XLVII. MOLLUSCA, VII.

CYCLOPHORIDAE (*In part*).

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

This contribution completes two species of operculated land shells, collected in the Abor Hills, belonging to genera of Cyclophoridae as noted in the *Records of the Indian Museum*, vol. viii, pt. vii, p. 493.

In the subfamily Cyclophorinae will be found the species of *Raphaulus* and *Lagocheilus*; those of Alyceinae were given on p. 503. Diplommatininae and Pomatiasinae are now treated of.

In *Lagocheilus* and *Pomatias*, before anything could be done with species from the Tsanspu valley, it was necessary to go through collections made by me when in charge of Survey operations in the Assam Hill Ranges, in Sikhim and the Eastern Himalaya. Some of these had scarcely been looked at since the day they were found. Several new species have been figured and will be described elsewhere. This preliminary work somewhat delayed the publication of results, but it has added much to our knowledge of distribution and it has also shown that in the Abor portion of the Eastern Himalayan Range new forms of the operculate land mollusca are quite as numerous as they are in the Helicidae and Zonitidae.

The number of species in the Cyclophoridae now recorded belong to the following genera and subgenera: *Cyclophorus* 2 (*Myxostoma* did not occur), *Glossostylus* 2, *Spiraculum* 6, *Pterocyclos* 5, *Alycaeus* 2, *Cycloryx* 2, *Dioryx* 5, *Raptomphalus* 4, *Raphaulus* 5, *Streptaulus* 2, *Lagocheilus* 2, *Diplommatina* 4, *Pseudopomatias* 2, *Eupomatias* 2, making a total of 45.

For about half of these I am indebted to Captain Oakes and the officers of the Survey with the Miri Political Mission, for the rest to Mr. S. W. Kemp and those with the Abor Expeditionary Force who assisted him. Officers and Civil Assistants of the Indian Survey have done much in the past for Natural History, especially in Conchology, and an expression of gratitude from workers in this branch of Natural History is due to those whose names appear in these contributions for the valuable help they have rendered.

The distribution of the land mollusca is so interesting and important in connection with the geography of India in Tertiary and even earlier times. The great main valleys of the Eastern Himalayas have each a markedly different molluscan fauna, but unfortunately our knowledge of them is very incomplete. The

Teesta, the Dikrang and now the Tsanspu have been well collected in and we have a small contribution from the Subansiri. Nothing, however, is known from the large valleys of Bhutan, such as the Wangchu and Mochu, the Ryduk and Sankos of the plains, the Monass and Barowli in the Aka Hills. The expedition there in 1913-14 brought us no knowledge of the land mollusca, and such opportunities have been so often lost that years go by before they come again. Surveyors have splendid opportunities for collecting in every branch of Natural History, and when employed at the hardest work there are hours I know which can be profitably spent on wet days, when clearing mountain tops. The native establishment and the people of the country are always available. All hill men, especially Ghurkas, Lepchas and Khasis, can be made keen collectors.

Subfamily *CYCLOPHORINAE.*

Genus **Raphaulus**, Pfr., 1856.

In 1886 the only species of this genus from Eastern Assam was *R. assamica*, G.-A., from Brahmakund, figured in *Mollusca of India*, plate xlvii, figs. 2, 2*a*, 2*b*. The Dihang valley, close by, has now yielded no less than 6 species, together with 2 species of the closely allied genus *Streptaulus* of Benson (1857), represented by a single very variable species *S. blanfordi*, a most abundant shell in Sikhim and extending to the Dafla Hills on the Eastward.

When writing on the genus *Raphaulus* in 1886 (*l. c.*, p. 196), taking this into consideration and the fact that the animal of *Streptaulus* proved similar to that of *Raphaulus*, I was not inclined to adopt Benson's genus. With two more species, however, presenting the same character of sutural tube as found in the Sikhim form, there are better grounds now for reconsidering and distinguishing the two forms and giving *Streptaulus* at least subgeneric rank. There is quite as much difference between them, moreover, as is to be found between *Pterocyclos* and *Spiraculum* and in *Alycaeus* and *Dioryx*. The range of *Streptaulus*, so far to the Eastward, will lead in all probability to other species turning up before long on the head waters of the Irrawaddy, the N'mai Hka and the Hkamti Long.

Raphaulus assamica, G.-A.

(Text-fig. 1 A.)

Locality.—Miri Hills, two specimens (*Lt. C. G. Lewis, R.E.*).

Shell elongately cylindrical, very solid, rather closely rimate; sculpture very fine and close costulation; colour, both shells bleached; spire high, sides flatly convex, apex pointed, slightly inclining to the right; suture moderately impressed; whorls 6, one above aperture flattened in front; aperture circular; peristome much thickened, upper margin horizontal; sutural tube well developed, directed obliquely downwards, 3 mm. in length.

Size: major diameter 8·75, minor 7·75, alt. 17·0 mm.

It is closely allied to *R. aborensis* and *yamneyensis*.

In 1911 Lieut. Lewis carried the survey a long distance into the Miri Country and did some good work there in spite of the hostile attitude of the Miris. I am much indebted to him and Lieut. Wahab for the shells they collected and am here able to thank them for this contribution to the molluscan fauna of the country.

Raphaulus yamneyensis, n. sp.

(Text-fig. 1 B.)

Locality.—Yamne Valley, only one specimen (*Capt. G. F. T. Oakes, R.E.*).

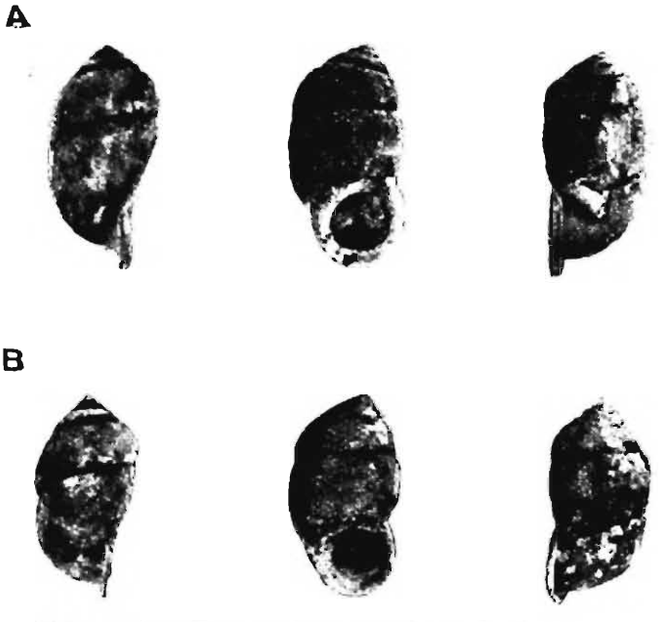

FIG. 1 A.—*Raphaulus assamica*, G.-A.
" 1 B.— " *yamneyensis*, n. sp.

Shell shape similar to *aborensis*; penultimate whorl flattened in front and more openly rimate; sculpture fine close costulation; colour, specimen bleached; spire high; apex pointed; whorls 6; aperture circular; peristome thickened, wide on upper margin; sutural tube broken off, it was directed obliquely upwards.

Size: major diameter 8·5, minor 7·75, alt. axis 15 mm.

Raphaulus aborensis, n. sp.

(Text-fig. 2 C.)

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

Shell elongately cylindrical, solid, not flattened in front, closely rimate; sculpture regularly and very closely costulate; colour bleached; spire high, rather inclined to the right, apex

pointed; suture moderately impressed; whorls 6, swollen, sides convex; aperture circular; peristome thickened, continuous, the sutural tube turns obliquely downward from the upper outer margin and widens out gradually; in two specimens out of four it is horizontal.

Size: major diameter 7·25, minor 7·0, alt. axis 14·0 mm.

Four specimens from Rotung are smaller and more tumid, the largest measuring 12·5×6·5 mm.

A single large example was sent me from the Miri Hills by Officers of the Survey, Lieuts. R. S. Wahab and C. G. Lewis, R.E.

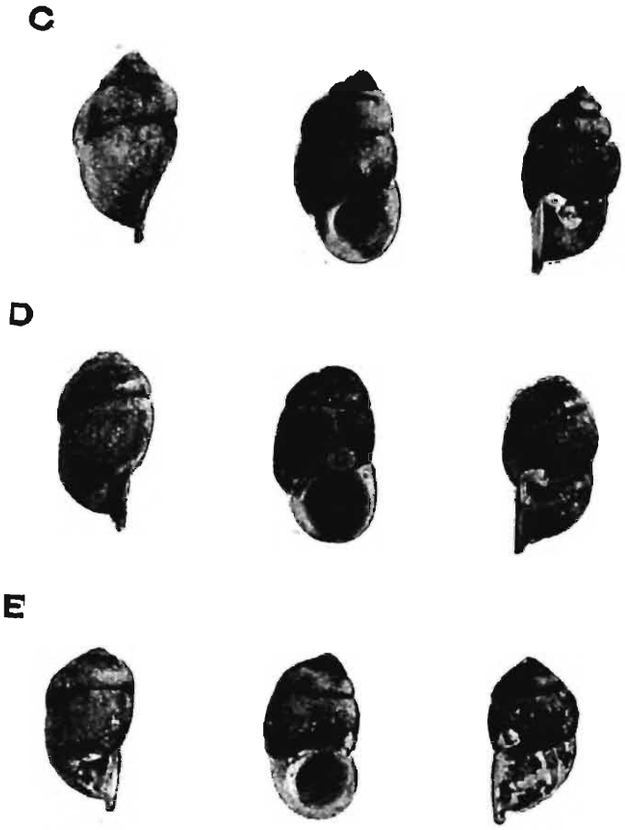

FIG. 2 C.—*Raphaulus aborensis*, n. sp.
,, 2 D.— ,, *oakesi*, n. sp.
,, 2 E.— ,, *shimangensis*, n. sp.

Raphaulus oakesi, n. sp.

(Text-fig. 2 D.)

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

Shell cylindrical, rimate, solid; sculpture very fine and regular costulation; colour dark ochraceous; spire moderately high, apex blunt; whorls 5, penultimate somewhat flattened in front; sutural tube horizontal; operculum horny, flat in front of about 6 whorls.

Size: major diameter 7·0, minor 6·5, alt. axis 13·0 mm.

This single species was secured with *R. aborensis*.

Raphaulus shimangensis, n. sp.

(Text-fig. 2 E.)

Locality.—Shimang Valley (*Capt. G. F. T Oakes, R.E.*).

Shell tumidly cylindrical, solid, openly rimate; sculpture very fine and regular costulation; colour bleached; spire moderately high, apex pointed, inclining to the right; suture moderately impressed; whorls 5; aperture circular; peristome thickened, horizontal on upper margin; sutural tube ascending obliquely.

Size: major diameter 7·0. minor 6·5, alt. axis 12·0 mm.

Approaches *R. aborensis*, but is smaller.

The Shimang River is a large tributary of the Tsanspu from the West, about 36 miles above Pasighat at the base of the mountains.

Genus Streptaulus, Benson, 1857.

Streptaulus miriensis, n. sp.

Locality.—Miri Hills, only one specimen, since broken (*Lieut. C. G. Lewis, R.E.*).

Shell cylindrical, pupiform, strongly excavated and keeled on umbilical region; sculpture very fine transverse regular striation; colour bleached; spire high, apex conic; whorls 6, the 4th with the greatest diameter, sides flatly convex, the aperture circular; peristome thickened, not continuous on upper margin.

Size: major diameter 5·0, minor 5·0, alt. axis 9·4 mm.

After getting as far as writing the above description I left my work room for lunch, leaving the shell on a slide resting on plasticine. On taking up work again I found it crushed. Thus one of the most interesting shells found recently on the Eastern Frontier has to be rediscovered. It was interesting because the sutural tube was exactly like that of *Raphaulus blanfordi* of Sikhim, *viz.* a narrow flat band running back along the suture with here and there minute perforations (vide *Mollusca of India*, plate xlvii, fig. 4*a*). Very fortunately I had compared the two species and noted that the Miri shell was quite distinct, that the antepenultimate whorl was the largest and the sculpture was very much finer, the deep excavation at the umbilicus was another very remarkable character.

Streptaulus luyorensis, n. sp.

Locality.—Luyor Valley, 2 specimens (*Capt. G. F. T Oakes, R.E.*).

Shell umbilicated, *Pupina*-like, solid, shining; sculpture fine close shallow striation; colour pale ochraceous; spire fairly high, apex blunt and rounded; suture impressed; whorls 6, 4th and 5th the largest and nearly equal in diameter; aperture circular; peristome thickened, reflected, with a callous on the body whorl; the sutural tube flattened, follows the suture and is perforated finely at intervals.

Size: major diameter 4·75, alt. axis 8·0 mm.

This is a close ally of *R. blanfordi*, but can be distinguished at once by its much more tumid form and blunt apex. It is far nearer to the Sikhim shell than the one which was unfortunately broken but which had been described as *R. miriensis*.

Lagocheilus oakesi, n. sp.

(Text-fig. 3 A.)

Locality.—Abor Hills, exact locality not stated (*Capt. G. F. T Oakes, R E.*).

Shell turbinate, rather flattened on base, rather openly umbilicated; sculpture very fine close liration, crossed with oblique lines of growth; colour umber brown with a greenish tint, grey inside the aperture; spire high, conic, apex fine; suture impressed;

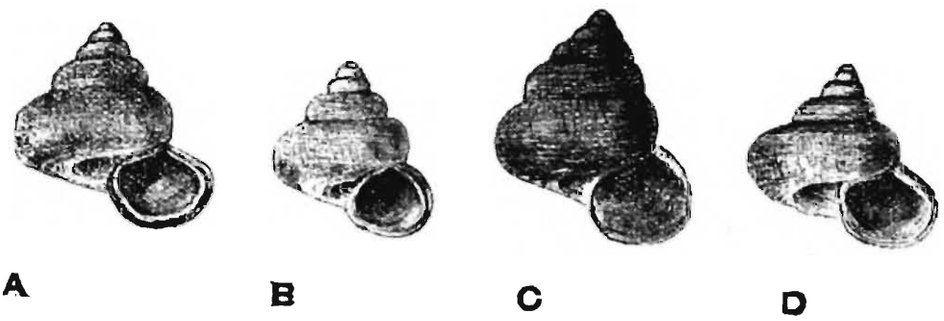

FIG. 3 A.—*Lagocheilus oakesi*, n. sp. × 4.
,, 3 B.— ,, ,, var. × 4.
,, 3 C.— ,, *daflaensis*, n. sp. × 4.
,, 3 D.— ,, *sikhimensis*, n. sp. × 4.

whorls 5½, rounded, the last rather flattened on the periphery; aperture ovate, obtusely angulate above, oblique; peristome double, continuous; columella margin rather flat above, then suboblique, subangulate in outline.

Size: major diameter 4·75, alt. axis 4·0 mm.

Only one specimen was received, which is in a fine state of preservation and the first of this genus to be received from the Abor Hills.

Lagocheilus oakesi, n. sp., var.

(Text-fig. 3 B.)

Locality.—Abor Hills, exact locality not stated (*Capt. G. F. T Oakes, R.E.*).

Shell turbinate, umbilicated; sculpture about 8 very fine lirae, crossed by very fine sinuous close striae, shell somewhat worn; colour umber brown, but bleached; spire high, apex fine, pointed; suture impressed; whorls 5½, sides rounded; aperture oblique,

oval angulate above, well rounded below; peristome double; columella margin curved.

Size: major diameter 4·0, alt. axis 3·5 mm.

Two specimens put up together from some other locality are much smaller, with the last whorl more rounded, and not quite so widely umbilicated. The differences are not sufficient to separate them and more examples are wanted.

Lagocheilus daflaensis, n. sp.

(Text-fig. 3 C.)

Locality.—Toruputu, Dafla Hills, 7000 ft. (*Godwin-Austen*).

Shell elongately conoid, umbilicated; sculpture about ten fine lirae, regularly disposed, crossed by fine epidermal striae of growth; colour dark brown; spire, sides nearly flat, apex fine; suture moderately impressed; whorls 6, sides rounded, evenly increasing; aperture circular, obtusely angulate above; peristome double, continuous, sinuate on outer margin, with a small nick at the suture.

Size (largest): major diameter 5·2, alt. axis 4·0 mm.

Lagocheilus sikhimensis, n. sp.

(Text-fig. 3 D.)

Locality.—Rishetchu, Sikhim (*W Robert*).

Shell openly umbilicated, turbinate, subturreted; sculpture, about 7 lirae on the peripheral part of the whorl, about 3 below, 5 can be seen within the umbilicus, none on the flatter part next the suture; colour umber brown; spire fairly high, apex small; suture open; whorls $5\frac{1}{2}$, tumid; aperture circular, obtusely angulate above; peristome double, narrow, continuous; columella margin subvertical.

Size: major diameter 5·0, alt. axis 3·0 mm.

I introduce this species here, as it completes our knowledge of the genus as distributed on the N.E. Himalaya. There are some undescribed species from the Assam Range which I hope soon to describe and figure.

In my paper on the Cyclostomacea of the Dafla Hills, Assam (*Journ. As. Soc. Bengal*, vol. XLV, 1876, p. 174), I give *Lagocheilus tomotrema*, Bs., as found on the Tanir Ridge and Toruputu Peak, "not common." Nevill, to whom I gave specimens, records in his *Hand List of Shells in the Indian Museum* (p. 282) 4 sp. from the Dafla Hills. I have before me 4 specimens from Toruputu and on examination under the microscope placed side by side with *L. tomotrema* from the Garo Hills, which is not far from the typical locality the Khasi Hills, the Dafla shell is certainly distinct.

Subfamily *DIPLOMMATININAE.*

Diplommatina perobesa, Preston.

(Text-fig. 4 A.)

Diplommatina perobesa, Preston, *Rec. Ind. Mus.*, VIII, p. 540, fig. 5 (1915).

Locality.—Upper Rotung, Abor Expedition, M $\frac{5997}{1}$ Ind. Mus. (*S. W Kemp*); no. 3139, Brit. Mus., same locality (*Capt. Oakes, R.E.*).

Original description.—"Shell obliquely ovate with exserted "spire, pale flesh colour, solid, opaque; whorls 7, the first two "submammillary, the third, fourth and fifth regularly increasing, "the sixth large, tumid, the last contracted and abandoning the "direction of the axis of the shell, sculptured with coarse, obso-"lete, oblique, transverse costulae; suture well impressed; colu-"mella margin vertically descending, bearing a strong, down-

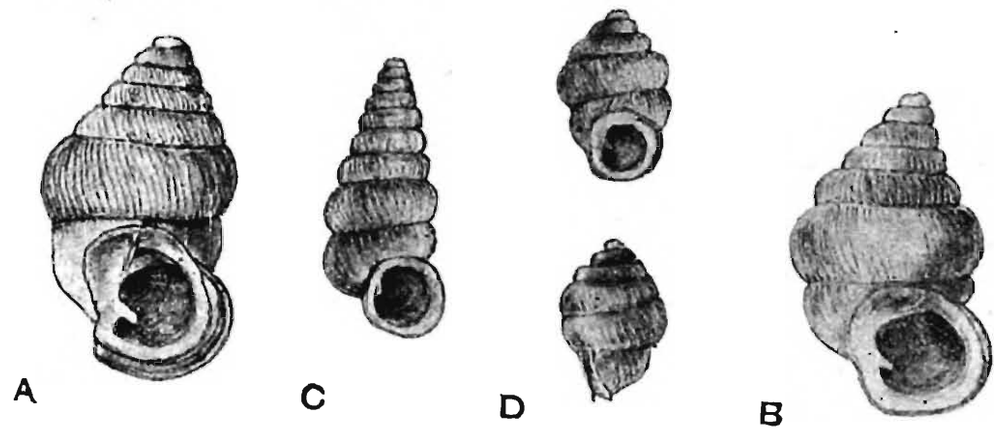

FIG. 4 A.—*Diplommatina perobesa*, Preston. × 8.
,, 4 B.— ,, *mucronatus*, n. sp. × 8.
,, 4 C.— ,, *acutulus*, n. sp. × 8.
,, 4 D.— ,, *miriensis*, n. sp. × 8.

"wardly bent, entering lamella above, sharply angled at the base, "diffused above into a thick, outwardly expanded, well defined, "parietal callus which joins the upper margin of the labrum and "gives to it a continuous appearance; labrum consisting of an out-"wardly expanded and slightly reflexed, shelf-like projection from "which springs an erect, rather thick rim; aperture subcircular.

"Alt. 4·5, diam. maj. 2·5 mm. Aperture alt. 1·25, diam. 1·5 "(nearly) mm.

"Hab.—Upper Rotung, at an altitude of 2000 ft., under "stems of plantain trees (*S. W. Kemp*)."

Diplommatina mucronatus, n. sp.

(Text-fig. 4 B.)

Locality.—Chanjuk La, Tsanspu Valley, λ 29°-15′, L. 95° 20′ (*Capt. G. F. T Oakes, R.E.*).

Shell ovately acuminate, rimate; sculpture regular, some-what distant costulation on the 4th and 5th whorls, becoming

finer and closer on the two last, the first 2 whorls smooth; colour white; spire pyramidal, becoming rapidly attenuate, apex fine, blunt; suture well impressed; whorls 7, penultimate the largest, sides well rounded, tumid; aperture oval, subvertical; peristome well thickened, distinctly double.

Size: major diam. 2·5, alt. axis. 4·75 mm.

Seven specimens of this species were sent home. As only two species of this genus are known from this great valley of the N.E. Himalaya, it is evident that many more remain to be discovered.

Diplommatina acutulus, n. sp.

(Text-fig. 4 C.)

Locality.—Miri Hills (Officers of Miri Mission, 1911-12).

Shell dextral, very elongate and slender; sculpture fine regular rather close costulation; colour white, with a very pale ochraceous tint; spire turreted; suture impressed; whorls 9, regularly increasing from the apex to the 7th, which is the largest, sides convex; aperture ovate, vertical; peristome circular, double; columella margin subvertical; tooth small, blunt.

Size: major diam. 1·0, total length 2·4 mm.

This species recalls *D. exilis*, W. Blf., from Ava, but it is far more attenuate and smaller It is a beautiful shell, and fortunately 2 examples were found in the earth which had fallen out of empty shells of *Cyclophorus*, showing what a rich and interesting molluscan fauna awaits a collector in these mountains.

Diplommatina miriensis, n. sp.

(Text-fig. 4 D.)

Locality.—Miri Hills (Officers, Miri Mission, 1911-1912).

Shell dextral, tumidly fusiform; sculpture regular, strong, fairly distant costulation; colour pale, with an ochre tinge; spire tapering rapidly, apex blunt; suture impressed; whorls 5, tumid, constriction above the aperture; aperture vertical, oval; peristome double, strong, broadly ovate; columella margin nearly vertical, with a strong tooth.

Size: major diam. 0 9, alt. axis 1·5 mm.

Only a single example of this minute shell was found in the earth that had fallen out of empty shells of the larger species, which covered the tray in which the specimens sent home were unpacked. Searching it over with a lens I was rewarded by its discovery and that of a second minute species.

Subfamily *POMATIASINAE*.

Pseudopomatias, von Möllendorff, 1885.

I adopt this generic title. It is of interest to note that William Blanford writing so long ago as 1864 in the *Annals and*

Magazine of Natural History on the classification of the Cyclostomacea of Eastern Asia (p. 463) says, "These species (referring to "*P. himalayae* and *pleurophorus* of Benson) agree well in general "form and in sculpture with the European members of the genus. "Some slight differences, however, in the characters of the peri-"stome and of the operculum may be sufficient to entitle the "Indian forms to sectional or even subgeneric distinction."

Pseudopomatias siyomensis, n. sp.

(Text-figs. 5 A and 6 C.)

Locality.—Siyom, Abor Hills. λ 28·31 L. 94·40 (*Capt. G. F. T Oakes*).

Shell perforate, elongately turreted, attenuate, solid; sculpture well defined strong costulation, more pronounced and distant on

Fig. 5 A.—*Pseudopomatias siyomensis*, n. sp.
,, 5 B.— ,, *luyorensis*, n. sp.
,, 5 C.—*Eupomatias sibbumensis*, n. sp.
,, 5 D.— ,, *oakesi*, n. sp.
(All multiplied 1·5.)

last whorl; colour white; an old well grown shell; spire long, sides flatly convex, fining to the apex which is sharp; suture impressed; whorls 9, flatly convex; aperture circular, vertical, peristome double, inner thickened, a slight nick on the upper sutural margin.

Size: major diameter 4·4, alt. axis 12·2 mm.

Only one specimen was found, but this is fully grown. It has much the shape of *P. grandis* of the Dafla Hills, but has much stronger costulation. I give a figure (fig. 6 D.) of the basal side of *P. himalayae* to show how *it differs from* this species.

Pseudopomatias luyorensis, n. sp.

(Text-fig. 5 B.)

Locality.—Luyor, Abor Hills (*Capt. G. F. T Oakes*).

Shell perforate, elongately fusiform, turreted, somewhat tumid, solid; sculpture fine close and regular costulation; colour pale umber brown; spire high, sides flatly convex, apex pointed; suture impressed; whorls 7, sides convex; aperture circular, verti-

cal; peristome closely double, continuous, the outer much expanded on the lower columellar side.

Size: major diameter 4·75, alt. axis 11·25 mm.

Only one specimen of this species was received; the form and sculpture at once show its distinctness from the other species from the valley of the Tsanspu.

The next two species differ so much from *Pseudopomatias* in the form of the last whorl that they require generic distinction.

Eupomatias, n. gen.

Shell in all respects similar to *Pseudopomatias*, with similar costulation; peristome double, well developed, perforate, the costulation on the left side of the last whorl terminates upon a strong raised keel bounding the umbilical region; this keel extends up to the peristome on the lower basal side of the aperture.

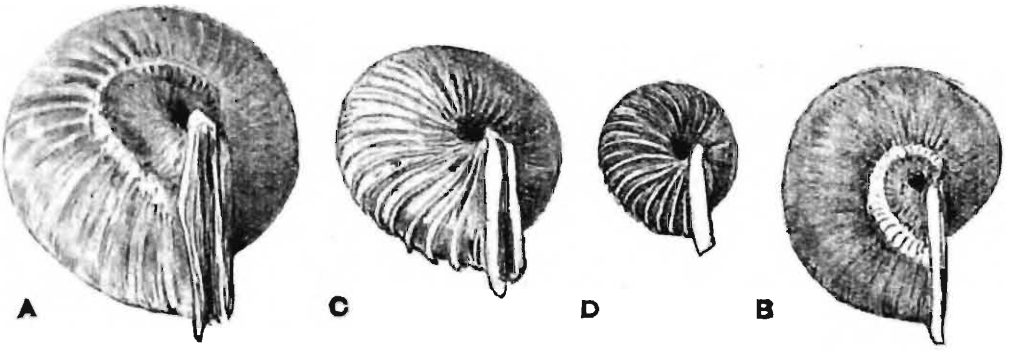

FIG. 6 A.—*Eupomatias sibbumensis*, n. sp.
,, 6 B.— ,, *oakesi*, n. sp.
,, 6 C.—*Pseudopomatias siyomensis*, n. sp.
,, 6 D.— ,, *himalayae*, Bs.
(All multiplied 6 times.)

Type: *Eupomatias sibbumensis*, n. sp.

The keel has a knotted or beaded appearance, and it would seem that the mantle edge must develop a close fold, the costulation causing an irregular thickening of the peristome as it is added to. I give figures (text-fig. 6 C and D) of the basal side of *Pseudopomatias himalayae*, Bs., and *siyomensis*, to show how *Eupomatias* differs from them.

Eupomatias sibbumensis, n. sp.

(Text-figs. 5 C and 6 A.)

Locality.—Sibbum, Yamne Valley, Abor Hills (*Capt. G. F. T Oakes, R.E.*).

Shell scarcely perforate, elongately turreted, solid; sculpture strong regular close costulation, which on last whorl terminates at the umbilical keel (text-fig. 6 A); colour not seen, shells bleached;

spire elongate, sides nearly flat; apex pointed; suture shallow; whorls 9, sides flatly convex; aperture nearly circular, vertical; peristome double, continuous, the inner expanded and slightly reflected on the left side; a well marked umbilical keel commences on the lower side of the last whorl in front and curving to the left extends to the lower margin behind the aperture.

Size: major diameter 5·8, alt. axis. 14·5 mm

This species is represented by three specimens, two are unfortunately old and imperfect.

Eupomatias oakesi, n. sp.

(Text-figs. 5 D and 6 B.)

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

Shell narrowly perforate, elongately turreted, solid, shiney; sculpture close regular fine ribbing, on the last whorl in front only seen near suture, then becoming quite smooth; colour ruddy umber brown in type, pale ochraceous in two others; spire elongate, sides slightly convex, apex rather blunt; suture impressed; whorls 7, flatly convex; aperture circular, angulate above; peristome thickened, closely double, continuous just behind on the columella margin, high up there is a very strong umbilical keel much curved, which terminates just behind the peristome on the lower left margin; it shows white against the brown colour of the shell, and is quite bead-like and raised (text-fig. 6 B); operculum horny, flat in front, multispiral, nucleus central.

Size: major diameter 3·75, alt. axis 11·0 mm.

From Shimang in the Abor Hills I have a single specimen of a *Pomatias*, not fully grown, with sculpture far coarser than any of the species now described from those hills; it has seven whorls, and is evidently a new species, but not in a state to describe.