XLVI. COLLEMBOLA.

(Plates LV—LVII).

By GEORGE H. CARPENTER, *M.Sc.*, *M.R.I.A.*, *Professor of Zoology in the Royal College of Science, Dublin.*

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.

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[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 lv, 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 Hawaian 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 1⅓ 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 $\frac{10\pm5}{19}$.

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. $\frac{10\,4\,8}{19}$. Sukli, east side of Dawna Hills, 2100 ft. (*F. H. Gravely*), one specimen, 22-29 Nov., 1911, Ind. Mus. $\frac{10\,4\,7}{19}$.

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 subcircular 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. Gravely*), two specimens, 22-30 Nov., 1911. Ind. Mus. $\frac{1048}{19}$.

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. $\frac{1044}{19}$.

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. $\frac{1049}{19}$.

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 kempi, 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. $\frac{6157}{19}$.

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.

REFERENCES TO LITERATURE.

1906. Börner, C., Das System der Collembolen, nebst Beschreibung neuer Collembolen des Hamburger naturhistorischen Museums. *Mitt. aus dem naturhist. Mus. Hamburg*, xxiii, 1906, pp. 147-88.

1913. ,, Neue Cyphoderinen. *Zool. Anz.*, xli, 1913, pp. 274-284.

1904. Carpenter, G. H., Collembola in Fauna Hawaiensis, iii, London, 1904, pp. 299-303, pl. ix.

1916. ,, The Apterygota of the Seychelles. *Proc. R. Irish Acad.*, xxxiii (B), 1916, pp. 1-70, pls. i-xviii.

1912. Imms, A. D., On some Collembola from India, Burma and Ceylon, with a Catalogue of the Oriental Species of the Order. *Proc. Zool. Soc. Lond.*, 1912, pp. 80-125, pls. vi-xii.

1898. Schäffer, C., Die Collembola des Bismarck-Archipels. *Archiv für Naturgeschichte*, 1898, pp. 393-425, pls. xi-xii.

1893. Schött, H., Beiträge zur Kentniss der Insektenfauna von Kamerun. I. Collembola. *Bih. t. K. Svensk. Vet. Akad. Handl.*, xix, pt. iv, no. 2, 1893, 28 pp., pls. i-vii.

1900. Willem, V. Recherches sur les Collemboles et les Thysanoures *Mem. Couronnés Acad. Roy. des Sciences de Belgique*, lviii, 1899-1900, 144 pp., pl. i-xvii.