris*, the finest specimens of which I have from South Sylhet, the largest measures major diameter 11, alt. axis 10 mm.

Curvella?

A single specimen was received from Captain Oakes, but is too immature for description, it is not allied to *C. sikkimensis*, the apex being much more acute. It is unfortunate that *Hapalus* cannot stand for this eastern section of shells approaching *Opeas* having been used for a genus of Coleoptera. Mr. Gude in *Faun. Br. India*, p. 348, following Pilsbry, adopts *Curvella*, the type of which is an East and South African species, *sulcata*. From a zoo-geographical point of view, it does not appear to me likely that a genus adapted to a country comparatively dry and of no great attitude, like East Africa, will possess characters similar to one ranging to 10,000 feet and more in an extremely wet, forest-clad country. I have examined the animal of *C. sikkimensis*, only a comparison of its anatomy with that of the African species can settle the question.

Glessula oakesi, n. sp.

(Text-fig. 8).

Locality.—Abor Hills (*Captain G. F. T Oakes, R.E.*)

Shell oblong turreted, shining surface; sculpture regular somewhat distant incised lines; colour ochraceous, one umber brown; spire high, sides very flatly convex; suture impressed; whorls 7, flatly convex, proportion of body whorl to length 100: 62·5; aperture rather narrowly oval, peristome outer lip thickened, columellar margin slightly convex.

Size: major diameter 7·0, alt. axis 16·5 mm.

Two specimens of this species, though rather smaller in size and not fully grown, were sent to me from Brahmakund by Mr. M. Ogle, No. 3578 B.M. coll. The largest measures 11×5 mm. The species was received alive in 1913, from Captain Oakes with other species and dissected.

Animal of *Glessula oakesi* from Rotung (Oakes). The sole of the foot is crossed by coarse ridges, there is a very distinct peripodial margin (text-fig. 8 A). The genitalia (figs. 8 B, C, D) was fairly well seen in one specimen but more material was sadly wanted. The hermaphrodite duct is conspicuous from its size and close convolution, bound closely together at its junction with the albumen gland. The penis is very short with a short stout flagellum terminating in three blunt knots, it thus differs from what I have been able to see in other species. The vas deferens is given off from near the head of the penis, the spermatheca was not seen.

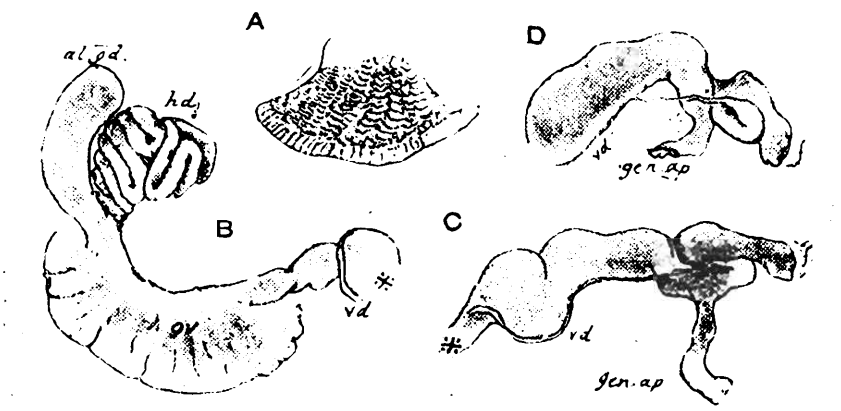

FIG. 8.—*Glessula oakesi*, n. sp.

A.—Side of foot.
B.—Albumen gland, hermaphrodite duct and oviduct to vas deferens.
C.—Vas deferens to penis.
D.— ,, ,, another view. All × 6.

Referring to the form of the flagellum I take the opportunity of giving here (text-fig. 9), in anticipation of a lengthy contribution to the Mollusca of India on the Glessulae of the North-East Frontier and Burma, a figure of the generative organs (fig. 9 C) of *Glessula ochracea*, G.-A., (a new species) from Sikhim in which the penis is of the form of *G. orophila* as figured by Prof. C. Semper (*Reis, Philippinen*), the flagellum is much flattened with a serrated edge on one side, indicative of the form of the spermatophore.

This species (*G. oakesi*) is the same as the one recorded from Rotung as *G. botellus*, Bs., of Southern India by Mr. H. B. Preston in the "*Records of the Indian Museum*," Vol. VIII, Nov. 1915, p. 539; it is a bare record, in any case remarkable as regards range. As I had not noticed this South Indian species among the large series sent me from the Abor Hills, I was anxious to see the shells which

had gone to Calcutta. Dr. Annandale very kindly sent these to me (October 1916) and I have compared them with specimens of *G. botellus* in the Henry Blanford collection from the Nilgiris, with the result that I cannot confirm Mr. Preston's determination. This Abor *Glessula* (*oakesi*) is decidedly smaller than *G. botellus*, and not so tumid, the whorls are closer wound, the outer lip is much more thickened than in *botellus*, the larger shell. I have compared the embryonic whorls and made enlarged drawings of *botellus*, of Mr. Preston's specimen, and of the type specimen of *oakesi*, the difference between the first and the two last is very marked, it is unmistakable.

Some explanation from me is necessary here. The shells

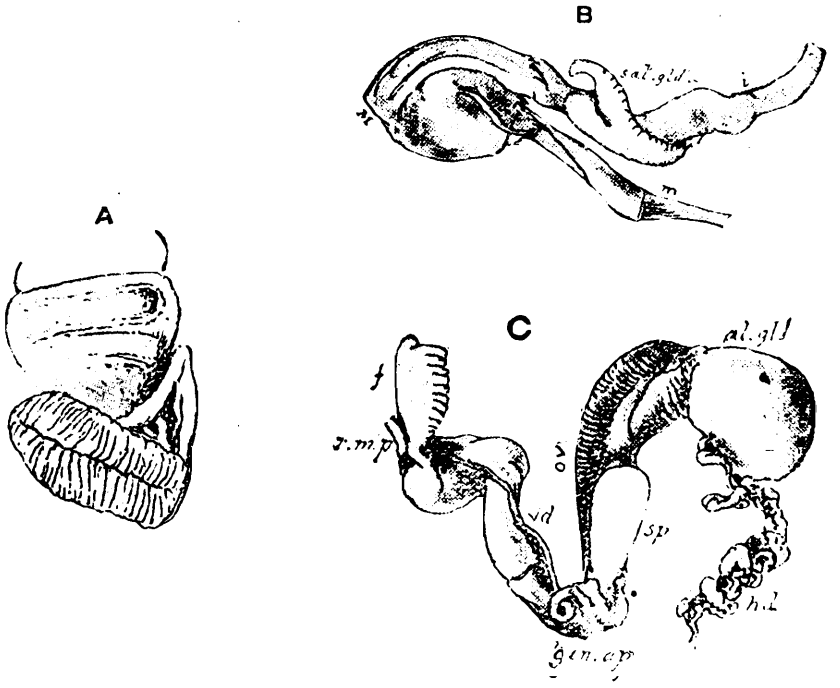

FIG. 9.—*Glessula ochracea*, G.-A.

A.—Sole of foot, extruding from the aperture, × 3.
B.—Buccal mass, retractor muscle and salivary gland, × 6.
C.—Genitalia, × 3.

treated of in Mr. Preston's contribution form a small part of the collection made by Mr. Kemp, sent to me by Dr. Annandale with instructions (January, 1914) to hand to Mr. Preston those I did not propose to work on myself, the museum numbers were only noted of those so handed over. It was also unfortunate as mentioned before that in one box sent home shells in glass tubes collected in Lower Burma were packed with others from the Abor Hills, two or three tubes were found broken and the contents at the bottom of the box, these were taken over by Mr. Preston. This accounts for errors in locality, for which Mr. Preston cannot be blamed. Collections from different areas should never be put up together and sent through the post.

Under the circumstances it would have been more satisfactory, had I seen Mr. Preston's contribution before it was sent to Calcutta, for I should have certainly noticed the range of *G. botellus* and the cases of wrong habitat, viz. *Sarika consepta* and *Clausilia insignis* stated to be found at Kobo on the Brahmaputra River when they came from the Dawna Hills. I have them in spirit from that range. Both are typical Tenasserim species.

Record such as this is to be regretted, it goes out to the whole world, and before it can be corrected no end of misconception may be created, upsetting and vitiating all deductions based on geographical distribution.

Glessula aborensis, n. sp.

Locality.—Abor Hills, five specimens (*Captain G. F. T Oakes, R.E.*)

Shell elongately turreted, sides nearly straight, sculpture very regular striation, less apparent on the last whorl, colour dark chesnut brown in the typical shell, more ochraceous in others, spire attenuate, apex blunt, suture impressed. Whorls 8, sides flatly convex, aperture ovate, outer lip thin with strong convexity, columellar margin nearly straight, feeble, slightly truncated.

Size: major diameter 5·0, alt. axis 16·25 mm.

The species varies in form, some being less attenuate, but all have the blunt apex and similar sculpture.

Clausilia ios, Bs., var.

One specimen received similar to those found in the Dafla Hills.

Clausilia annandalei, Preston.

(Text-figs. 10 C-D).

This was described by Mr. H. B. Preston from Upper Rotung in the "*Records of the Indian Museum*," Vol. VIII, Pt. VIII, Nov. 1915, p. 538. I did not know until I received the part that any species of the genus were in his hands or how many examples he had to deal with, the type I find has gone back to Calcutta. I have two also from "Upper Rotung" (No. 6000) collected by Mr. Kemp, one of which is figured (text-fig. 10 D, side view), another single specimen (No. 5951) from Rotung, fig. 10 C. Among Captain Oake's shells was one specimen from Shimang. Fig. 10 D which though not so attenuate as 5951 is no doubt this species.

Clausilia aborensis, n. sp.

(Text-figs. 10 A, E, EI, EII).

Locality.—Abor Hills (*Captain G. F. T Oakes, R.E.*)

Shell rimate, elongately fusiform, rather solid; sculpture close regular well-developed costulation; colour pale ochraceous in type,

pale ash in others; spire, sides convex, attenuate towards apex, somewhat tumid on the 3 last whorls; suture shallow; whorls 11, flatly convex; aperture ovate; peristome thickened, slightly reflected; palatal plicae are not visible externally, only one long plica below the suture. The clausilium I did not see in its true position, it fell out. It is very small, only 2·5 mm. in length, thickened, smooth, milky white, oblong, rounded at one end, subangulate at the other with a slight cleft. The side view (fig. 10 EI) shows it to be considerably curved elongately to fit into its place. Parietal folds fine and close together.

Size: major diameter 5·2, alt. axis 19·8 mm.

This is a variable species, one example having a much finer

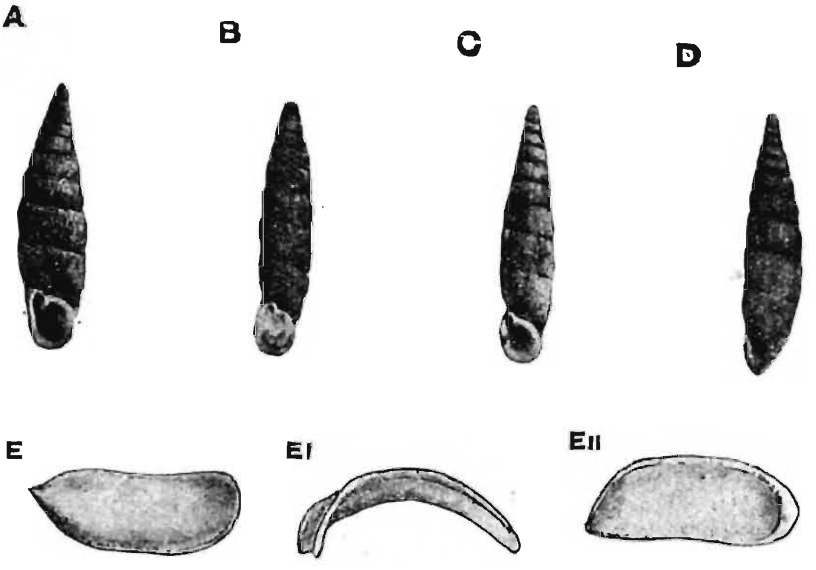

FIG. 10 A.—*Clausilia aborensis*, n. sp. × 1·5.
,, 10 B.— ,, *shimangensis*, n. sp. × 1·5.
,, 10 C.— ,, *annandalei*, Preston. × 1·5.
,, 10 D.— ,, ,, ,, × 1·5.
,, 10 E.—Clausilium of *C. aborensis*, convex side. × 9.
,, 10 EI— ,, ,, side view.
,, 10 EII— ,, ,, concave side.

attenuate spire and twelve whorls, reaching 22 25 mm. in length, while the smallest is 17·8 only.

Clausilia shimangensis, n. sp.

(Text-fig. 10 B.)

Locality.—Shimang, Abor Hills (*Captain G. F. T Oakes, R.E.*)

Shell rimate, fusiform, turreted, sculpture regular close, strong costulation, colour pale ochraceous. Spire attenuate, with sides slightly convex. Whorls 9, really near twelve, apical lost, sides flat; aperture piriform, very slightly oblique, peristome very strong and reflected.

Size: major diameter 4·0, alt. axis 20 mm. (length allowed for tip of apex broken off).

Only two specimens obtained, one in the area lat. 28° 15′—29° 15′ and long. 94° 20′—95° 10′. There are other species yet to be collected and described judging from the immature shells received.

Paludomus aborensis, ? n. sp.

Locality.—Streams near Rotung, only one specimen recorded and that may not be a fully grown shell (*S. W Kemp.*)

Shell elongately conical; sculpture fine, smooth surface with distant lines of growth; colour pale greenish-yellow with 3 strong bands below periphery of equal breadth in the largest specimen, in a smaller specimen three broad bands of dark madder, the centre one the broadest, on the three apicals they become blended together; spire high, tapering, apex acute; suture shallow; whorls 6, regularly increasing; aperture ovate; peristome thin; columellar margin slightly convex, not much thickened, operculum not preserved.

Size: major diameter 7·0, alt. axis 11·5 mm.

Said to be common in above locality.

This concludes the record of what is known up to the present of the landshells of the valley of the Brahmaputra both above its debouchement into the plain of Assam and the adjacent country. I have to thank Dr. N. Annandale for placing the museum collection in my hands, and again I have to thank all who were instrumental in bringing the collections together. Finally, the saddest task comes now of recording the death of Captain G. F. T. Oakes, R.E., of the Indian Survey, on whom falls the credit of collecting a very large number of species. He died a soldier's death on the Western Front at Ovilliers de Boiselle when gallantly urging on his men to complete a communication trench. Captain Oakes was a most promising officer in the Survey Department and when employed for two field seasons in the Abor Hills, triangulated and mapped a very large area, carrying his survey some 100 miles up the course of the Brahmaputra, together with its great tributaries the Siyom, Shimang and Yamne.

His helping hand towards the Zoology of the North-East Frontier as far as the Mollusca is concerned was greater than I ever expected, and given with an earnest desire to help, shown in the many letters I received from him. My great and lasting regret is we never met, the war affecting the coming and going of everybody.

In bringing the record of the Abor land shells to an end it is satisfactory to feel that the expedition into that part of the Eastern Himalaya had added so very largly to the Molluscan Fauna of India. At the same time it has greatly increased the interest attaching to the distribution of Indian genera and species, as well as to what extent this is bound up with the Geographical and Geological features of the country. My survey work in the Assam Range and in the Eastern Himalaya has given me intimate know-

ledge of it as to make such investigation a task of intense interest. I have a map in preparation, for it is impossible without one to show all the subject brings with it.

[In reference to the note on page 600 of this volume the opportunity is taken to reproduce here the figures of *Bensonia aborensis* and *Rahula koboensis* described in the previous instalment (pp. 596 and 599) of Col. Godwin-Austen's account of the Abor Molluscs.—*Ed.*]

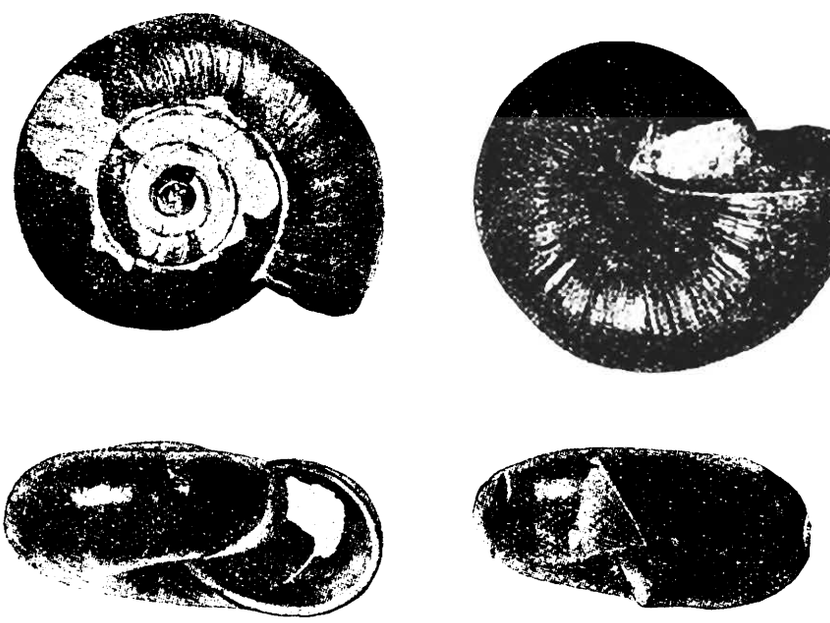

FIG. 1.—*Bensonia? aborensis*, n. sp., nat.-size (p. 596). (From photograph by Mr. J. Green).

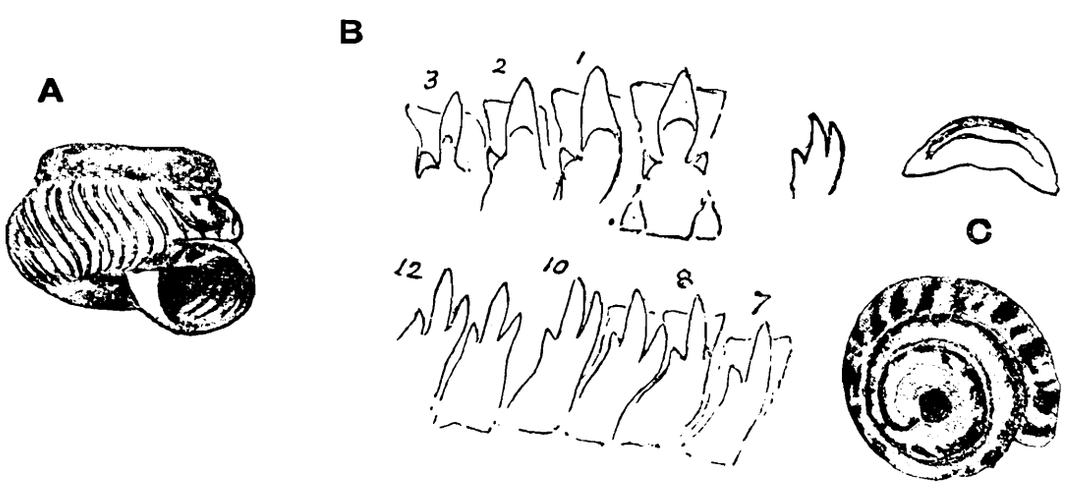

FIG. 3.—*Rahula koboensis*, n. sp. (p. 499).

A. Part of shell of animal dissected, × 12.
B. Portion of rādula, × 1100; jaw, × 58.
C. The visceral sac, × 9.