

XLVI. COLLEMBOLA.

(Plates LV—LVII).

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Through the courtesy of Dr. Nelson Annandale, Director, Zoological Survey of India, I have been entrusted with the few specimens of spring-tails collected by Mr. S. W. Kemp on the Abor Expedition, and with some other insects of the same order from Lower Burma, in the Indian Museum collections. The result of work on these Collembola is now given. Seven species are enumerated: six of these are described as new, one (from Rotung in the Abor Hills) being made the type of an interesting new genus resembling *Cyphoderus*, but showing certain primitive and annectant characters. The remaining species is a *Cyphoderus* already described in Imms' paper (1912) on Collembola from India, Burma and Ceylon, to which the present brief contribution may be regarded as supplementary. Excepting the Rotung specimen just mentioned, all the spring-tails now described belong to well-known genera with a wide distribution, one being referable to the family Poduridae and the rest to the Entomobryidae. I have taken advantage of the material at my disposal to give some details of the jaws of *Protanura* and *Paronela*, as the structure of these appendages in Collembola is of high interest to students of insect morphology.

PODURIDAE.

NEANURINAE.

All the Poduridae in the collection belong to a single species referable to the sub-family Neanurinae, whose members are easily recognized as a rule by their spine-bearing tubercles.

Protanura, Börner, 1906.

This genus was established by Börner (1906, pp. 167-9) for those Neanurinae in which the mandibles and maxillae have toothed apices, whereas in *Neanura* (*Achorutes* as Börner calls it)¹ the maxillae are simple, terminating in a single sharp point.

¹ I have already (1916, p. 29) given reasons for refusing to follow Börner in this highly inconvenient change of nomenclature.

Protanura spinifera, sp. nov.

(Plate 1v, figs. 1-9).

Three ocelli, a smooth post-antennal area, and two spinose tubercles on each side of the head (fig. 1). Mandible (figs. 3, 4) with three apical teeth, a sharp crescentic molar tooth, and a delicate dorsal toothed lamella. Maxillary lacinia (fig. 6) with three apical teeth, a long delicate external "comb" bearing bifid teeth and terminating in a "brush," and an internal two-toothed process; no basal process. Foot (fig. 8) with strongly toothed claw and small empodial appendage. Dorsal tubercles wanting on abdominal segments; intermediate and dorso-lateral tubercles rounded, the former very small; each tubercle bearing a sensory bristle.

Length 2.5 mm. Colour yellow; eyes on black spots.

Localities.—N.E. Assam: Sadiya, five specimens, Abor Expedition (S. W. Kemp), Indian Museum $\frac{6156}{19}$. Lower Burma: Farm Caves near Moulmein, two specimens (F. H. G.), Nov. 17 - Dec. 11, 1911, Indian Museum $\frac{1046}{19}$.

This species is nearly related to *P. kraepelini*, Börner (1906, pp. 169-70), from Java, with which it seems to agree rather closely in the arrangement of the abdominal tubercles and in the structure of the jaws. That species, however, has the three ocelli almost in a straight line, while in *P. spinifera* they form an elongated triangle. The specimen from the Farm Caves, Moulmein, might have been regarded as referable to *Neanura pudibunda*, Imms (1912, pp. 86-7), the types of which came from an adjacent and similar locality, and agree with the insect now described in the arrangement of the eyes, but that the disposition of the abdominal tubercles in the present species differs altogether from that shown in Imms' figure (*loc. cit.*, pl. vi, fig. 12). As Imms does not mention the nature of the jaws, it is impossible to know whether his species is referable to *Neanura* or to *Protanura*.

The third and fourth segments of the feeler in *P. spinifera* are imperfectly distinguished from one another; the arrangement of the spines and retractile sense-organ at the apex is shown in fig. 2. The mandibles are of much interest on account of the delicate dorsal lamella beset with fine teeth (fig. 4, *la*). This structure is mentioned by Börner in his description of *P. kraepelini*, and the Hawaiian species *P. citronella* (Carp.) has a somewhat similar appendage (Carpenter, 1904, pl. ix, fig. 25, *d*). The maxillulae (fig. 5, *Mxl.*) are simple chitinous plates with outer and inner ridges, covering most of the dorsal aspect of the tongue (fig. 5, *Hy*). The maxillary lacinia in *Protanura* is—as Börner has pointed out—like that of *Anurida*, and differs very markedly from the simple lancet-like maxilla of *Neanura*. The outer comb-appendage (fig. 6, *a*) is a very beautiful structure with its inner row of bifid teeth and terminal spreading whorl of bristles forming a "brush." It evidently corresponds to the outer lamella in the maxillary lacinia of *Anurida*. The labium (fig. 7) consists of paired sclerites with

their inner (sutural) edges ridged and toothed at the apex. Each carries a number of strong bristles, three of which are especially prominent.

The foot-claw (fig. 8) and the arrangement of the abdominal tubercles (see fig. 1) have been sufficiently described. The fourth abdominal sternum (fig. 9, iv) bears a pair of short conical processes which represent the spring (fig. 9, d); just behind these the paired sternal plates of the fifth abdominal segment (fig. 9, v) guard the reproductive aperture. Willem has figured a very similar arrangement of the ventral abdominal surface in *Neanura muscorum* (1900, pl. viii, fig. 3).

ENTOMOBRYIDAE.

Six species of this large family are included in the collection. All belong to the sub-family Entomobryinae, and are distributed among three of its tribes. One species—a *Lepidocyrtus* of somewhat aberrant form—is a member of the Entomobryini; there are three remarkable Paronellini, all of which can be referred to the type genus *Paronella*; finally there are two Cyphoderini; one a species, *Cyphoderus simulans*, described by Imms, and the other the type of an interesting new genus.

ENTOMOBRYINI

Lepidocyrtus, Bourlet.

Lepidocyrtus caudatus, sp. nov.

(Plate lv, figs. 10-12).

Mesonotum slightly prominent, half as long again as metanotum. Fourth abdominal segment six times as long as third, sixth abdominal tergum prolonged into a slender cerciform process (fig. 10). Feeler two and a half times as long as head, proportion of its segment as 4:8:6:9. Leg with distinct joint differentiating tarsus from tibia in second and third pairs. Foot-claw with prominent internal teeth, empodium long, acuminate, tenent hair thick and clubbed (fig. 11). Spring more than half as long as body; dentes $1\frac{1}{3}$ times length of manubrium; mucro (fig. 12) with strong procurved terminal and dorsal teeth and a slender dorsal spine.

Length 2.5 mm. Colour pale yellow with violet patches on the antennal segments, a violet streak along each side of the head, violet spots on edge of mesonotum, third, fourth and fifth abdominal segments, top of middle and third thighs, base and top of middle and on hind shins (fig. 10).

Locality.—Moulmein, Lower Burma (one specimen), 16th Nov., 1911. Ind. Mus $\frac{10+5}{19}$.

The elongate cerciform tergum of the sixth abdominal segment seems to be the most distinctive feature of this species. It comes rather near to *L. imperialis*, Carpenter (1916, p. 41) from the Seychelles, *L. maximus*, Schött (1893, pp. 11-13) from Cameroon, West Africa, and *L. pictus*, Schäffer (1898, pp. 415-16) from

Ralum, Bismarck Archipelago, but it differs from all of them in its relatively shorter and less prominent mesonotum.

PARONELLINI.

Paronella, Schött, 1893.

Trichorypha, Schött, 1893.

The comprehensive genus *Paronella*, as now understood, has a wide range over the eastern tropics from West Africa to Malaya. It comprises scaled entomobryine spring-tails with rigid dentes and broadly toothed mucrones, the feeler showing great variety in appearance and length, and the thoracic segments being of normal form. Five Indian species of *Paronella* have already been described by Imms (1912).

***Paronella crassicornis*, sp. nov.**

(Plate lvi, figs. 13-23).

Feelers robust, as long as head and body; relative length of their segments as 9:10:10:12; first segment with long bristles and thick terminal whorls of hairs, second segment with dense rows of bristles beneath, third with some strong long bristles. Fourth abdominal segment with tergum imperfectly divided, eight times as long as third (fig. 13). Legs with definite joint between shin and foot. Foot-claw (fig. 22) with paired basal lateral and internal teeth and an internal distal tooth; empodium elongate lanceolate with minute external tooth. Spring nearly as long as body; manubrium five-sixths as long as dens (fig. 13); mucro with two terminal and two dorsal teeth (fig. 23).

Length 4 mm. Colour rich brown with dark patches on the prothorax, the base and tip of the first and second and the tip of the fourth antennal segment. The haunches and thighs and most of the three hinder abdominal segments almost black, only a dorsal area on the fourth somewhat paler.

Localities.—Lower Burma: Dawna Hills, 400-2400 ft., Third Camp to Misty Hollow (*F. H. Gravely*), four specimens, 22-30 Nov., 1911, Ind. Mus. $\frac{1048}{19}$. Sukli, east side of Dawna Hills, 2100 ft. (*F. H. Gravely*), one specimen, 22-29 Nov., 1911, Ind. Mus. $\frac{1047}{19}$.

This handsome spring-tail may be readily distinguished from other species of *Paronella* by its rich brown colouration, and the thickness of the feelers which have a dense hairy clothing, especially on the second segment. The specimen figured (pl. lvi, fig. 13) has the right feeler with three segments only, the terminal combining the characters of the third and fourth in a normal feeler. There are eight ocelli on each side of the head (fig. 14), the two hind inner ones being much smaller than the others.

A study of the jaws has been made, and it will be seen that they resemble rather closely those of a species of *Cremastocephalus* (Carpenter, 1916, p. 46, pl. xviii, figs. 78-81), a genus of which

belongs to the same tribe. The mandible (fig. 15) offers no remarkable feature. The maxillulae (fig. 16, *Mxl*) have prominent apical lobes and strong external ridges; the tongue (fig. 16, *Hy*) is markedly widened distally and has a narrow median groove. The maxilla (fig. 16), has—like that of *Cremastocephalus*—a lacinia sub-circular in outline with short, even teeth, and a lamella with very numerous radially arranged bristles (figs. 17, 18) some of which are elegantly plumose (fig. 19). The end of the gales—like that of *Cremastocephalus*—is delicately lamelliform (figs. 20, 21, *ga*), surrounding the small conical bristle-bearing palp (figs. 20, 21, *p*). Study of the jaws in other genera of the Paronellini will show if these characters are distinctive of the tribe as a whole.

***Paronella flava*, sp. nov.**

(Plate lvi, figs. 24-27).

Feelers slender, somewhat shorter than body, relative lengths of their segments as 13:18:13:25. Fourth abdominal segment with tergum imperfectly divided, seven times as long as third. Legs with definite joint between shin and foot; foot-claw (fig. 26) with paired basal lateral and internal teeth and an internal distal tooth; empodial appendage long and slender. Spring three-quarters as long as body, dens half as long again as manubrium; mucro (fig. 27) with two terminal and two dorsal teeth.

Length 3 mm. Colour yellow with blackish transverse bands on the terga of the metathorax and the first abdominal segment; tips of antennal segments black-tipped.

Locality.—Lower Burma: Dawna Hills, 400-2400 ft., Third Camp to Misty Hollow (*F. H. Gravelly*), two specimens, 22-30 Nov., 1911. Ind. Mus. $\frac{1048}{110}$.

This species is clearly related to the preceding which it resembles in the structure of foot-claw and mucro, in the absence of a scale-appendage near the base of the latter, in the arrangement and relative size of the ocelli (fig. 25), and in the curious imperfect jointing of the fourth abdominal segment. In build and colour the two insects are of course most readily distinguishable.

***Paronella elongata*, sp. nov.**

(Plate lvii, figs. 28-33).

Feelers (imperfect) much longer than body. Eight ocelli on each side of head, the two anterior small and two inner posterior very small (fig. 29). Fourth abdominal segment eight times as long as third. Legs very long with definite tibio-tarsal joint. Foot-claw (figs. 30, 31) with paired basal lateral and internal teeth, and an internal distal tooth. Spring nearly three-quarters as long as body; dens a fifth as long again as manubrium, with scale-appendage at base of mucro; mucro (figs. 32, 33) with a small ventral, two terminal and two dorsal teeth.

Length 4 mm. Colour yellow, with a dark violet longitudinal streak along each side of the body and head; dark markings at the base and tip of first antennal segment, on hind thighs and on all the feet.

Locality.—Burmo-Siamese frontier: Myawadi, Amherst District, 900 ft. (*F. H. Gravely*), one specimen, 24-26 Nov., 1911. Ind. Mus. $\frac{10.44}{19}$.

This species is related to *Paronella börneri*, Imms (1912, pp. 106-8), from Nepal, which it resembles in its very elongate feelers and in the form of the mucro. It differs in the relative lengths of the antennal segments and in the details of colouration. *P. börneri* is also yellow with violet markings, but these do not form continuous lateral bands along the body. *P. dahlii*, Schäffer (1898, pp. 409-10), from Ralum, Bismarck Archipelago, belongs to the same group.

CYPHODERINI.

These are blind, pale, scaled spring-tails living in underground situations such as caves and ants' nests, or beneath stones. The spring has rigid dentes and, as a rule, elongate mucrones.

Cyphoderus, Nicolet.

Cyphoderus simulans, Imms.

Locality.—Lower Burma: Kawkareik, Amherst District (*F. H. Gravely*), three specimens, 19-20 Nov. 1911. Ind. Mus. $\frac{10.40}{19}$.

The types of this species were described by Imms (1912, pp. 115-16, pl. xii, figs. 90, 91) from specimens taken in the Khayon Caves, near Moulmein, Lower Burma.

Cyphoderopsis, gen. nov.

Body scaled, resembling *Cyphoderus* in aspect, eyes absent. Feet with normal toothed claw and simple empodial appendage (figs. 36, 37). Dens rigid, tapering, with a double row of strong spines and a delicate distal scale-appendage; mucro elongate and narrow with terminal and dorsal teeth (fig. 38). Type *C. kempi*, sp. nov.

This remarkable genus seems to be clearly referable to the Cyphoderini, most members of which it resembles in its general appearance, and in the structure of the feelers and mucro. The foot-claws and empodial appendages are, however, of the simple type usual among the Entomobryini and Paronellini, while the dentes, with their series of teeth and their scale-appendages, recall strikingly those of the latter tribe. *Cyphoderopsis* may be regarded therefore as in many respects a connecting link between the typical Cyphoderini and the Paronellini. The features of *Cyphoderus* and allied genera have been recently well set forth by Börner (1913).

Cyphoderopsis kemp, sp. nov.

(Plate lvii, figs. 34-38).

Feelers one and a quarter times as long as head; proportional lengths of their segments as 5 : 8 : 6 : 14. Feet of second and third pairs with feebly clubbed hairs; claws with strong internal basal teeth and two internal distal teeth, lateral teeth wanting; empodial appendage simple, narrowly lanceolate (figs. 36, 37). Fourth abdominal segment four times as long as third. Spring two-thirds as long as body, manubrium longer than dens and mucro together, dens three and a half times as long as mucro (fig. 34); mucro with blunt terminal tooth and a strong proximal dorsal tooth with minute serrations at its base, and a feeble distal dorsal tooth (fig. 38).

Length 1.5 mm. Colour white with feeble brown mottlings, especially noticeable on the head at the area usually occupied by the eyes (fig. 35).

Locality.—N.E. Assam: Rotung, 1400 ft., under stones (*S. W. Kemp*), one specimen, 26 Nov. 1911. Abor Expedition. Ind. Mus. ⁶¹⁵⁷/₁₉.

I have pleasure in associating this interesting little spring-tail with the name of its discoverer Mr. Stanley W. Kemp.

It is to be hoped that further specimens will be found so that a fuller knowledge of the structure may be obtained. The obvious features are, however, so striking that I have ventured without scruple to establish the new genus and species on a single insect.

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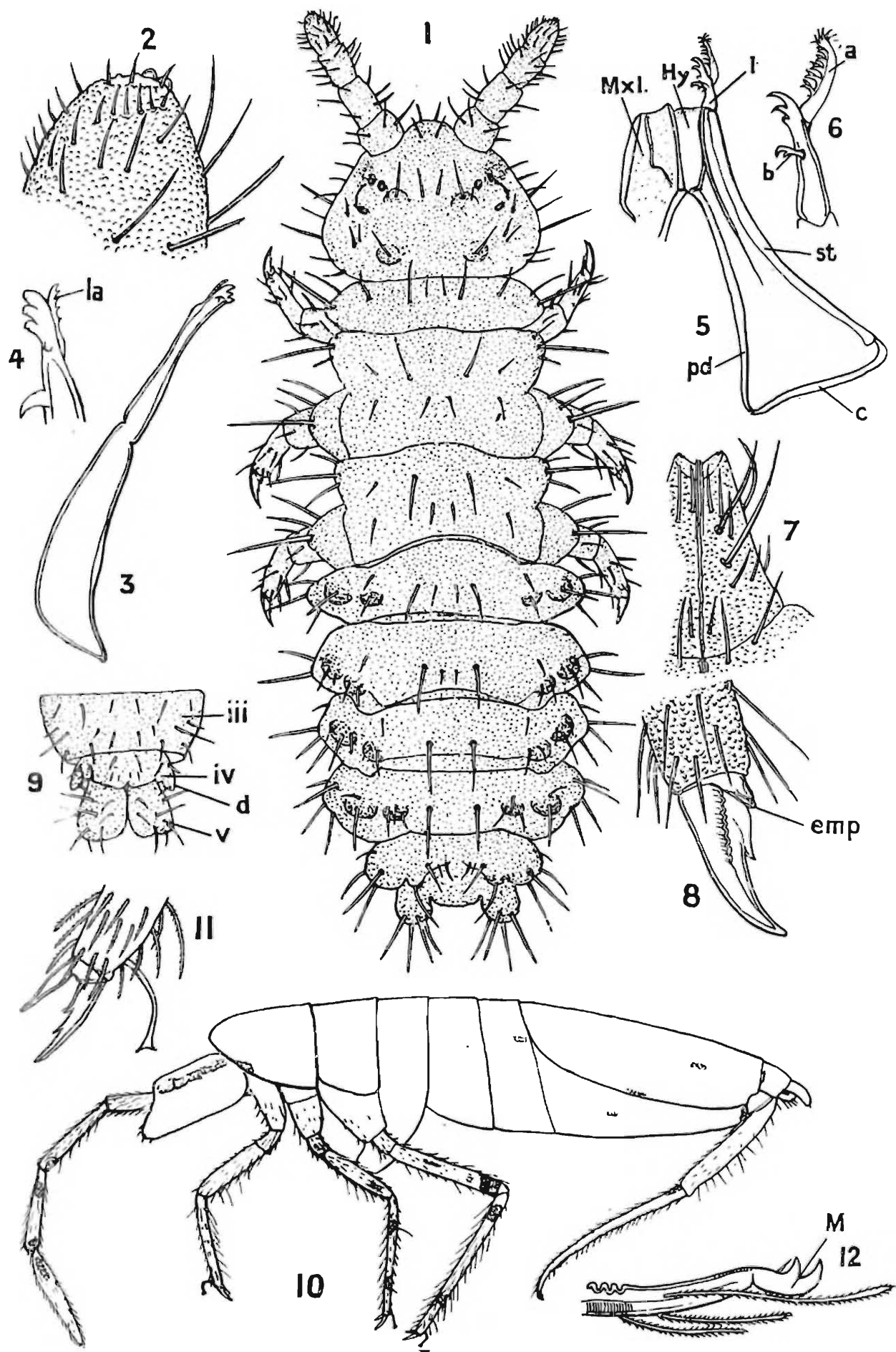
EXPLANATION OF PLATE I.V.

Protanura spinifera, sp. nov.

- FIG. 1.—Dorsal view. × 40.
,, 2.—Tip of left feeler, dorsal view. × 330.
,, 3.—Left mandible, dorsal view. × 85.
,, 4.—Right mandible, ventral view. (*la*) lamella. × 620.
,, 5.—Left maxillula (*Mxl.*); right maxilla, and tongue (*Hy.*);
 (*c*) cardo; (*st*) stipes; (*i*) lacinia of maxilla. × 85.
,, 6.—Lacinia of maxilla, (*a*) outer comb appendage; (*b*) inner
 toothed process. × 430.
,, 7.—Labium. × 85.
,, 8.—Foot of hind-leg. (*emp*) empodial appendage. × 310.
,, 9.—Third (iii), fourth (iv), and fifth (v) abdominal segments,
 ventral view, (*d*) vestigial dens of spring. × 40.

Lepidocyrtus caudatus, sp. nov.

- FIG. 10.—Lateral view. × 40.
,, 11.—Foot of hind-leg. × 310.
,, 12.—End of dens, and mucro of spring. × 620.



ABOR COLLEMBOLA.

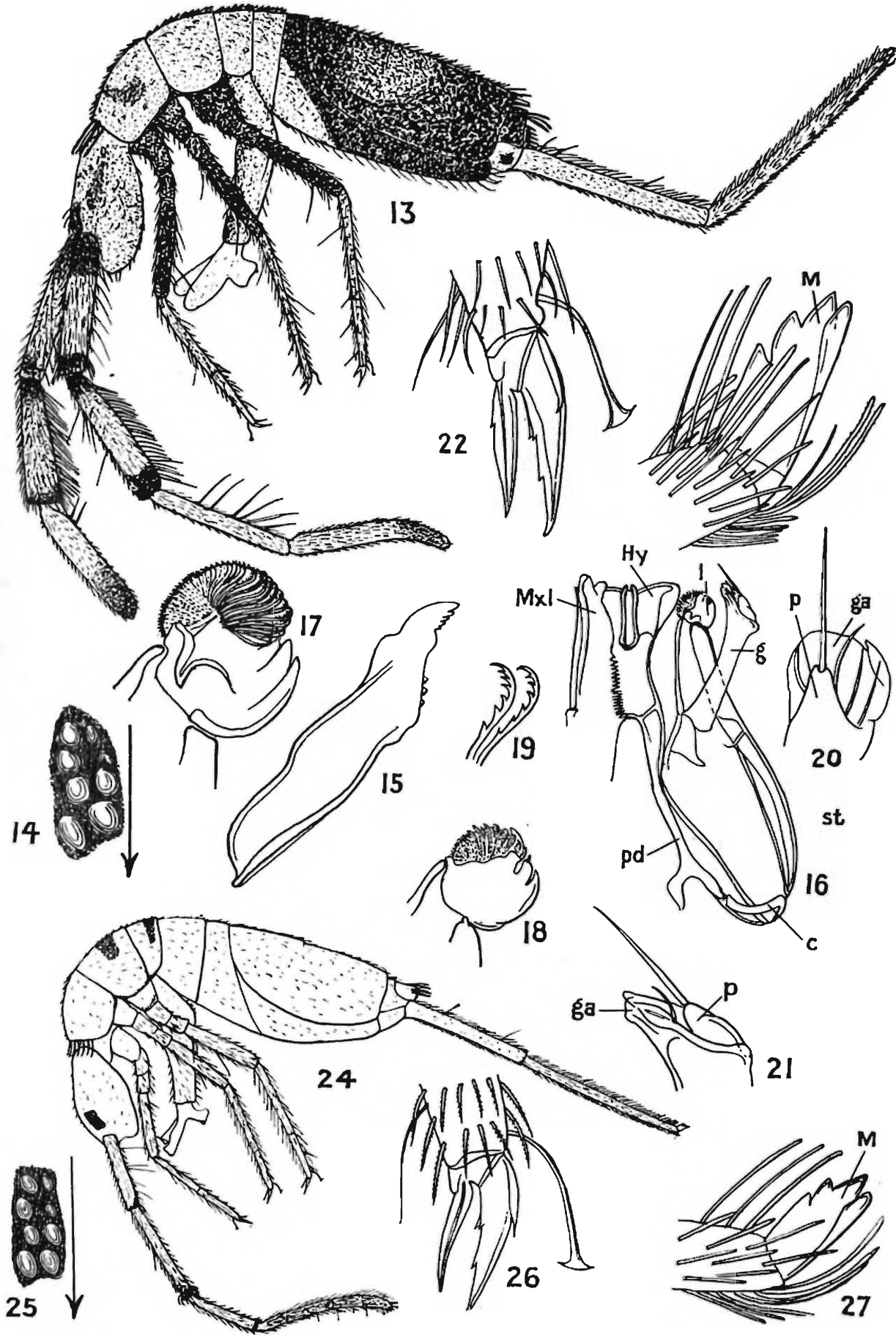
EXPLANATION OF PLATE LVI.

Paronella crassicornis, sp. nov.

- FIG. 13.—Lateral view. × 20.
,, 14.—Ocelli of right side. × 120.
,, 15.—Left mandible, dorsal view. × 160.
,, 16.—Left maxillula (*Mxl*); tongue (*Hy*) and right maxilla, dorsal view; (*c*) cardo; (*st*) stipes; (*g*) galea; (*p*) palp of maxilla; (*pd*) foot of tongue. × 160.
,, 17.—Lacinia of left maxilla, dorsal view. × 310.
,, 18.—Lacinia of right maxilla, ventral view. × 240.
,, 19.—Tips of plumose bristles from lacinial lamella. × 870.
,, 20.—Extremity of maxillary galea (*ga*) and palp (*p*), lateral view. × 240.
,, 21.—The same, dorsal view. × 240.
,, 22.—Foot of third leg. × 240.
,, 23.—End of dens, and mucro of spring, lateral view. × 240.

Paronella flava, sp. nov.

- FIG. 24.—Lateral view. × 20.
,, 25.—Ocelli of right side. × 120.
,, 26.—Foot of third leg. × 240.
,, 27.—End of dens and mucro of spring. × 240.



ABOR COLLEMBOLA.

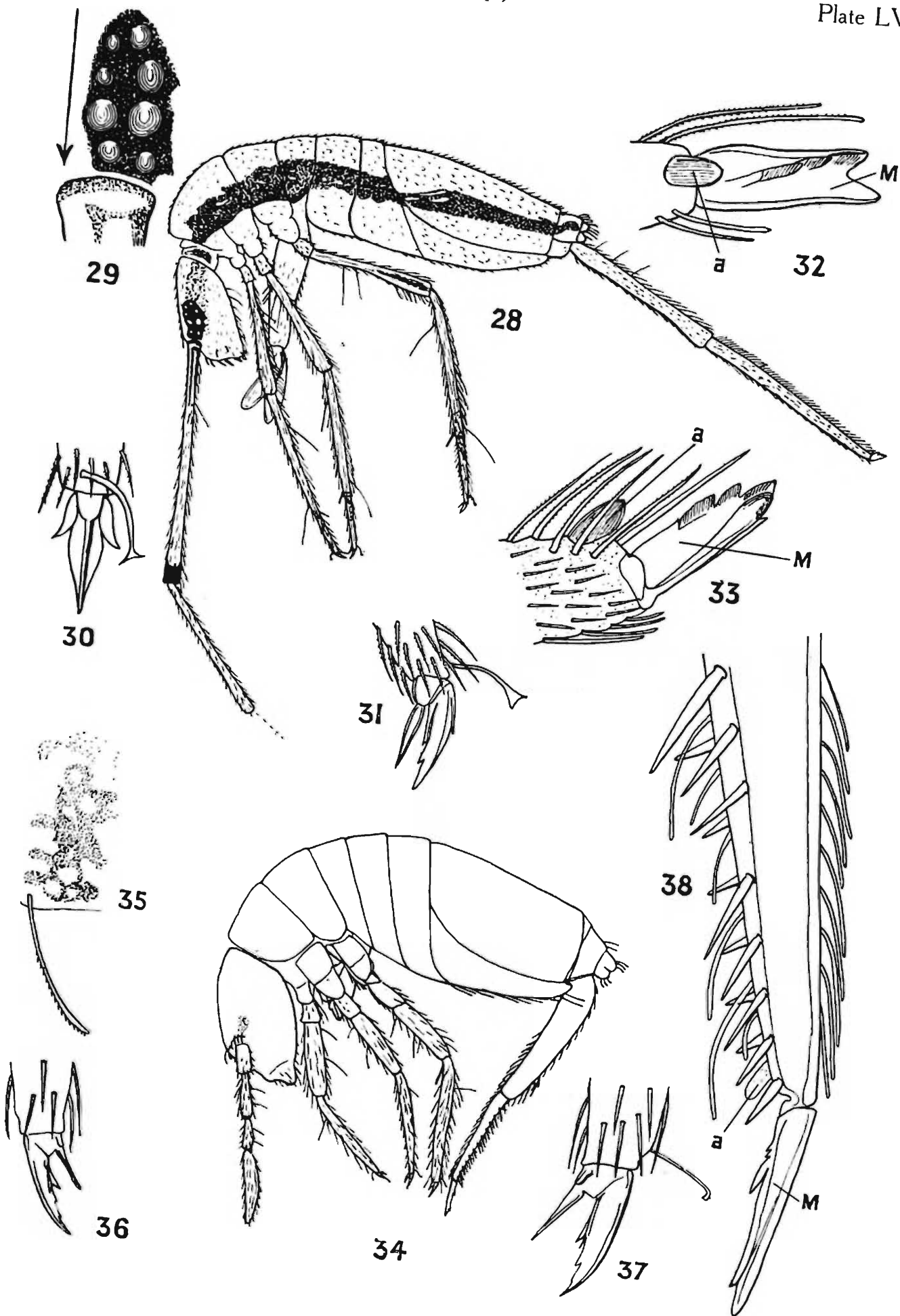
EXPLANATION OF PLATE LVII.

Paronella elongata, sp. nov.

- FIG. 28.—Lateral view. $\times 20$.
,, 29.—Ocelli of left side and base of feeler. $\times 120$.
,, 30.—Foot of third leg, dorsal view. $\times 240$.
,, 31.—The same, lateral view. $\times 240$.
,, 32.—End of left dens, and mucro of spring, dorsal view,
(s) scale-appendage. $\times 240$.
,, 33.—The same, lateral view. $\times 240$.

Cyphoderopsis kempi, sp. nov.

- FIG. 34.—Lateral view. $\times 35$.
,, 35.—Left ocellar area. $\times 620$.
,, 36.—Foot of fore leg. $\times 620$.
,, 37.—Foot of hind-leg. $\times 620$.
,, 38.—Distal portion of dens with rows of spines, and scale
appendage (a), and mucro (M) of spring. $\times 620$.



ABOR COLLEMBOLA.

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 Sikkim 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, 2a, 2b. 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 Daffa 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 *Pterocyclops* 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.).

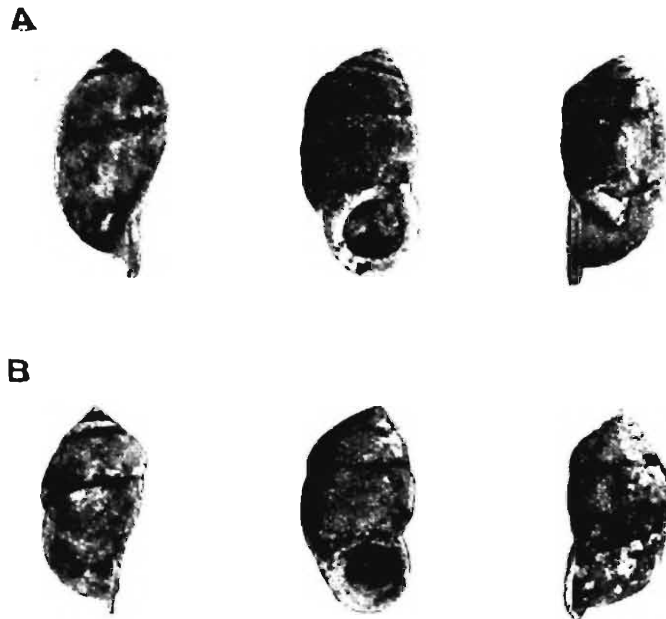


FIG. 1 A.—*Raphaulus assamica*, G.-A.
 .. 1 B.— .. *yamneyensis*, n. sp.

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.

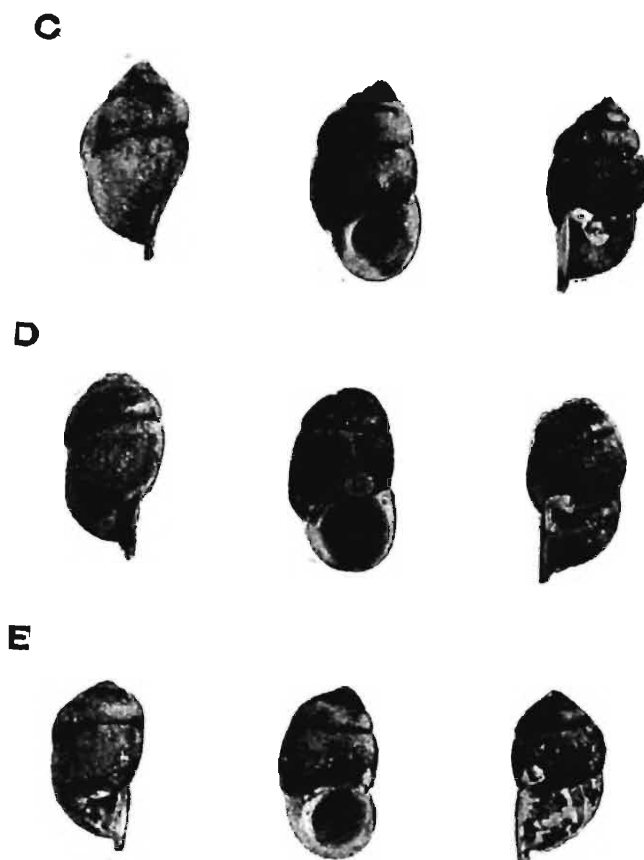


FIG. 2 C.—*Raphaulus aborensis*, n. sp.
 „ 2 D.— „ *oakesi*, n. sp.
 „ 2 E.— „ *shimangensis*, n. sp.

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 Sikkim, viz. a narrow flat band running back along the suture with here and there minute perforations (vide *Mollusca of India*, plate xlvii, fig. 4a). 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;

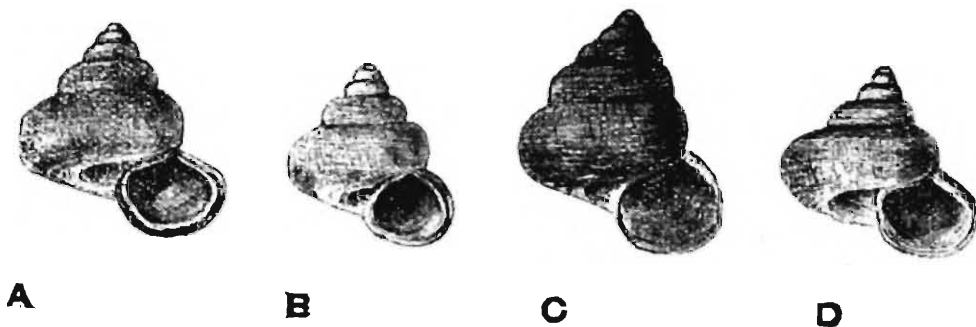


FIG. 3 A.—*Lagocheilus oakesi*, n. sp. $\times 4$.
 „ 3 B.— „ „ var. $\times 4$.
 „ 3 C.— „ *daflaensis*, n. sp. $\times 4$.
 „ 3 D.— „ *sikhimensis*, n. sp. $\times 4$.

whorls $5\frac{1}{2}$, 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 $5\frac{1}{2}$, 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, subturrited; 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 ⁵⁹⁹⁷ Ind. Mus. (S. W. Kemp); no. 3139, Brit. Mus., same locality (Capt. Oakes, R.E.).

Original description.—"Shell obliquely ovate with exerted
"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-

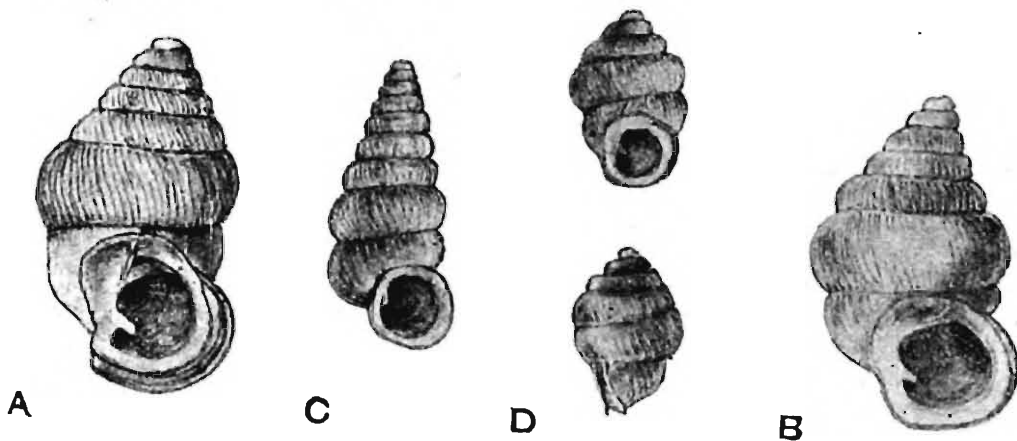


FIG. 4 A.—*Diplommatina perobesa*, Preston. $\times 8$.
 " 4 B.— " *mucronatus*, n. sp. $\times 8$.
 " 4 C.— " *acutulus*, n. sp. $\times 8$.
 " 4 D.— " *miriensis*, n. sp. $\times 8$.

"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 peristome 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

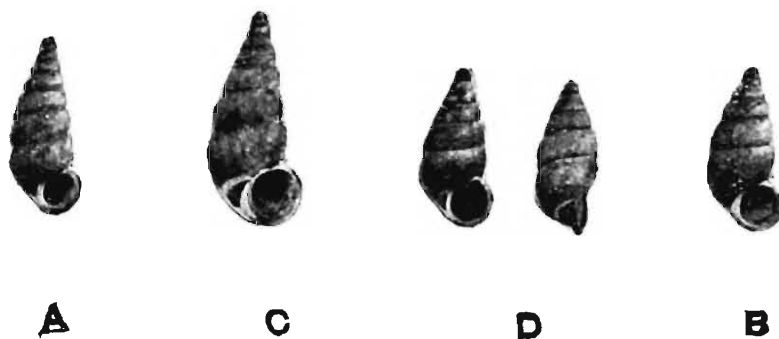


FIG. 5 A.—*Pseudopomatias siyomensis*, n. sp.
 " 5 B.— " *luyorensis*, n. sp.
 " 5 C.—*Eupomatias sibbumensis*, n. sp.
 " 5 D.— " *oakesi*, n. sp.
 (All multiplied 1·5.)

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 Daffa 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.

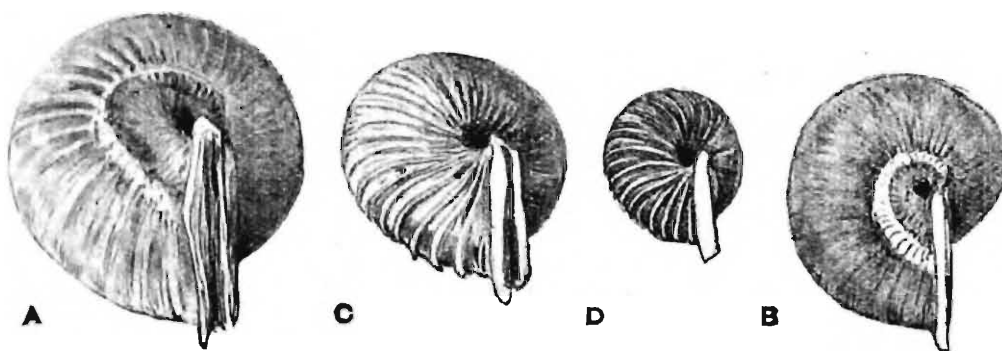


FIG. 6 A.—*Eupomatias sibbumensis*, n. sp.
 " 6 B.—" *oakesi*, n. sp.
 " 6 C.—*Pseudopomatias siyomensis*, n. sp.
 " 6 D.—" *himalayae*, Bs.
 (All multiplied 6 times.)

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, shiny; 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, multi-spiral, 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.

