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# The Blepharoceridae of Japan

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# The Blepharoceridae of Japan.

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*With Plate VIII—XVII and Ten Text-figures.*

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## INTRODUCTION.

Four species of Japanese Blepharoceridae were ever described from adult specimens, but neither larval nor pupal forms are known at all. During my stay in the Province of Ettyû in the summer of 1925, several odd insect larvae were obtained from the stomach of a salmonoid fish, of which some, to my great pleasure, belonged to this family. Since this occasion I took up the Japanese Blepharocerid fauna for my subject of study and was fortunate enough to find till now as much as five genera, eighteen species and four varieties. Most of them are sure to be new to science, besides the imagos, larvae of different stages and pupae being consulted. Attentions were paid of their ecological accounts, such as the life cycle, behavior or distribution. In giving herewith the description of our Blepharoceridae, I can not help expressing here to Prof. T. Kawamura my sincere thanks for his kind help and leadership throughout my work. I am deeply indebted also to Prof. Dr. H. Yuasa for his kind guidance and many advices. I am also obliged to Prof. Dr. T. Esaki, Mr. M. Iwata, Mr. M. Uéno, Mr. K. Imanisi and Mr. K. Kitahara for favouring me with materials, and Mr. R. Takahasi for lending me some useful literatures.

## SOME MORPHOLOGICAL REMARKS.

Although the general morphology of this group of insects is already well acquainted with, I should like to give here a short review of the

body structure in the different stages of this family, since there have been found some important and interesting characters upon which the establishment of my new forms are based.

*Imago.* The eye of the imago is wonderfully variable both with species and sexes. It is sometime holoptic or contiguous and the other time dichoptic or separated, and is generally bisected by an unfaceted cross-band into two parts. The upper part, as a rule, is composed of large, less pigmented, brown facets, while the lower part is always of small, strongly pigmented, blackish brown ones, though sometimes both parts may be composed of blackish brown, smaller facets. The size of the upper part is much variable and many transitional cases are found. It may be said that the upper part of the eye of generalized species and of the female, is more widened and largely faceted than that of the specialized species and of the male. The antenna is slender, nine to fifteen jointed, with two scapal and the other flagellar joints. The flagellum is variable according both with species and sexes, being in the same species more slender and shorter in the female than in the male, and among the joints the first and the last ones are most variable. Maxillary palpus is five jointed, the last joint of which is most variable with sexes and species. The pronotum and the metanotum are rudimentary while the mesonotum is very conspicuous. The mesonotum is furnished with a slight median stripe, a pair of short lateral longitudinal stripes, and two pairs of incomplete, but conspicuous transverse sutures (text-fig. 1). The wing is rather broad, iridescent and subhyaline, except the opaque costal cell. The veins are dark brown, but rather light in the posterior half of the wing. The venation is most variable with genera and species, and is of systematical importance. The legs are slender and are usually furnished in the hind tibia with a pair of terminal spurs of different size. The tarsus is five jointed, the last of which is furnished with a pair of claws and a rudimentary empodium. The hypopygium of the female is simple, with dorsal- and ventral-plate and a pair of lamellae, while that of the male (figs. 6, 7, 23, 24, etc.) is much complicated, being accordingly of systematical importance. Behind the eighth tergite and sternite are a dorsal- (basal-) plate and a ventral-plate respectively. The dorsal-plate is smaller than the ventral-plate, and the lateral margins of the latter are partly turned dorsalwards. Next to the dorsal-plate is a guard-plate which is laterally bilobed, and protruded from the inner margin of the ventral-plate are a pair of claspers which are generally bilobed dorso-ventrally.

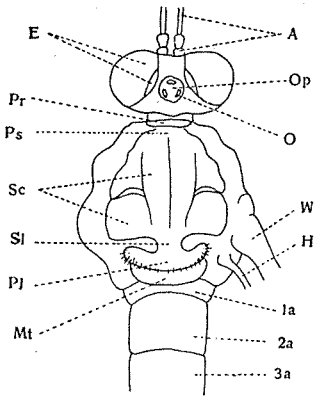


Fig. 1. *Philorus voidis* sp. nov., male, dorsal view,  $\times 20$ . A, antenna; E, compound-eye; O, ocellus; Op, ocellar protuberance; Pr, pronotum; Ps, prescutum; Sc, scutum; Sl, scutellum; Pl, post-scutellum; Mt, metanotum; W, wing; H, halter; 1a, 2a, 3a, first, second and third abdominal segments.

*Larvae in different stages.* The morphology of the larva shall be described principally on the last larval instar, because this is the most specialized of all stages. Of seven body-segments of the larva, the first one is composed of the head, the thorax and the first abdominal segment, while the last body-segment is consisted of the seventh, eighth and ninth abdominal segments fused together. In some special cases, the last two body-segments are fused into a mass (figs. 56, 57). Majority of the body-segments is composed of the anterior, small neck-piece and the posterior, large main-piece which is divided into two parts by a weak transverse groove. The antenna is two or three jointed, sometimes jointless, the length of which is much variable with species. At the mid-dorsal surface of the thorax is a dark spot which is called a

thoracic spot. This spot is an indication of the respiratory lamellae of pupa underneath the skin, and is much variable with species either showing U, V or  $\infty$  in shape (figs. 15, 66, 81) or even lacking. When the thoracic spot is obscured or absent, the pupal respiratory lamellae can easily be revealed by a removal of the skin (figs. 1, 4). The abdominal segment is usually furnished with chitinous thorns or warts on the dorsal side, and with some appendages on the lateral sides. Of these lateral appendages dorsally placed one is called a feeler and ventrally placed a claw. The feeler is much variable in number and form, while the claw is always conical in shape. There are a pair of feeler-like appendages (not claws) on the lateral sides of the seventh abdominal segment. The caudal margin of the body is usually semicircular and is often furnished with a pair of chitinous appendages which are called caudal appendages (figs. 15, 16, 48, 49). The caudal appendages are sometimes rudimentary and remain as a pair of chitinous plates (figs. 57, 61). There are six suckers arranged in a longitudinal series at the median ventral surface of from first to sixth abdominal segments. It is worthy of mentioning that these suckers are a correspondent to the claws. On the antero-lateral sides of each

from second to sixth abdominal segments (figs. 3, 73, 82) there are a pair of gill-tufts which are called segmental gill-tufts. Each segmental gill-tuft is composed of slender, white filaments, the number of which is much variable. Posterior to the last sucker are two pairs of dissimilar gill filaments which are called anal gills.

Now, it is of decided importance how to catch the best available characteristics of each larval stage. The coloration, dimension, as well as the relative size of the head plates, feelers, claws, suckers etc. are all much varied in different stages. But, the number of the filaments in the segmental gill-tuft and of the joints in the antenna is fairly constant in every stage, as is given in the following table.

Table I.

genera	stages	I		II		III		IV	
		g. f.	a. j.	g. f.	a. j.	g. f.	a. j.	g. f.	a. j.
<i>Bibiocephala</i>	}	0	I	I	I	3	2	5	2
		0	I	I	1.5	3	2	5	3
<i>Philorus</i>		0	I	I	1.5	3	2	5	3
<i>Parablepharocera</i>		0	I	I	1.5	4	2	7	2
<i>Blepharocera</i>		0	I	I	1.5	4	2	7	2

The length of the body in every stage is nearly doubled in the next interval; for instance, the larvae of *Bibiocephala infuscata* are measured: first instars 1.4-2 mm.; second instars 1.8-3.5 mm.; third instars 4-7.5mm.; fourth instars 8-15mm. On the other hand, thorns, claws, feelers, gill filaments, suckers etc. do not show any remarkable growth, but retain their sizes for the interval of two stages that they pass after the moulting. From these two phenomena is caused a rather odd appearance of the larva. For instance, suckers in the fourth instar just after the moulting have a diameter equal to the body breadth, and are entirely contiguous to each other in a longitudinal series.

The third instar nearly agrees in form with the fourth instar, except the above mentioned differences. The second instar is usually furnished with antennae of two joints, of which the proximal joint is rudimentary, and the distal joint is elongated. The feeler and the claw are rather small and simple. The caudal appendage, if present, is very rudimentary. The second instar of *Flapalothrix* described by Bischoff (1922)

has three filaments of the segmental gill-tuft. This state, however, seems to me rather unique and may be called an exceptional case.

The body of the first instar is small and slender, and the antenna is very short and jointless. The first body-segment is large and oval, of which the head plates are weakly chitinized. The thorax is in general furnished with three transverse rows of thornlets, and each abdominal segment with two similar rows. The caudal margin is slightly convex, without any appendages. The feeler and the claw together with the segmental gill-tuft are entirely absent. The lateral margin of from first to sixth abdominal segments is slightly prominent and is furnished with two, very small setae and a cylindrical cuticular process with a circular series of about ten hooks which is curved outwards (text-fig. 2. B, C, fig. 90). This process is retractile, as described by Tonnoir (1924). In the first instar of *Philorus vividis* (text-fig. 2, A),

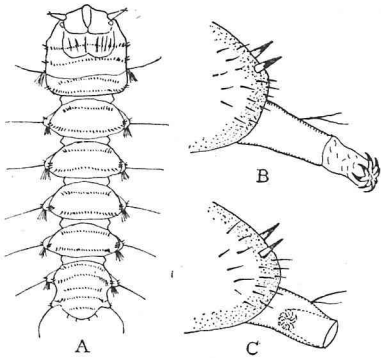


Fig. 2. A. *Philorus vividis* sp. nov., first instar, dorsal view,  $\times 40$ ; B. *Paracurupira chiltoni* Campbell, retractile hooked-appendage of first instar, in expansion (after Tonnoir); C. the same, in retraction (after Tonnoir).

which is rather an exceptional case, the place of the retractile hooked process is occupied by a long stout bristle and a tuft of about ten short bristles. The suckers and anal gills are normal.

*Pupa.* Thirteen segments can be recognized in the body of the pupa, namely the head, the pro-, meso- and metathorax, and from first to ninth abdominal segments. The head is small, and when the convexity of the body is enormous, it is invisible in dorsal aspect, but if the body is flat, as in *Philorus vividis* (fig. 75), it is very obvious. The boundary between the prothorax and mesothorax

is incomplete, since the median parts of both segments are confluent. On both sides of the dorso-median line of prothorax are a pair of appendages which are called pupal horns and are of systematic importance. This is composed of a few, usually four, respiratory lamellae of various sizes. A longitudinal raphe passing through the dorso-median parts of the head and the pro-mesothorax is called a cephalo-thoracic seam. The anterior end of the cephalo-thoracic seam is branched into two parts on the head. The mesothorax is broadest, and is touched by the metathorax, the second and third abdominal segments posteriorly.

The metathorax and the first abdominal segment are very small, and are entirely enclosed by other segments together with the second abdominal segment. The eighth and ninth abdominal segments are fused, but are dividable by an ungranulated transverse band. The dorsal side of the body is covered by numerous, minute, chitinous dots, the granulation of which is much variable with species. The ventral side of the body is covered by a delicate hyaline membrane, through which the arrangement of the imaginal organs is well recognized as shown in the figure (fig. 21). Three pairs of tufts with slender white filaments are found on the inner sides of the pads, and two more pairs corresponding to the second and third abdominal segments are also found on the dorsal side of the wing-sacs. These tufts seem to be residua of the larval segmental gill-tufts, because each one is provided, in certain genera, with five or seven filaments (fig. 11).

### CLASSIFICATION.

#### Key to the genera.

##### *Imago.*

- A<sub>1</sub> Vein Media<sub>3</sub> present.
- B<sub>1</sub> Media<sub>3</sub> complete, partly fused with Cubitus<sub>1</sub>. Radius<sub>2</sub> ending at the margin of the wing. .... *Edwardsina* Alexander.
- B<sub>2</sub> Media<sub>3</sub> incomplete, apart from Cubitus<sub>1</sub>.
- C<sub>1</sub> Radius<sub>2</sub> partly distinct, running into Radius<sub>1</sub>. So-called m-cu cross-vein present. .... *Bibiocephala* Osten-Sacken.
- C<sub>2</sub> Radius<sub>2</sub> wholly fused with Radius<sub>3</sub>.
- D<sub>1</sub> So-called m-cu cross-vein present. .... *Philorus* Kellogg.
- D<sub>2</sub> So-called m-cu cross-vein absent.
- E<sub>1</sub> Eyes dichoptic, each not bisected by a band or line .....  
..... *Liponcera* Loew.
- E<sub>2</sub> Eyes holoptic or dichoptic, each bisected by an unfaceted band or line.
- F<sub>1</sub> Radial sector elongated, longer than twice the r-m cross-vein. .... *Parablepharocera* g. nov.
- F<sub>2</sub> Radial sector usually short, shorter than twice the r-m cross-vein. .... *Blepharocera* Macquart.
- A<sub>2</sub> Vein Media<sub>3</sub> absent.
- B<sub>1</sub> Radial vein at least two branched.
- C<sub>1</sub> Second longitudinal vein branched or Radius<sub>2+3</sub> and Radius<sub>1+5</sub> distinct.
- D<sub>1</sub> Eyes holoptic, each not bisected by a band.

- E<sub>1</sub> Ungues of ordinary structure; tibiae with spurs at the tip. .... *Curupira* Osten-Sacken.
- E<sub>2</sub> Ungues abnormal, pulvilliform; tibiae without spurs at the tip. .... *Hapalothrix* Loew.
- D<sub>2</sub> Eyes holoptic, each bisected by an unafaceted cross-band. ..  
..... *Neocurupira* Lamb.
- C<sub>2</sub> Second longitudinal vein unbranched or Radius<sub>2+3</sub> and Radius<sub>4+5</sub> wholly fused.
- D<sub>1</sub> Radio-medial cross-vein present.
  - E<sub>1</sub> Eyes dichoptic, each not bisected by a band. ....  
..... *Pallostoma* Schiner.
  - E<sub>2</sub> Eyes dichoptic, each bisected by an unafaceted cross-band.  
..... *Perithcates* Lamb.
  - D<sub>2</sub> Radio-medial cross-vein absent. .... *Apistomyia* Bigot.
- B<sub>2</sub> Radial vein unbranched or unique. .... *Hammatorhina* Loew.

**Larva** (fourth instar).

- A<sub>1</sub> Without chitinous appendages on the lateral side of each first six abdominal segments, but with a fleshy lobe. .... *Edwardsina*.
- A<sub>2</sub> With chitinous appendages on the lateral side of each first six abdominal segments.
  - B<sub>1</sub> With a claw-form and a feeler-form appendages on the lateral side of each first six abdominal segments; feeler-form appendage with stout apical bristles.
    - C<sub>1</sub> With a chitinous appendage on the lateral side of the seventh abdominal segment; segmental gill-tuft with five filaments.
      - D<sub>1</sub> Neck-pieces rather inconspicuous; thorns lacking or rudimentary on the dorsal side of each body-segment. ....  
..... *Bibioccephala*.
      - D<sub>2</sub> Neck-pieces very conspicuous; six stout thorns or warts on the dorsal side of each body-segment. .... *Philorus*.
    - C<sub>2</sub> Without chitinous appendage on the lateral side of the seventh abdominal segment; segmental gill-tuft with seven filaments.  
..... *Liponeura*.
  - B<sub>2</sub> With a claw-form appendage on the lateral side of each first six abdominal segments; feeler-form appendages generally lacking, if present without stout apical bristles.
    - C<sub>1</sub> Feeler-form appendages without stout apical bristles present or absent; seventh body-segment not semicircular.
      - D<sub>1</sub> A pair of feeler-form appendages present on the lateral side



- of each first six abdominal segments; caudal appendages present. ....*Parablepharocera* g. nov.
- D<sub>2</sub> Feeler-form appendages generally absent, if present very rudimentary; caudal appendages absent. ....*Blepharocera*.
- C<sub>2</sub> Feeler-form appendages absent; seventh body-segment semicircular.
- D<sub>1</sub> Claw-form appendage not dichotomized on each first six abdominal segments. ....*Curupira*.
- D<sub>2</sub> Claw-form appendage dichotomized horizontally on each first six abdominal segments. ....*Hapalothrix*.

### **Pupa.**

- A<sub>1</sub> Pupal horn with a proximal common stem and many respiratory lamellae distally arranged. ....*Edwardsina*.
- A<sub>2</sub> Pupal horn with four respiratory lamellae arranged before and behind.
- B<sub>1</sub> Respiratory lamellae elongated, the tips pointed; body rather convex, outer margin undulated.
- C<sub>1</sub> With granulation on the dorsal side of prothorax.
- D<sub>1</sub> Without granulation on the dorsal side of mesothorax. ....  
.....*Bibiocephala*.
- D<sub>2</sub> With granulation on the dorsal side of mesothorax, but exceptionally on the prothorax lacking. ....*Liponcira*.
- C<sub>2</sub> Without granulation on the dorsal side of prothorax.
- D<sub>1</sub> Body slightly convex; abdominal margin slightly undulated; dorso-median ridge of abdomen conspicuous. ....  
.....*Parablepharocera* g. nov.
- D<sub>2</sub> Body strongly convex; abdominal margin undulated; dorso-median ridge of abdomen inconspicuous. ....*Blepharocera*.
- B<sub>2</sub> Respiratory lamellae semicircular, but exceptionally elongated and pointed; body more or less flat, outer margin smooth. Granulation on the mesothorax more or less preserved, but exceptionally lacking. ....*Philorus*.

### **Key to the Japanese species.**

Genus *Bibiocephala* Osten-Sacken.

### **Imago.**

- A<sub>1</sub> Eyes holoptic, bisected in both sexes; antennae fifteen jointed; vein R<sub>2</sub> longer than R<sub>3+4+5</sub>; lobes of the guard-plate of male hypopygium

- shorter than the basal breadth of the plate, dorsal-plate nearly equal to the ventral-plate in length. ....  
 ..... *Bibiocephala infuscata* (Matsumura).  
 A<sub>2</sub> Eyes dichoptic at least in male, bisected in both sexes; antennae fourteen jointed; vein R<sub>2</sub> equal or shorter than R<sub>3+4+5</sub>; lobes of the guard-plate of male hypopygium longer than the basal breadth of the plate, dorsal-plate nearly half the ventral-plate in length.  
 B<sub>1</sub> Vein R<sub>2</sub> nearly equal to R<sub>3+4+5</sub>; posterior margin of the ventral-plate of male hypopygium undulated. ....  
 ..... *Bibiocephala japonica* Alexander.  
 B<sub>2</sub> Vein R<sub>2</sub> nearly half the R<sub>3+4+5</sub>; posterior margin of the ventral-plate of male hypopygium not undulated. ....  
 ..... *Bibiocephala montana* sp. nov.

**Larva** (fourth instar).

- A<sub>1</sub> Feeler-form appendages dichotomized vertically; antennae two jointed. With six rudimentary warts on the dorsal side of each first seven abdominal segments.  
 B<sub>1</sub> Dorsal side dark brown throughout; length ca. 15 mm. ....  
 ..... *Bibiocephala infuscata* (Matsumura).  
 B<sub>2</sub> Dorsal side yellowish brown, except the blackish third and fourth body-segments; length ca. 10 mm. ....  
 ..... *Bibiocephala infuscata* var. *minor* nov.  
 A<sub>2</sub> Feeler-form appendages not dichotomized; antennae three jointed.  
 B<sub>1</sub> With a pair of caudal appendages.  
 C<sub>1</sub> Antennae 1/2 the first body-segment; feelers large, strongly chitinized; without thornlets on the dorsal side of thorax. ...  
 ..... *Bibiocephala japonica* Alexander.  
 C<sub>2</sub> Antennae 1/5 the first body-segment; feelers small, slightly chitinized; with three transverse rows of thornlets on the dorsal side of thorax. .... *Bibiocephala iyaensis* sp. nov.  
 B<sub>2</sub> Without caudal appendages.  
 C<sub>1</sub> Two lateral warts on the dorsal side of each first six abdominal segments; dorsal side dark brown. ....  
 ..... *Bibiocephala montana* var. *bispina* nov.  
 C<sub>2</sub> No warts on the dorsal side; dorsal side light yellowish. ...  
 ..... *Bibiocephala montana* sp. nov.

**Pupa.**

- A<sub>1</sub> Pupal horns gigantic, lamellae of which broadened distally; without

- longitudinal ridge between the bases of the pupal horns; anterior margins of the prothorax smooth.
- B<sub>1</sub> Dorsal side brownish black; length ca. 10.5 mm. ....  
.....*Bibiocephala infuscata* (Matsumura).
- B<sub>2</sub> Dorsal side obscure brown; length ca. 7.5 mm. ....  
.....*Bibiocephala infuscata* var. *minor* nov.
- A<sub>2</sub> Pupal horns slender, lamellae of which pointed distally; with a longitudinal ridge between the bases of the pupal horns; anterior margins of the prothorax undulated.
- B<sub>1</sub> Pupal mattress present; pupal horns rather horizontal and large, the tips contiguous. ....*Bibiocephala japonica* Alexander.
- B<sub>2</sub> Pupal mattress absent; pupal horns rather erect and small, the tips separated.
- C<sub>1</sub> Dorsal side blackish brown. ....  
.....*Bibiocephala montana* var. *bispina* nov.
- C<sub>2</sub> Dorsal side yellowish brown. ....*Bibiocephala montana* sp. nov.

Genus *Philorus* Kellogg.

**Imago.**

- A<sub>1</sub> Anterior cross-vein r-m touched to R<sub>4+5</sub>; lobes of the guard-plate of male hypopygium elongated, longer than the basal breadth of the plate. Eyes dichoptic, bisected in both sexes; antennae fourteen jointed. ....*Philorus bilobatoides* sp. nov.
- A<sub>2</sub> Anterior cross-vein r-m touched to Rs; lobes of the guard-plate of male hypopygium shortened, shorter than the basal breadth of the plate.
- B<sub>1</sub> Rs shorter than R<sub>2+3</sub>; antennae fourteen jointed; eyes holoptic or dichoptic, bisected in both sexes.
- C<sub>1</sub> Eyes holoptic in female, dichoptic in male; straight part of Rs nearly twice the basal deflection of it. ....  
.....*Philorus alpinus* sp. nov.
- C<sub>2</sub> Eyes dichoptic in both sexes; straight part of Rs more than thrice the basal deflection of it. ...*Philorus kuyaensis* sp. nov.
- B<sub>2</sub> Rs longer than R<sub>2+3</sub>; antennae at most thirteen jointed; eyes dichoptic, bisected in both sexes, but the upper parts rudimentary.
- C<sub>1</sub> Antennae thirteen jointed.
- D<sub>1</sub> Vein R<sub>4+5</sub> nearly equal to the straight part of Rs; flagellar joints of antennae swollen proximally. With a pair of clasper-like appendages on the dorsal parts of the ventral-

- plate of male hypopygium; ventral lobes of the claspers elongated, conspicuously swollen apically. ....  
 .....*Philorus longirostris* sp. nov.
- D<sub>2</sub> Vein R<sub>4+5</sub> slightly shorter than the straight part of Rs; flagellar joints of antennae cylindrical or ellipsoidal. ....  
 .....*Philorus chosonensis* sp. nov.
- C<sub>2</sub> Antennae twelve jointed. Vein R<sub>4+5</sub> slightly shorter than the straight part of Rs; flagellar joints of antennae swollen proximally. Without clasper-like appendages on the dorsal parts of the ventral-plate of male hypopygium; ventral lobes of claspers not elongated. ....*Philorus vividis* sp. nov.

**Larva** (fourth instar).

- A<sub>1</sub> Neck-pieces and feeler-form appendages inconspicuous; three transverse rows of thornlets on the dorsal side of thorax.
- B<sub>1</sub> Lateral thorns absent on the dorsal side of second to seventh abdominal segments; dorsal side dark yellowish brown; length ca. 8 mm. ....*Philorus bilobatoides* sp. nov.
- B<sub>2</sub> Lateral thorns present on the dorsal side of each first seven abdominal segments; dorsal side light yellowish, except the blackish second and third body-segments; length ca. 5.5 mm. ..  
 .....*Philorus bilobatoides* var. *longispina* nov.
- A<sub>2</sub> Neck-pieces and feeler-form appendages conspicuous; no thornlets on the dorsal side of thorax.
- B<sub>1</sub> Caudal appendages elongated rod-like; feeler not dichotomized, without dorsal branch. ....*Philorus alpinus* sp. nov.
- B<sub>2</sub> Caudal appendages rudimentary or absent; feeler dichotomized, with a dorsal branch.
- C<sub>1</sub> Last two body-segments entirely fused; antennae 1/5 the first body-segments; feelers and claws strongly chitinized.
- D<sub>1</sub> Dorsal branch of the feeler stout thorn-like; stout thorns on the dorsal side of the body.
- E<sub>1</sub> Thorns much elongated; body 10-13 mm. in length. ....  
 .....*Philorus kibunensis* sp. nov.
- E<sub>2</sub> Thorns not very long; body 7.5-9.5 mm. in length. ....  
 .....*Philorus czoensis* sp. nov.
- D<sub>2</sub> Dorsal branch of the feeler rather rudimentary; small and blunted thorns on the dorsal side of the body. Length 7-9 mm. ....*Philorus kuyaensis* sp. nov.
- C<sub>2</sub> Last two body-segments rather distinct; antennae 1/3 the first

body-segment; feelers and claws slightly chitinized.

D<sub>1</sub> Dorsal branch of the feeler slender thorn-like; segmental gill-tuft with thick and short filaments.

E<sub>1</sub> Blunted thorns or warts on the dorsal side of the body; caudal margin strongly undulated, with semicircular rudiments of appendages slightly chitinized.

F<sub>1</sub> Length ca. 8 mm.; dorsal side dark brown throughout.  
.....*Philorus sikokucnsis* sp. nov.

F<sub>2</sub> Length ca. 6.5 mm.; dorsal side yellowish brown, except the yellowish marginal parts of the segments and last two body-segments. ...*Philorus simasimensis* sp. nov.

E<sub>2</sub> Sharp thorns on the dorsal side of the body; caudal margin slightly undulated, with rudiments of appendages strongly chitinized.

F<sub>1</sub> Length ca. 7 mm.; dorsal side dark brown throughout.  
.....*Philorus longirostris* sp. nov.

F<sub>2</sub> Length ca. 5 mm.; dorsal side brownish yellow, except the dark brown median parts of the first three body-segments. ....*Philorus longirostris* var. *minor* nov.

F<sub>3</sub> Length ca. 5 mm.; dorsal side dark brown, except the yellowish first body-segments. ....  
.....*Philorus chosencnsis* sp. nov.

D<sub>2</sub> Dorsal branch of the feeler wholly vanished; segmental gill-tuft with thin and elongated filaments. ....  
.....*Philorus vividis* sp. nov.

### **Pupa.**

A<sub>1</sub> Lamellae of the pupal horns elongated and pointed; with a longitudinal ridge between the bases of the pupal horns; anterior margins of the prothorax undulated. ....*Philorus bilobatoides* sp. nov.

A<sub>2</sub> Lamellae of the pupal horns nearly semicircular; without longitudinal ridge between the bases of the pupal horns; anterior margins of the prothorax smooth.

B<sub>1</sub> Pupal horns large, bases of which slightly separated on each side of the cephalo-thoracic seam.

C<sub>1</sub> With many notches at the margins of the second and third pairs of lamellae of pupal horns. Without granulation on the dorsal side of prothorax, and the marginal parts of abdomen; with granulation on the mesothorax and metathorax. ....  
.....*Philorus alpinus* sp. nov.

- C<sub>2</sub> Without many notches at the margins of the lamellae of pupal horns.
- D<sub>1</sub> With granulation on the dorsal side of prothorax.
- E<sub>1</sub> Length 7.5-9 mm., breadth 4.5-6 mm. ....  
 .....*Philorus kibunensis* sp. nov.
- E<sub>2</sub> Length 7-8 mm., breadth 4-4.5 mm. ....  
 .....*Philorus ezocensis* sp. nov.
- E<sub>3</sub> Length 5.5-6.5 mm., breadth 3.5-4 mm. ....  
 .....*Philorus kuyaensis* sp. nov.
- D<sub>2</sub> Without granulation on the dorsal side of prothorax.
- E<sub>1</sub> With a notch at the margin of each second and third pairs of lamellae of pupal horns; without granulation on the dorsal side of mesothorax, metathorax and the marginal parts of abdomen. ....*Philorus sikokuensis* sp. nov.
- E<sub>2</sub> Without notch at the margin of the lamellae of pupal horns; with granulation on the dorsal side of mesothorax, metathorax and whole abdomen. ....  
 .....*Philorus simasimensis* sp. nov.
- B<sub>2</sub> Pupal horns small, bases of which entirely contiguous on the cephalo-thoracic seam.
- C<sub>1</sub> With granulation on the dorsal side of prothorax and whole abdomen; dorsal side dark brown.
- D<sub>1</sub> Pupal horns very small, membraneous parts of the lamellae quite reduced. ....*Philorus longirostris* sp. nov.
- D<sub>2</sub> Pupal horns not very small, membraneous parts of the lamellae fairly preserved. ....*Philorus chosonensis* sp. nov.
- C<sub>2</sub> Without granulation on the dorsal side of prothorax and the marginal parts of abdomen; dorsal side light yellowish brown. Pupal horns not very small, membraneous parts of the lamellae fairly preserved. ....*Philorus vividis* sp. nov.

Genus *Parablepharocera* nov.

*Imago.*

- A<sub>1</sub> Eyes holoptic, bisected in both sexes; ventral lobes of the claspers of male hypopygium larger than the dorsal lobes. ....  
 .....*Parablepharocera esakii* (Alexander).
- A<sub>2</sub> Eyes holoptic in female, dichoptic in male, bisected in both sexes; ventral lobes of the claspers of male hypopygium smaller than the dorsal lobes. ....*Parablepharocera shirakii* (Alexander).

**Larva** (fourth instar).

- A<sub>1</sub> Anterior feeler similar to the posterior feeler, both strongly chitinized; dorsal side dark brown; length ca. 10 mm. ....  
 ..... *Parablepharocera esakii* (Alexander).  
 A<sub>2</sub> Anterior feeler larger than the posterior feeler, both slightly chitinized; dorsal side light greenish brown; length ca. 8 mm. ....  
 ..... *Parablepharocera shirakii* (Alexander).

**Pupa.**

- A<sub>1</sub> Dorsal side blackish brown; length ca. 7 mm. ....  
 ..... *Parablepharocera esakii* (Alexander).  
 A<sub>2</sub> Dorsal side dark yellowish brown; length ca. 5 mm. ....  
 ..... *Parablepharocera shirakii* (Alexander).

**A DISCUSSION ON THE CLASSIFICATION.**

The important characters for the classification in the imagos are the venation and the structure of the male hypopygium. The latter was taken by Bischoff (1924) for the most important and lastly reliable character for the classification of species. Most genera can be distinguished by the venation (text-fig. 3), and the most species by the venation and the male hypopygium. In genera with various types of venational characters, species can easily be defined by them, but when the venation is fairly constant definition must be relied upon the male hypopygia. The characters of the eye, antenna, mouth-parts and leg are more or less important for the classification of species.

The important larval characters for the classification of genera are the number and the form of feeler and filaments of the segmental gill-tuft. For the classification of species the attributes of the antenna, dorsal thorns or warts, feeler, last two body-segments, caudal margin etc. are important. The classification of pupae is much harder than that of larvae. Closely related species, even genera, are often difficult to separate. The pupal characters good for this purpose are found on the pupal horn, granulation, shape of the body, etc.

*Phylorus bilobatoides* is an interesting species, since it seems to stand at the turning-point of both genera *Phylorus* and *Liponeura* from *Bibiocephala* (figs. 42-47, text-fig. 7). Kellogg (1907) has described a South-European species, *Phylorus bilobata* (text-fig. 3. F), which was formerly reported as *Liponeura bilobata* by Loew (1869). But, in spite of the decided venational character, Bischoff (1922) is inclined to ascribe this species again to *Liponeura*, since *Liponeura*

is known from the Old World while *Philorus* is an American genus. *Philorus* is, however, found not only in North America, but also in Asia, and before Bischoff's statement, *Philorus bionis* (text fig. 3. E) had

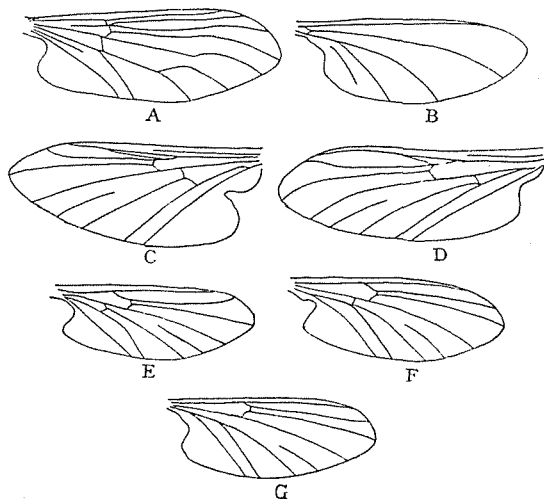


Fig. 3. A. Wing of *Edwardsina chilensis* Alexander (after Alexander); B. *Hammatorhina bella* Loew (after Kellogg); C. *Bibiocephala grandis* Kellogg ( „ ); D. *Bibiocephala comstocki* Kellogg ( „ ); E. *Philorus bionis* Agharker (after Agharker); F. *Philorus bilobata* Loew (after Kellogg); G. *Liponeura cinerascence* var. *minor* (after Bischoff).

already been described by S. P. Agharker (1914) from Kashmir. These three species seem to belong to *Philorus* according to their venational character. But *Philorus bilobatooides* is more or less close to *Bibiocephala*, its long Rs and the elongated guard-plate of the male hypopygium resembling very much to those of *Bibiocephala montana* (figs. 34, 35). The larval characters of *P. bilobatooides* (figs. 37-43) approach to *Philorus*, while the pupal characters of the same are rather close to *Bibiocephala*. The larva of *Liponeura* described by Komárek (1914) from Zchenes-Zchali of Caucasus, with plump convex body and stout dorsal thorns, is supposed to be an immature form of the *bilobata*-group of the genus *Philorus*.

The larva A with six or seven filaments of segmental gill-tuft described by Agharker (1914) from Kashmir is obviously a fourth larval instar of the genus *Blepharocera*, and the number of the gill filaments in it must be seven. His larva A' seems to me nothing other than an immature form of the former. Furthermore, Agharker's larva B and larva C with four filaments of the segmental gill-tuft should be the



fourth instars of a specialized, hygropetric species of *Phylorus*, and the true numbers of the gill filaments are presumably five.

There is found no distinction in the venational characters between two genera, *Liponeura* and *Blepharocera*. Kellogg (1907) did not separate them, although European workers are inclined to distinguish them.

My new genus *Parablepharocera* is distinguished from *Blepharocera* with a long Rs, which is nearly twice in length the anterior cross-vein r-m, while that of *Blepharocera* is nearly equal or at most less than twice the r-m in length (*Blepharocera tenuipes*). The larva of this genus is characterized by the presence of two feelers on each side of the first six abdominal segments and a pair of caudal appendages, while that of *Blepharocera* is furnished with neither feelers nor caudal appendages (*Blepharocera jordani*, as an exceptional case, is furnished with a rudimentary feeler on each side of the segments). The pupa of both genera is scarcely distinguishable, but in the granulation they can be separated from *Liponeura*.

The first of the four species hitherto described from Japan is *Liponeura infuscata* Matsumura (1916). In this species, according to the original description and an accompanying figure, vein  $M_3$  is lacking, vein  $R_2$  with the obscure tip is rather elongated and branched from Rs very closely to the turning point of  $R_3$  and  $R_{4+5}$ . From these characteristics it seems to me that this is not a species of *Liponeura*, as Alexander (1922) said, "the *Liponeura infuscata* Matsumura (1916) is a very different species whose true generic position is very doubtful." If I am right in supposing that the incomplete  $M_3$  was overlooked, it would better be ascribed to the genus *Bibliocephala*. *Bibliocephala japonica* Alexander (1922) is the second species, which can easily be identified by the venational characters. The third species *Blepharocera shirakii* Alexander (1922) which has been described with a few

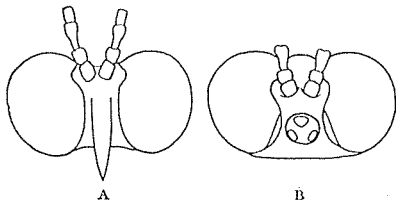


Fig. 4. A. *Blepharocera japonica* sp. nov., head of male, frontal view,  $\times 20$ ; B. *do.*, anterodorsal view,  $\times 20$ .

reliable specific characters, is one that I call *Parablepharocera shirakii* in the present paper. A sketch of the venation of Alexander's type specimen, kindly sent by Mr. R. Takahasi of Formosa, showed at once that it is a species of *Parablepharocera*, the Rs being four times as long as the r-m. A difference of that specimen from my own

is found in the body length, Alexander's male being longer, just as long as my female. The fourth species *Blepharocera esakii* Alexander (1924) is sure to be also a species of *Parablepharocera* on its characteristic features, i. e. "Rs long, fully five to six times the basal deflection of  $R_{4+5}$ ". Similar to the foregoing case, the body length of the original male is almost equal to that of the female of my specimens. The date of collection tells that the original specimen is a winter-type as my specimens are.

### LIFE CYCLE.

Many places rich in this insects near Kyoto and Kobe were visited in regular repetitions during the years 1926 and 1927, and from the data thus obtained it was able to determine the life cycles of most species of this family.

Concerning the life cycle, this family may be divided into two groups: the winter-type and the summer-type. In the winter-type the postembryonal development is accomplished in the cold season of the year and the resting stage in the warm season. In this mode of life cycle, the hatching takes place in the autumn and the pupation and emergence in the spring. Two sub-types are further distinguished in the winter-type: the first sub-type, in which the hatching occurs in early October and the fourth larval stage is attained till December, and the second sub-type, in which the hatching in early December and the fourth larval stage in early spring. Between these two sub-types, some transitional cases may be found.

In the summer-type, on the contrary, different stages of metamorphosis are found in the warm season of the year and the resting stage in the cold season. In this type of life cycle, the larva appears in the middle of the spring and the apparent first generation is accomplished within two months, so that the imagos, larvae and pupae may live in the same time, until they disappear in the fall of autumn. Accordingly, the temperature range of the winter-type is from nearly  $0^{\circ}$  to  $10^{\circ}$  C, while that of the summer-type from nearly  $10^{\circ}$  to  $25^{\circ}$  C, the highest temperature of habitats. This confrontation of two types of life cycle is distinct in lower districts, but in high mountains things go very different, and the winter-type is prevalent even in summer. Although the problem of generation should be solved by breeding experiments, the winter-type can be assumed, with all probabilities, to be monogeneric while the summer-type to be polygeneric.



In table II the life cycles of some species near Kyoto and Kobe are indicated judged from many data. The rest of the species not mentioned in the table are those whose data are more or less poor. But they are sure to belong to one of two principal categories above mentioned. For instance, *Philorus czoensis* is probably a monogeneric winter-type, because it was found in the stages of pupating larva and pupa on May 26, 1926 at the foot of the Mt. Ezohudi. On the other hand, *Philorus alpinus* is a polygeneric summer-type, because its larvae of different stages were found accompanied with pupae and imagoes on Aug. 6, 1926 and July 18, 1927, at the foot of the Tokugô Pass.

### SOME NOTES ON BEHAVIOR.

The habitat of the larva and pupa of this family are confined in rapid mountain streams. There are two types of living mode: a submersed-type and a hygropetric-type. The latter type is a mode of living in which the larva and pupa are always found on wet surface of rock more or less apart from the water. Most of the species of *Philorus* are belonged to this type, and especially so is *Philorus vividis*, whose larva can live wherever the rock is wet, as far as half meter from the stream. Transitional cases between these two type are also found. The larva of hibernating species of *Philorus* is partly submersed, but the pupating larva and the pupa are hygropetric.

The locomotion of the larva is accomplished by six ventral suckers. There are two different types of movement in the larva: the lateral movement and the linear movement. The lateral movement has been ingeniously described by Kellogg and other authors, but the latter has been less noticed. The lateral movement of submersed-type is very slow, while that of the hygropetric-type is very remarkable. The linear movement is a mode of displacement like creeping of slugs or planarians. The process of adhesion of larva and pupa also varies with species. Both larva and pupa of the submersed-type are used to hold the substrata so fast that they are often torn by collector's hand, while those of the hygropetric-type are rather easily dislodged. The pupa lies generally directed downstream, but where the current is whirling it may be directed in several manner. Sometimes a stiffening of musculature, as commonly called "death mimicry" is shown by a dislodged larva.

The larva just before pupation is dull in motion and its body is strongly compressed before and behind. The mechanism of moulting

in pupation is based upon the elasticity of pupal horns already formed under the skin. The lamellae of the pupal horns must be turned forwards about  $90^\circ$  or  $180^\circ$  around their bases in the course of the growth (figs. 4, 14). Larvae with stretched pupal horns tearing the skin are often observed in formalin. It is concordance with hard or delicate larval skin, that large pupal horns are found in hibernating species and small horns in summer species.

The emergence is carried out by splitting the cephalo-thoracic seam of the pupa. It was observed on April 25, 1926 at Sakamoto near Otsu, where the hygropetric pupae of *Phylorus kuyaensis* are found on the surface of overhanging rock continuously wet with spray and overflowing water. The head and a part of thorax were protruded at 2.50 p.m.; fore-legs, mid-legs, wings and abdomen gradually drawn out, then the expanded wings motionless and the legs supporting the body; the hind-legs are drawn out lastly. The midge began fluttering at 3.05 p.m. The imago just issued is pale and delicate, and the folds of wings are still incompletely expanded. A captured female was kept in a glass tube and survived for four days. The broken pupal cases are often found among mature specimens put in alcohol or formalin. The hygropetric species are free from the danger of being swept away by the current in emergence, as referred by Kellogg, but are burdened by a drawback of being damaged by some predators as is often witnessed.

The imagos are found either resting on the objects near or in the stream, or engaged in nuptial dance in rushing spray. The midges are very abundant on sunny day, often coming to rest even on the collector's hat. The flight is generally a timid fluttering and soon goes to rest, but in nuptial dance it is very active. When the midge is at rest, the trunk is supported by the legs and the wings are expanded roof-like. The antennae are always oscillating. The copulation of *Phylorus vividis* was twice observed on July 27 and on August 27, 1926 at Yamada near Kobe.; at the first time on a tree hanging over the stream, and the second time on a wet rock-bed where the larva and pupa were frequented. The oviposition was also observed on May 11, 1929 at Kurama near Kyoto, where one female of *Bibiocephala japonica* was engaged in egg-laying on a wet rock-bed, not being disturbed by the approach of the observer.

As many species associate in a habitat and each of them has the different types of life cycles, there can be seen a seasonal succession. This is observed obviously in the lower streams where the seasons

change regularly, but in high mountains it is more or less fluctuated. The following table shows the seasonal succession of the species in Kibune near Kyoto which may be called a typical locality of this family.

TABLE III.

month species	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
<i>Bi. infusata</i>	oooo	oooo	oooo	oooo	oo					oooo	oooo	oooo
<i>Bi. japonica</i>	oooo	oooo	oooo	oooo	oo							oooo
<i>Bi. montana</i>	oooo	oooo	oooo	oooo	oo							oooo
<i>Ph. bilobatoides</i>	oooo	oooo	oooo	oooo	oo						oo	oooo
<i>Ph. bil. v. longispina</i>	oooo	oooo	oooo	oooo	oo						oo	oooo
<i>Ph. kibamensis</i>	oooo	oooo	oooo	oooo	o					oooo	oooo	oooo
<i>Ph. kuyaensis</i>	oooo	oooo	oooo	oooo	o					oo	oooo	oooo
<i>Ph. longirostris</i>				oooo	oooo	oooo	oooo	oooo	oooo	oooo	oooo	oooo
<i>Ph. vividis</i>				oooo	oooo	oooo	oooo	oooo	oooo	oooo	oooo	oo
<i>Pa. esakii</i>	oooo	oooo	oooo	oooo	oo					oooo	oooo	oooo
<i>Pa. shirakii</i>				oooo	oooo	oooo	oooo	oooo	oooo	oooo	oooo	oooo
<i>Bl. japonica</i>				oo	oooo	oooo	oooo	oooo	oooo	oooo	oooo	

DESCRIPTION OF SPECIES.

Genus *Bibiocephala* Osten-Sacken (1874).

*Bibiocephala infusata* (Matsumura) (1916).

(Pl. VIII, figs. 1-11.)

Specimens taken out from the mature pupal cases. Head transverse, frons and vertex blackish brown with long black setae. Eyes contiguous, densely pubescent, bisected in both sexes; upper parts with large brown facets nearly four times the lower parts with small blackish brown facets. Ocelli yellowish brown, ocellar protuberance black, with dense setae. Antennae short and pubescent, fifteen jointed; first flagellar joint longer than the others, of which proximal joints cylindrical, distal ones ellipsoidal, last joint smallest. Labrum

with praelabrum subequal to the vertical height of the head. Maxillary palpi five jointed, fourth and fifth joints thin, the latter club-shaped. Scutellum and postscutellum of mesonotum with dense setae. Wings partly examined. Venation:  $R_2$  branched slightly before  $R_3$  and  $R_{4+5}$  furcated, running parallel to  $R_3$ , the tip of which unfortunately untraceable;  $R_s$  rather elongated, in alignment with the very short  $R_{3+4+5}$ ; basal deflection of  $R_{4+5}$  rather eminent, nearly half the r-m in length; incomplete  $M_3$  rather elongated. Each hind tibia with a pair of terminal spurs of different size. Male hypopygium dark brown and conspicuous; dorsal-plate inconspicuous, convex posteriorly; ventral-plate rather large, median posterior margin of which slightly projected; guard-plate large and bilobed, the lobes of which shorter than the basal breadth of the plate, dark brown, with dense setae; claspers bilobed, dark brown, with setae.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 14-16 mm., breadth 5-5.5 mm. Body gigantic, strongly convex dorsally. Dorsal side yellowish brown or dark brown, ventral light brown. Neck-pieces inconspicuous. First body-segment rather rectangular, head small. Antennae two-jointed, very short and  $1/8$  the first body-segment; first joint club-like, distal end swollen inwards, second joint obliquely directed outwards, the tip pointed. Thoracic spot entirely obscured, but the large pupal horns already formed under the skin. Six small warts on the dorsal side of each first six abdominal segments. Feelers small and dichotomized; dorsal branch thorn-like, directed dorsally. Claws small and conical, retracted inwards. Last two body-segments distinct, caudal margin nearly semicircular. Dense setae on the ventral side of the body. Segmental gill-tuft retracted inwards, with five, thick, grey filaments. Suckers large.

*Third instar*. Length 4-7.5 mm. Dorsal side dark brown, ventral light brown. Antennae two jointed, first joint slightly shorter than the second. Six small warts on each first six abdominal segments. Feelers very small and dichotomized. Caudal margin nearly semicircular and black. Segmental gill-tuft with three, thick and curved filaments. Anal gill slightly greenish. Dense setae throughout the body.

*Second instar*. Length 1.8-3.5 mm. Dorsal side dark yellowish brown, ventral yellowish white. Antennae jointless, very short and black. Six rudimentary warts on each first six abdominal segments. Feelers dischotomized, but the dorsal branch very rudimentary. Caudal margin semicircular. Segmental gill-tuft with a unique, dark filament. Scattered setae throughout the body.

*First instar.* Length 1.4-2 mm. Body very slender, nearly naked. Dorsal side light yellowish brown, ventral white. First body-segment oval, pointed anteriorly. Antennae jointless, very short and black. Eyes large and reddish brown. Three transverse rows of thornlets on the dorsal side of thorax, and two rows on each former seven abdominal segments. Feeler and claw absent, but a retractile hooked appendage and a pair of small setae present. A pair of feeler-like appendages on the seventh abdominal segment. Caudal margin nearly trapezoidal with two pairs of small bristles. Segmental gill-tuft absent; anal gill normal; suckers small.

*Pupa* (more than 20 specimens). Length 10-10.5 mm., breadth 4.8-5.5 mm. Body elliptic, strongly convex dorsally. Dorsal side blackish brown. Pupal horns gigantic, the bases separated. Each horn with four lamellae broadened distally, the tips of which slightly turned backwards. Basal and central parts of the lamella blackish brown, marginal part grey brown. Foremost pair of lamellae rather large, obliquely turned inwards but not contiguous; second and third pairs obliquely turned outwards; hindmost pair turned postero-interiorly, the tips nearly contiguous. Head semicircular. Thick and black granulation on the most part of prothorax, metathorax and whole abdomen, but absent on the mesothorax. Pads large and elliptic. Residium of segmental gill-tuft with five filaments.

*Habits:* monogeneric submersed winter-type, hibernating in fourth larval stage; widely distributed.

*Localities:* Kurama, Kibune, Atago and Kumogahata near Kyoto; Sakamoto near Otsu; Hayatuki and Oze in Province of Ettyû; Katura and Maki in Province of Hida; Tokugô, Agematu, Hukusima, Inamati and Yorita in Province of Sinano; Yamagata in Province of Uzen.

***Bibiocephala infuscata* var. *minor* nov.**

(Pl. IX, figs. 12-14).

*Larva* (4 specimens). *Fourth instar* (fullgrown). Length ca. 10 mm., breadth ca. 3.2 mm. Body rather small and light. Thorax light greenish brown, thoracic spot obscured. First abdominal segment light yellowish brown; a part of the second, and whole of the third and fourth abdominal segments blackish; succeeding segments dark greenish brown. Marginal parts of the ventral side of the body greenish brown and with dense setae. Rather rudimentary warts on the dorsal side.



*Pupa* (3 specimens). Length ca. 8 mm., breadth ca. 4.2 mm. Dorsal side dark brown.

*Habits*: supposedly similar to *typica*.

*Locality*: Maruyama, in Yamada near Kobe.

***Bibiocephala japonica*** Alexander (1922)...

(Pl. IX, figs. 15-19, Pl. X, figs. 20-24).

Male already described, but female, larvae of different stages and pupa new.

*Male* (more than 10 specimens): body ca. 6.5 mm., wing ca. 8 mm. *Female* (more than 10 specimens): body ca. 9 mm., wing ca. 11 mm. Eyes dichoptic in male, the upper parts with slightly lighter facets much smaller than the lower parts with small, blackish brown facets. Eyes holoptic in female, the upper parts with large brown facets subequal to the lower parts with small blackish facets. Antennae rather long and fourteen jointed, dark brown with pubescence; flagella in female thin, thinner than the scapes; flagellar joints cylindrical, tapering apically, of which the last joint smallest. Labrum with praelabrum one and half the vertical height of the head. Maxillary palpi five-jointed, first joint thick and short, succeeding joints subequal, swollen apically. Wings broad, veins blackish brown. Venation: Sc rudimentary, scarcely attaining the base of Rs; Rs slightly sinuous at the base, in alignment with  $R_{3+4+5}$ ;  $R_2$  distinct, shorter than Rs;  $R_{3+4+5}$  subequal to Rs; r-m sinuous, subequal to Rs; so-called m-cu sinuous, subequal to r-m. Each hind tibia with a pair of terminal spurs of different size. Male hypopygium dark brown and conspicuous; dorsal-plate nearly quadrilateral, blackish brown, with setae; ventral-plate nearly twice the dorsal-plate and the hind margin slightly notched; guard-plate bilobed, the lobes of which strongly elongated, longer than the basal breadth of the plate, blackish brown, with dense setae; claspers bilobed, ventral lobes of which longer than the dorsal ones.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 7-10 mm., breadth 2-2.6 mm. Body flat, neck-pieces rather conspicuous. Color dorsally yellowish or dark brown, ventrally white. First body-segment nearly circular. Antennae three jointed, rather long, nearly  $1/2$  the first body-segment. Thoracic spot U-shaped and black. A pair of lateral warts on the dorsal side of the first abdominal segment; two transverse rows of small chitin dots on each first three abdominal segments. Feelers boot-like, the tips obliquely turned back-

wards. Caudal appendages strongly chitinized, the tips curved inwards, with stout bristles at the outer margins. Segmental gill-tuft with five, rather slender, white filaments. Anal gill rather small.

*Third instar.* Length 3.5-5.5 mm. Color dorsally brown, ventrally white. Antennae equally two jointed. First abdominal segment with a pair of lateral warts. Feelers and caudal appendages well chitinized, but rather small and simple. Segmental gill-tuft with three, white filaments.

*Second instar.* Length 2-3 mm. Color dorsally dark yellowish brown, ventrally white. Antennae unequally two jointed, proximal joint very short, distal one long and pointed. Two transverse rows of small setae on the dorsal side of each abdominal segment. Feelers simple and rod-like. Caudal appendages rudimentary. Segmental gill-tuft with a unique filament directed anteriorly. Anal gill rather yellowish.

*First instar.* Body slender, 1.3-1.8 mm. in length. Color dorsally obscure yellow, ventrally pale. First body-segment large and oval. Antennae very short and jointless. Head large, eyes brown. Three transverse rows of thornlets on the dorsal side of thorax, and two rows on each abdominal segments. Feeler and claw absent, but a retractile hooked appendage and two small setae present. Seventh abdominal segment with a pair of small conical appendages apically bristled. Caudal margin trapezoidal, with a pair of small setae at each angle. No segmental gill-tuft. Anal gill normal. Suckers very small.

*Pupa* (numerous specimens). Length 5.5-7.5 mm., breadth 2.8-4 mm. Body elongated oval and rather flattened, abdominal margin strongly undulated. Dorsal side yellowish brown till black. Pupal horns large and rather horizontal, distal parts of which slightly curved intero-dorsally. Each horn with four, subsimilar, blackish brown lamellae compactly arranged dorso-ventrally. Head semicircular, obscured anteriorly. Prothorax projected in two lobes on each side of the head, with a median longitudinal ridge on the dorsal side. Pupal-mattress present between the bases of the pupal horns. Thick granulation of rather large black dots on the most part of prothorax. No granulation on the mesothorax, but the median part of which with many slight, zigzag, transverse lines. Thick granulation on the most metathorax and whole abdomen. Last abdominal segment slightly projected. Marginal parts of the tergum of each abdominal segment turned ventrally. Pads large and elliptic. Residium of segmental gill-tuft with five filaments.

*Habits*: monogeneric, submersed winter-type, hibernating in growing larval stages; widely distributed.

*Localities*: Kurama, Kibune, Atago and Kumogahata near Kyoto; Sakamoto near Otsu; Yamada, Takidani, Arima, and Karato near Kobe; Minomo in Province of Settu; Seryô, Kaminomati, Hattyo and Ido in Province of Tanba; Hokusima, Agematu, Suhara, Inamati, Iida, Ômati and Simasima in Province of Sinano; Mt. Syakuzyô in Province of Hida; Takao in Province of Musasi; Hinoemata in Province of Iwasiro; Yamagata in Province of Uzen; Tuzuro and Iya in Sikoku; Mt. Ezohudi in Hokkaido.

***Bibiocephala iyaensis*** sp. nov.

(Text-fig. 5).

*Larva* (2 specimens). *Fourth instar* (fullgrown). Length 8-11 mm., breadth ca. 3.2 mm. Dorsal side obscure yellowish brown, ventral white. Neck-pieces rather conspicuous. Antennae thin and short, three jointed,  $1/5$  the first body-segment. Thoracic spot U-shaped and black. Three transverse rows of brown thornlets or tubercles on the dorsal side of thorax, and two rows on each first seven abdominal segments. Four blunted median warts on each abdominal segments, of which first segment with a pair of very rudimentary lateral warts additionally, and the seventh with only two median warts. Feelers small boot-like, slightly chitinized; claws thick and short. Last two body-segments distinct. Caudal appendages small conical, pointed apically, with setae at the outer margins. Segmental gill-tuft with five, rather thick, white filaments. Anal gill rather large; suckers normal.

*Habits*: supposedly monogeneric, submersed winter-type.

*Localities*: Mt. Turugi and Iya in Sikoku.

***Bibiocephala montana*** sp. nov.

(Pl. X, figs. 25-28. Pl. XI, figs. 34-36).

*Male* (5 specimens): body 4.5 mm., wing .6 mm. Females taken out from the mature pupal cases. Head blackish brown; ocelli yellowish brown, ocellar protuberance black. Eyes dichoptic, bisected in both sexes; upper parts very small, lower parts large, both with small, blackish brown pubescent facets. Antennae rather long, fourteen jointed; flagellar joints cylindrical, blackish brown with pubescence, of which last joint narrowed in the middle, nearly one and half the preceding joint in length. Labrum with praelabrum subequal to the

vertical height of the head. Maxillary palpi five jointed, last joint slender and longest, especially in female twice the preceding one. Wings broad, veins dark brown. Venation: Sc rudimentary, attaining the tip of  $R_2$ ; Rs short, the base slightly sinuous;  $R_2$  subequal to Rs;  $R_{3+4+5}$  in alignment with and twice as long as Rs; r-m subequal and perpendicular to  $R_{3+4+5}$ ; so-called m-cu subequal to r-m. Each hind tibia with a pair of terminal spurs of different size. Male hypopygium conspicuous. Dorsal-plate rather large, posterior margin of which slightly concave, dark brown, with setae. Ventral-plate large, posterior margin slightly concave. Guard-plate bilobed, lobes of which elongated, longer than the basal breadth of the plate, blackish, with dense setae. Claspers bilobed, ventral lobe larger than the dorsal one, with dense apical setae.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 6-7 mm., breadth ca. 2.2 mm. Body flat, very lightly colored. Dorsal side yellowish or pale, ventral white. Antennae slightly chitinized, three jointed, rather long and  $1/2$  the first body-segment. Thoracic spot U-shaped, blackish brown. No chitinous protuberances on the dorsal side of the body. Feelers rather small, boot-like, and together with the claws slightly chitinized. Caudal margin nearly semicircular, and no appendages. Segmental gill-tuft with five, rather thick filaments. Anal gill rather small.

*Third instar*. Body slender and flat, measured ca. 4 mm. Dorsal side yellowish pale, ventral white. Antennae equally two jointed. No chitinous protuberances on the dorsal side. Feelers rather boot-like. Caudal margin semicircular without appendages. Segmental gill-tuft with three, thick filaments.

*Pupa* (numerous specimens). Length 4.5-5.5 mm., breadth 2.4-2.8 mm. Body rather elliptic, slightly pointed posteriorly. Abdominal margin slightly undulated. Dorsal side yellow or yellowish brown. Pupal horns rather small and erect, the bases as well as the tips separated one another. Each horn with four, nearly similar lamellae apically pointed. Head small, nearly semicircular. Prothorax slightly projected on each side of the head, and with a slight median longitudinal ridge between the bases of pupal horns. No pupal mattress. Thick granulation of rather large brown dots on the most

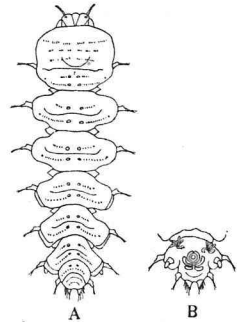


Fig. 5. A. *Bibiocephala iyaensis* sp. nov., fullgrown larva, dorsal view,  $\times 4$ ; B. do., last two body-segments, ventral view,  $\times 4$ .

prothorax. No granulation on the mesothorax, but the median part of which with many, slight, zigzag, transverse lines. Thick granulation of small yellowish brown dots on the most metathorax and whole abdomen. Pads elliptic, dark brown. Residuum of segmental gill-tuft with five filaments.

*Habits*: monogeneric, submersed winter-type, hibernating in growing larval stages; widely distributed and frequented in mountain regions.

*Localities*: Kurama, Kibune and Atago near Kyoto; Sakamoto near Otsu; Hayatuki, Kurobe, and Zara-Pass in Province of Ettyû; many places in the Hida mountains; Simasima, Tokugô, Kamikôti, Omati, Hukusima, Agematu, Suhara, Narai and Mt. Komagadake in Province of Sinano; Toyamazawa near Nikkô.

***Bibiocephala montana* var. *bispina* nov.**

(Pl. XI, figs. 29-33)

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 6-7 mm., breadth ca. 2 mm. Body slender, neck-pieces conspicuous. Dorsal side dark brown, ventral white. Antennae three jointed, nearly  $\frac{1}{3}$  the first body-segment. Thoracic spot U-shaped and black. In some cases, thorax with three transverse rows of scattered thornlets on the dorsal side. A pair of lateral warts and two transverse rows of small protuberances on the dorsal side of each abdominal segment. Feelers well chitinized and boot-like. Segmental gill-tuft with five, rather small filaments. Anal gill rather large.

*Third instar*. Body slender, measured ca. 4 mm. Antennae equally two jointed. A pair of lateral warts on each abdominal segment. Feelers and claws well chitinized. Segmental gill-tuft with three filaments.

*Second instar*. Body slender, measured ca. 2.5 mm. Antennae unequally two jointed, first joint rudimentary, second joint long and black. A pair of small lateral warts on each abdominal segment. Segmental gill-tuft with a unique, white filament.

*First instar*. Length ca. 1.7 mm. Body slender. Dorsal side obscure yellowish brown, ventral yellowish pale. Antennae very short and jointless. Three transverse rows of thornlets on the dorsal side of thorax, and two rows on each first seven abdominal segments. Feelers and claws absent, but the lateral side of each first six abdominal segments slightly projected, with a retractile hooked appendage and two short setae. Seventh abdominal segment with a pair of

lateral processes apically bristled. Caudal margin semicircular. No segmental gill-tuft.

*Pupa* (more than 10 specimens). Length 3.5-5 mm., breadth 1.7-2.5 mm. Dorsal side blackish. Granulation of rather large and black dots on the dorsal side of the body.

*Habits*: supposedly similar to *typica*, widely distributed and frequented in mountain regions.

*Localities*: Kamikôti in Province of Sinano; Gamada in Province of Hida; many other places in the Hida Mountains; Yamagata in Province of Uzen.

Genus *Philorus* Kellogg (1903).

*Philorus bilobatoides* sp. nov.

(Pl. XI, figs. 42, 43, Pl. XII, figs. 44-47, text-fig. 6).

*Male* (5 specimens): body 5.5 mm., wing 6.5 mm. Females taken out from the mature pupal cases. Eyes dichoptic, bisected in both sexes; upper parts very small, less than  $1/4$  the lower parts even in female, and together with the lower parts with small, blackish brown facets. Antennae fourteen jointed; flagella in male long and pubescent, in female short and bristled; flagellar joints subequal cylindrical, of which the last joint very short and elliptic. Labrum with prae-labrum slightly longer than the vertical height of the head. Maxillary palpi five jointed; second and third joints subequal and longest; last joint longer than the fourth, especially in male. Wings hyaline, veins dark brown. Venation: Sc rudimentary, ending slightly beyond the base of Rs; Rs very long, more than twice the r-m or four times the basal deflection of  $R_{1+5}$ ;  $R_2$  entirely fused with  $R_3$  or r-m touched to  $R_{4+5}$ ;  $R_{2+3}$  and  $R_{4+5}$  parallel proximally divergent apically, the former slightly curved forwards; m-cu slightly sinuous, rather longer than r-m; basal deflection of  $Cu_1$  very short. Each hind tibia with a single terminal spur setaceous. Claws conspicuous, but no denticles. Male hypopygium conspicuous: dorsal-plate rather small, slightly concave posteriorly; ventral-plate rather large, posterior margin of which concave; guard-plate bilobed, lobes of which much elongated, slightly longer than the basal breadth of the plate, blackish, with dense setae at the inner margins; claspers bilobed, dorsal lobe small, ventral one large, and convex ventrally, the tip of which turned dorsally.

*Larva* (more than 10 specimens). *Fourth instar* (fullgrown). Length 7.5-8.5 mm., breadth 2-2.5 mm. Body plump, strongly convex, neck-pieces inconspicuous. Color dorsally yellowish brown.

ventrally pale yellowish. Antennae three jointed, thin and short, nearly  $1/6$  the first body-segment. Thoracic spot obscured and dark, but the pupal respiratory lamellae piled in U-shape under the skin. Thorax with three transverse rows of blackish brown thornlets on the dorsal side. First abdominal segment with six stout thorns on the dorsal side, of which the lateral thorns much smaller. Second to seventh abdominal segment with four median thorns, but the lateral thorns very rudimentary or wanting; eighth segment with two median thorns only. Each abdominal segment with two transverse rows of scattered thornlets additionally. Feelers small, rather distinctly dichotomized. Last two body-segments rather compact, caudal margin nearly semi-circular, chitinized ventrally. Segmental gill-tuft with five, rather large filaments. Anal gill large. Ventral side of the body with dense setae throughout.



Fig. 6. *Philorus bilobatoides*  
sp. nov., wing,  $\times 6$ .

*Third instar.* Length ca. 4 mm. Dorsal side obscure brown, ventral white. Antennae equally two jointed. Thorax with three transverse rows of thornlets. First abdominal segment with six thorns,

and each second to seventh segment with four median thorns. Thornlets on the dorsal side of abdomen rare. Feelers small, slightly dichotomized. Caudal margin nearly semicircular. Segmental gill-tuft with three filaments.

*Pupa* (more than 20 specimens). Length 5.5-6.5 mm., breadth 3.2-4 mm. Body oval and flat, abdominal margin slightly undulated. Color dorsally greenish or brownish yellow. Pupal horns nearly erect, bases of which distinctly separated, but the tips nearly contiguous and pointed. Each horn with four, similar lamellae compactly arranged before and behind. Head nearly semicircular. Anterior margins of prothorax slightly projected. A slight longitudinal ridge on the median part of prothorax. Thick granulation of yellowish dots on the most parts of prothorax, metathorax and whole abdomen, but on the mesothorax very limited. Median part of mesothorax with many, slight, zigzag, transverse lines. Marginal parts of terga slightly turned ventrally. Pads rather large and elliptic. Residuum of segmental gill-tuft with five filaments.

*Habits:* monogeneric, submersed winter-type; widely distributed.

*Localities:* Kibune, Kurama and Atago near Kyoto; Sakamoto near Otsu; Iya in Sikoku; Mt. Nukedo in Province of Hida; Yamagata in Province of Uzen.

***Phlorus bilobatoides* var. *longispina* nov.**

(Pl. XI, figs. 37-41).

*Larva* (more than 20 specimens). *Fourth instar* (fullgrown). Length ca. 5.5 mm., breadth ca. 1.8 mm. Body plump, strongly convex. Dorsal side light yellowish brown, except the blackish posterior half of the second and whole third abdominal segment. Antennae three jointed, thin and short, nearly  $\frac{1}{5}$  the first body-segment. Thoracic spot U-shaped. Thorax with three transverse rows of blackish brown thornlets on the dorsal side. Each first to seventh abdominal segment with six very stout thorns; the bases of the median thorns on the first two segments entirely contiguous. Abdomen with scattered thornlets on the dorsal side additionally. Feelers small, distinctly dichotomized. Last two body-segments rather compact; caudal margin well chitinized, nearly semicircular. Segmental gill-tuft with five, slender, white filaments.

*Habits*: supposedly similar to *typica*.

*Localities*: Kurama, Kibune and Atago near Kyoto; Seryô in Province of Tanba; Hukusima and Agematu in Province of Sinano.

***Phlorus alpinus* sp. nov.**

(Pl. XII, figs. 48-55).

*Male* (4 specimens): body 6 mm., wing 7 mm. *Female* (6 specimens): body 7 mm., wing 9 mm. Head black, vertex and frons with black setae. Ocelli yellowish, ocellar protuberance black. Eyes holoptic in female, dichoptic in male, bisected in both sexes. Upper parts in female with large brown facets much larger than the lower parts with small blackish brown facets. Upper parts in male rather approached each other and slightly light; lower parts much larger than the upper parts, and together with the upper parts with small blackish brown facets. Antennae very short and slender, fourteen jointed; scapal joints large, subspherical and with black setae; flagellar joints cylindrical, dark, with pubescence, of which the first joint longer than twice the second joint. Labrum with praelabrum slightly longer than the vertical height of the head. Maxillary palpi five jointed; second to fourth joints subequal, swollen apically; the last joint slender and long, nearly thrice the preceding joint. Wings broad, veins dark brown. Venation: Sc rudimentary, ending slightly beyond the base of Rs; basal deflection of Rs sinuous and short, but the straight part long, nearly twice the former;  $R_{2+3}$  nearly straight, the tip slightly turned



anteriorly, thrice the straight part of Rs; r-m sinuous, touched to Rs, slightly longer than the basal deflection of it ( $R_{2+3}$  and  $R_{4+5}$  partly fused, or cell  $R_{2+3}$  bisected in a female, as an exceptional case). Each hind tibia with a pair of terminal spurs of different size setaceous; claws very conspicuous, but no denticles. Male hypopygium subspherical and much complicated. Dorsal-plate reduced, concave posteriorly; ventral-plate large, hind margin concave, dark brown, with setae. Guard-plate rather small, lobes of which postero-laterally projected in conversed V-shape, blackish brown, with dense setae. Claspers trilobed, the tip of each lobe faced one another; dorsal lobe dark brown, with strong setae at the inner margin; middle lobe hindmost, distally yellowish brown, with strong setae at the tip; ventral lobe rather large and flat, directed inwards, yellowish brown, with small apical setae.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 6-8 mm., breadth 1.8-2.2 mm. Body apparently flat, neck-pieces conspicuous. Dorsal side obscure yellowish brown, ventral white. Antennae indistinctly three jointed, nearly  $1/2$  the first body-segment; first and third joint short and black, second joint long and pale. Thoracic spot rather obscuredly  $\infty$ -shaped. Abdominal segment with six stout thorns on the dorsal side, but the seventh segment with four median thorns. Feelers very long and rod-like (not dichotomized), and chitinized black with many stout bristles around the apical parts. Claws conspicuous, slightly shorter than the feelers; basal part of which chitinized black, apical part yellowish brown, with stout setae at the dorsal surface. Last two body-segments distinct. Caudal appendages rod-like, but shorter than the feelers, strongly chitinized black. Segmental gill-tuft with a short stem and five, very thick, white filaments directed laterally. Anal gill rather large; suckers rather small.

*Third instar*: Length 3-4 mm. Dorsal side obscure yellowish brown. Antennae subequally two jointed, intermediate one third portion pale, other parts black. Six thorns on each first six abdominal segments. Feelers and claws elongated, chitinized black. Caudal appendages short, chitinized black. Segmental gill-tuft with three thick filaments.

*Second instar*. Length ca. 2 mm. Dorsal side obscure brownish yellow. Antennae unequally two jointed. Six rather blunted thorns on each first six abdominal segments. Feelers and claws rather small, chitinized black. Caudal appendages rather rudimentary. Segmental gill-tuft with a unique small filament.

*Pupa* (more than 10 specimens). Length 5-7 mm., breadth 3-3.8 mm. Body oval, rather flattened, outer margin nearly smooth. Dorsal side yellowish brown or dark brown. Pupal horns nearly contiguous at the base, each with four subsemicircular lamellae, apical part of which membranous and grey. First and fourth pairs of lamellae rather large, inner distal margins contiguous; second and third pairs rather small and fan-like, with many notches at the margins. Head nearly semicircular. No granulation on the prothorax. A part of mesothorax with granulation of small yellowish brown dots in V-shape. Most part of metathorax and inner half of abdomen scatteredly granulated. Marginal part of abdomen and the median parts of third to fifth abdominal segments rather lightly colored. Pads circular and dark brown. No residuum of segmental gill-tuft.

*Habits*: polygeneric, hygropetric summer-type; distributed in alpine regions.

*Localities*: Tokugô and Kosibu in Province of Sinano; Gamada in Province of Hida; Kurobe in Province of Ettyû.

***Phlorus kibunensis* sp. nov.**

(Pl. XIII, fig. 59, text-fig. 7).

*Larva* (more than 20 specimens). *Fourth instar* (fullgrown). Length 10-13 mm., breadth 3-3.5 mm. Body convex, neck-pieces conspicuous. Dorsal side dark brownish, ventral yellowish pale. First body-segment elliptic and transverse. Antennae short and slender, subequally three jointed,  $\frac{1}{5}$  the first body-segment. Thoracic spot dark, rather obscuredly  $\infty$ -shaped. Very long and stout, six thorns on the dorsal side of each first six abdominal segments, of which four median thorns erect, two lateral thorns ivory-like and curved dorsally. Seventh abdominal segment with four, eighth with two median thorns. Feelers large and conspicuously dichotomized; dorsal branch very large thorn-like, curved dorsally; ventral branch rather small and conical, with two apical bristles. Last two body-segments compactly fused. Caudal margin semicircular with a pair of blackish rudiments of appendages on the ventral side. Segmental gill-tuft with five, small, white filaments, of which three directed anteriorly and two posteriorly. Anal gill very small and spherical.

*Third instar*. Length ca. 6 mm., breadth ca. 1.5 mm. Neck-pieces distinct, but the body slightly plump. Dorsal side blackish or dark brown, except the yellowish basal parts of thorns. Ventral side white. Antennae equally two jointed. Rather stout six thorns on the dorsal

side of each first six abdominal segments; seventh and eighth segment with four and two median thorns respectively. Dorsal branch of the feeler rather stout thorn-like, but shorter than the ventral branch. Last two body-segments fairly distinct. Caudal margin semicircular, with a pair of chitin plates. Segmental gill-tuft with three rather thick filaments. Suckers rather large.

*Pupa* (more than 10 specimens). Length 7.5–9 mm., breadth 4.5–6 mm. Body oval and flat, outer margin nearly smooth. Dorsal

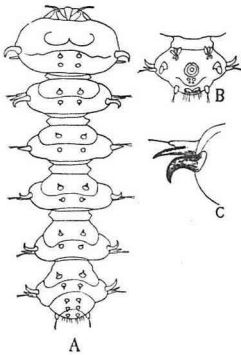


Fig. 7. *A.* *Philorus kibumensis* sp. nov., full-grown larva, dorsal view,  $\times 4$ ; *B.* *do.* last two body-segments, ventral view,  $\times 4$ ; *C.* *do.*, feeler and lateral thorn, dorsal view,  $\times 12$ .

side brownish black. Pupal horns large, bases of which contiguous. Each horn with four, subsemicircular lamellae, chitinized proximally, apically membraneous and dark grey. First and fourth pairs of lamellae rather larger, distal inner margins contiguous respectively; intermediate pairs of lamellae rather small, separated each other. Head nearly semicircular. Thick granulation of small black dots on the most prothorax, the V-shaped median part of mesothorax, the most metathorax and whole abdomen. Pads small and circular. No residuum of segmental gill-tuft.

*Habits*: monogeneric winter-type, hibernating in fourth larval stage, mostly submersed, but partly hygropetric.

*Localities*: Kibune and Atago near Kyoto; Oze in Province of Ettyū; Iya in Sikoku.

***Philorus ezoensis* sp. nov.**

(Pl. XIII, figs. 56–58)

*Larva* (8 specimens). *Fourth instar* (fullgrown). Length 7.5–9.5 mm., breadth 2.5–3 mm. Body rather plump, convex dorsally, neck-pieces conspicuous. Dorsal side dark brown, ventral yellowish. Antennae slender and short, subequally three jointed, nearly  $1/5$  the first body-segment. Thoracic spot rather obscured, dark brown. Six stout thorns on the dorsal side of each first to seventh abdominal segments, of which lateral thorns rather dorsally curved. Feelers strongly chitinized and dichotomized; dorsal branch stout thorn-like, slightly curved dorsally. Last two body-segments entirely fused, and the seventh abdominal segment with a pair of feeler-like appendages. Caudal margins lightly convex with a pair of black rudiments of appendages

on the ventral side. Segmental gill-tuft with five, rather large, white filaments. Anal gill very small, nearly subspherical.

*Pupa* (7 specimens). Length 7-8 mm., breadth 4-4.5 mm. Body oval and flat, outer margin rather smooth. Dorsal side dark yellowish brown. Pupal horns contiguous at the base. Each horn with four, nearly semicircular lamellae, chitinized proximally, distally membranous and grey. First and fourth pairs of lamellae rather larger, inner distal margins contiguous respectively; intermediated pairs of lamellae slightly smaller, separated each other. Head small, subsemicircular. Thick granulation of small dark brown dots on the most prothorax, the V-shaped median part of mesothorax, the most metathorax and whole abdomen. Pads subcircular. No residuum of segmental gill-tuft.

*Habits*: monogeneric winter-type, mostly submersed but partly hygropetric.

*Locality*: Mt. Ezohudi in Hokkaidô.

***Philorus kuyaensis* sp. nov.**

(Pl. XIII, figs. 60-62, Pl. XIV, figs. 63-65).

*Male* (2 specimens): body 7 mm., wing 9.5 mm. *Female* (3 specimens): body 9 mm., wing 11.5 mm. Head transverse, vertex and frons blackish brown with long black setae. Ocelli yellowish brown, ocellar protuberance black. Eyes dichoptic, bisected in both sexes; upper parts in male nearly  $\frac{1}{4}$  the lower parts, in female nearly  $\frac{1}{2}$ ; both parts with small, blackish brown, pubescent facets, but the facets of female upper parts slightly larger. Antennae short and bristled, fourteen jointed; flagellar joints very thin, nearly ellipsoidal, of which the last joint slightly shorter than the preceding one in male, in female rather longer. Labrum with praelabrum subequal to the vertical height of the head. Maxillary palpi five jointed; second to fourth joints subequal, but the fourth swollen apically; last joint slender, more than twice the preceding one in male, but in female club-shaped and shorter than the others. Wings broad, veins dark brown. Venation: Sc rudimentary, ending slightly beyond the base of Rs; basal deflection of Rs short, straight part of which rather elongated, nearly thrice the former;  $R_{2+3}$  subequal to Rs, slightly curved anteriorly; r-m sinuous, slightly longer than the basal deflection of Rs; so-called m-cu sinuous, nearly half the r-m. Each hind tibia with a pair of terminal spurs of different size setaceous. Male hypopygium conspicuous, subspherical and blackish brown. Dorsal-plate small,

concave posteriorly, with long setae. Ventral-plate rather large, concave posteriorly, dorsal parts of which conspicuously elongated inwards. Guard-plate very rudimentary, blackish brown, with setae. Claspers trilobed; dorsal lobe blackish brown; middle lobe smallest and foremost, blackish brown, with many black short setae; ventral lobe broad, anterior margin turned ventrally.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 7-9 mm., breadth 2.3-2.8 mm. Body convex, neck-pieces conspicuous. Dorsal side dark orange, ventral yellowish. First body-segment transverse, nearly elliptic. Antennae thin and short, three jointed, nearly  $1/5$  the first body-segment. Thoracic spot  $\infty$ -shaped, dark brown. Six small warts on the dorsal side of each first seven abdominal segments. Feelers rather small and dichotomized, dorsal branch rudimentary. Last two body-segments nearly fused. Caudal margin semicircular, with a pair of chitinized rudiments of appendages on the ventral side. Segmental gill-tuft with five, slender, white filaments. Posterior filaments of anal gill very small and subspherical.

*Third instar*. Body elongated, measured 4-6.5 mm. Dorsal side light yellowish brown. Antennae equally two jointed. Six thorns on each abdominal segment, but the seventh with four median warts. Feelers distinctly dichotomized, dorsal branch thorn-like. Caudal margin with a pair of rudiments of appendages ventrally. Segmental gill-tuft with three filaments.

*Second instar*. Body slender, measured 1.5-3 mm. Dorsal side obscure yellow. First body-segment nearly pentagonal. Antennae unequally two jointed. Six warts on each abdominal segment. Feelers small and rather rod-like, dorsal branch rudimentary. Caudal margin semicircular, with rudiments of appendages ventrally. Segmental gill-tuft with a unique slender filament.

*Pupa* (numerous specimens). Length 5.5-7 mm., breadth 3.5-4.2 mm. Body oval and flat, outer margin smooth. Dorsal side dark brown till black. Pupal horns rather small and contiguous at the base. Each horn with four, nearly semicircular lamellae, chitinized proximally, distally membraneous and grey. First and fourth pairs of lamellae rather large, inner distal margins contiguous respectively; intermediated pairs of lamellae rather small, separated each other. Head rather large, slightly elongated posteriorly. Thick granulation of small black dots on the whole prothorax, the V-shaped median part of mesothorax, the most metathorax and whole abdomen. Pads small and subcircular. No residuum of segmental gill-tuft.

*Habits*: monogeneric winter-type, hibernating in fourth larval stage, mostly submersed but partly hygropetric.

*Localities*: Atago, Kibune, Kurama and Kumogahata near Kyoto; Sakamoto near Otsu; Oze in Province of Ettyû; Iida, Mt. Komagadake, Simasima and Nakabusa in Province of Sinano; Takao in Province of Musasi; Iya in Sikoku.

***Philorus sikokuensis* sp. nov.**

(Text-fig. 8)

*Larva* (more than 30 specimens). *Fourth instar*. Length ca. 8 mm., breadth ca. 2.2 mm. Body slender, neck-pieces conspicuous. Dorsal side blackish brown, ventral white. Antennae three jointed,  $1/4$  the first body-segment. Six, small, yellowish thorns or warts on the dorsal side of each first seven abdominal segments. Feelers rather large and dichotomized, dorsal branch small thorn-like. Last two body-segments distinct. Caudal margin undulated, with a pair of semicircular rudiments of appendages slightly chitinized. Segmental gill-tuft with a short stem and five, rather thick, white filaments. Anal gill rather large.

*Third instar*. Length ca. 4 mm. Body slender. Dorsal side dark brown. Antennae equally two jointed. Six small thorns on each first seven abdominal segments. Feelers distinctly dichotomized, dorsal branch thorn-like. Caudal margin undulated, but the appendages rudimentary. Segmental gill-tuft with three filaments.

*Second instar*. Length ca. 2.5 mm. Body slender. Dorsal side blackish. Antennae unequally two jointed. Six small thorns on each abdominal segment. Feelers small and the dorsal branch rudimentary. Caudal margin rather semicircular. Segmental gill-tuft with a unique filament.

*Pupa* (a single specimen). Length ca. 6.5 mm., breadth ca. 4 mm. Body oval and flat, posterior end pointed. Dorsal side dark brown with remarkable glittering luster. Pupal horns rather large, the bases nearly contiguous. Each horn with four, sub-semicircular lamellae, of which first and fourth lamellae larger, inner margins of which contiguous to those of another

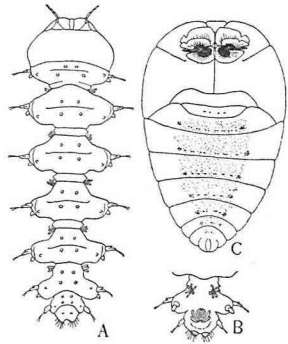


Fig. 8. A. *Philorus sikokuensis* sp. nov., fourth larval instar, dorsal view,  $\times 5$ ; B. *do.*, last two body-segments, ventral view,  $\times 5$ ; C. *do.*, pupa, dorsal view,  $\times 5$ .

horn respectively. A small notch on the outer margin of each first and second lamellae. Head rather large, nearly semicircular. No granulation on the prothorax, mesothorax and metathorax. Inner part of abdomen with scattered granulation of small yellowish dots, but the first abdominal segment without granulation. Pads circular and brownish. No residuum of segmental gill-tuft.

*Habits*: supposedly polygeneric, hygropetric summer-type.

*Localities*: Tuzuro and Iya in Sikoku.

***Philorus simasimensis* sp. nov.**

*Larva* (more than 20 specimens). *Fourth instar* (fullgrown). Length 6-7 mm., breadth 1.7-1.9 mm. Body slender, neck-pieces conspicuous. Dorsal side obscure yellowish brown, except the yellowish marginal parts and last two body-segments. Ventral side pale. Antennae three jointed,  $\frac{1}{3}$  the first body-segment. Six small blunted thorns or warts on the dorsal side of each first seven abdominal segments. Feelers rather short, dorsal thorns of which rather rudimentary. Last two body-segments distinct. Caudal margin slightly undulated, but the rudiments of appendages small, slightly chitinized. Segmental gill-tuft with a short stem and five, rather thick filaments. Anal gill rather large.

*Third instar*. Length 3-4 mm. Body slender. Dorsal side obscure yellowish brown all over. Antennae equally two jointed. Six small blunted thorns or warts on each first seven abdominal segments. Feelers blackish brown, with a small dorsal thorn. Caudal margin slightly undulated, chitinized brown. Segmental gill-tuft with three, rather thick filaments.

*Pupa* (5 specimens). Length ca. 5 mm., breadth ca. 3 mm. Body oval and flat, slightly pointed posteriorly. Dorsal side obscure yellowish brown. Pupal horns rather small, the bases nearly contiguous. Each horn with four, delicate, subsemicircular lamellae, of which first and fourth lamellae larger, and contiguous to those of another horn respectively. Head nearly semicircular. No granulation on the prothorax. Scattered granulation of small, yellowish brown dots on the very limited V-shaped part of mesothorax, a part of metathorax and whole abdomen. Pads semicircular. No residuum of segmental gill-tuft.

*Habits*: supposedly polygeneric, hygropetric summer-type.

*Locality*: Simasima in Province of Sinano.

***Philorus longirostris*** sp. nov.

(Pl. XIV, figs. 66-71).

*Male* (3 specimens): body 4.5 mm., wing 5.5 mm. *Female* (4 specimens): body 5.5 mm., wing 7 mm. Body slender and light, obscure yellowish. Frons yellowish, vertex brown, with setae. Ocelli light yellowish, ocellar protuberance blackish. Eyes very small and kidney-formed, dichoptic and bisected in both sexes, but the upper parts quite rudimentary with but a few facets; facets of both parts small and black. Antennae long, thirteen jointed; scapal joints pear-shaped, nearly glabrous; first flagellar joint cylindrical and elongated, nearly twice the second joint, but the basal part of which thin and glabrous, distal part pubescent; succeeding joints black and pubescent, swollen proximally; last joint long, nearly one and half the preceding one in length. Mouth-parts elongated, labrum with praelabrum nearly one and half the vertical height of the head. Mandibles of the female very long and slender. Maxillary palpi five jointed; second to fourth joints subequal, slightly swollen apically; last joint long and pale, nearly twice the preceding joint. Wings rather narrow, veins dark brown. Venation: Sc rudimentary, ending at the base of Rs; basal deflection of Rs short, straight part much elongated;  $R_{2+3}$  much shorter than the straight part of Rs;  $R_{4+5}$  subequal to the straight part of Rs; r-m slightly longer than the basal deflection of Rs; so-called m-cu sinuous, slightly shorter than r-m. Each hind tibia with a pair of terminal spurs of different size in female, but in male with one spur only; claws conspicuous, but no denticles. Male hypopygium complicated, subspherical and dark brown. Dorsal-plate very small, with setae; ventral-plate very large, strongly concave posteriorly, dorsal part of which with a pair of elongated, conical, postero-dorsally directed, appendages densely setaceous. Claspers bilobed. Dorsal lobe small, with dense setae distally, proximally with anteriorly directed stout setae. Ventral lobe conspicuous and bilobed at the inner margin; proximal outer margin with four stout setae; distal part of the lobe pale, turned anteriorly, the tip swollen and cap-like.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 6-8 mm., breadth 1.8-2.4 mm. Body slender, neck-pieces conspicuous. Dorsal side dark yellowish brown all over, ventral light yellowish. First body-segment transverse, nearly elliptic. Antennae long, three jointed, nearly  $1/3$  the first body-segment. Thoracic spot small,  $\infty$ -shaped, with two pairs of black and short lateral stripes. Six small thorns or warts on each first seven abdominal segments, and two warts



on the eighth segment. Feelers rather small, slightly dichotomized, dorsal branch small thorn-like. Last two body-segments rather distinct. Caudal margin semicircular with a pair of small chitinous plates ventrally. Segmental gill-tuft with five, thick and white filaments. Anal gill small, posterior filaments of which subspherical.

*Third instar.* Body slender, measuring 3-4 mm. Dorsal side dark brown, ventral white. Antennae subequally two jointed. Six rather large thorns or warts on each abdominal segment. Feelers small and dichotomized, dorsal branch rather stout. Caudal margin chitinized. Segmental gill-tuft with three, rather thick filaments.

*Second instar.* Body very slender, measuring 1.5-2.5 mm. Dorsal side greenish brown. Antennae unequally two jointed. Six small warts on each abdominal segment. Feelers small, dorsal branch rudimentary. Caudal margin rather convex and chitinized. Segmental gill-tuft with a unique filament.

*First instar.* Length 1.1-1.3 mm. Body slender, segmentation distinct. Dorsal side obscure yellowish brown, ventral white. First body-segment nearly circular. Antennae jointless, with a pair of small apical prominences. Two transverse rows of thornlets on the dorsal side of thorax and each first seven abdominal segments. Feelers and claws absent, but the lateral side of each first six abdominal segments slightly projected, with a very long and stout apical bristle and a tuft of five or six, short bristles. Seventh abdominal segment with a pair of lateral processes apically bristled. Last two body-segments distinct, caudal margin nearly semicircular, with some very short setae. No segmental gill-tuft.

*Pupa* (more than 20 specimens). Length 3.5-5.5 mm., breadth 2-3 mm. Body rather convex and elongated oval, posterior end rather pointed, outer margin smooth. Dorsal side yellowish or dark brown. Pupal horns rudimentary, the bases of which entirely contiguous in  $\infty$ -shape. Each horn with four lamellae of different size. First and fourth pairs of lamellae contiguous, with chitinized bases and rudimentary, membranous, apical parts; second and third pairs of lamellae very small and dissimilar, separated before and behind. Head large, rather triangular. Scattered granulation of very small brown dots on the prothorax, V-shaped median part of mesothorax, most part of metathorax and whole abdomen. Pads small and subcircular. No residuum of segmental gill-tuft.

*Habits:* polygeneric hygropetric summer-type, dominating at the highest temperature of habitat.

*Localities*: Kibune and Atago near Kyoto; Sakamoto near Otsu; Yamada near Kobe; Nakanoyu, Kamikôti, Tokugô, Agematu and Ôtaki in Province of Sinano; Dorokawa in Province of Yamato; Yunohira near Beppu in Kyûsyû.

***Phlorus longirostris* var. *minor* nov.**

*Larva* (more than 20 specimens). *Fourth instar*. Length 3.5-5.5 mm., breadth 1.2-1.7 mm. Body rather small. Dorsal side obscure yellowish, except the blackish brown median parts of first three abdominal segments. Antennae three jointed,  $\frac{1}{3}$  the first body-segment (thoracic spot not yet appeared). Six thorns on each abdominal segment, but the eighth segment with two median warts. Feelers rather small, distinctly dichotomized; dorsal branch slender thorn-like, slightly curved dorsally. Last two body-segments rather compact. Caudal margin slightly undulated. Segmental gill-tuft with a short stem and five, rather thick filaments.

*Third instar*. Length 2-3.5 mm. Dorsal side dark yellowish brown throughout. Antennae equally two jointed. Six thorns on the dorsal side of each abdominal segment. Feelers small, dorsal branch inconspicuous. Segmental gill-tuft with three thick filaments.

*Habits*: supposedly similar to typica.

*Locality*: Mt. Syakuzyô in Province of Hida.

***Phlorus chosenensis* sp. nov.**

*Female* (a single specimen): body 4.8 mm., wing 5.8 mm. Body very slender, light brownish yellow. Frons yellow, vertex brown with scattered setae. Ocelli yellowish, ocellar protuberance blackish brown. Eyes very small, dichoptic and bisected, but the upper parts very rudimentary with but a few facets. Facets on the lower parts small and brownish black, on the upper parts much lighter. Antennae rather slender and short, obscure yellowish, thirteen jointed; scapal joints pear-shaped, nearly glabrous; first flagellar joint cylindrical, nearly twice the second joint; succeeding joints cylindrical or ellipsoidal, of which the last joint shortest. Labrum together with praelabrum longer than the vertical height of the head. Mandibles slender, much elongated, with denticles at the inner margins. Maxillary palpi five jointed; second to fourth joints subequal, conspicuously swollen apically; last joint very slender and pale, longer than twice the preceding joint. Wings rather broad, veins dark brown. Venation: Sc rudimentary,

ending slightly beyond the base of Rs; basal deflection of Rs short, slightly atrophied proximally, straight part very long;  $R_{2+3}$  short, nearly  $3/5$  the straight part of Rs;  $R_{4+5}$  slightly shorter than the straight part of Rs; r-m sinuous, slightly longer than the basal deflection of Rs; so-called m-cu rather straight, nearly half the r-m. Each hind tibia with a pair of terminal spurs of different size shortly bristled. Claws conspicuous, with many fine hairs proximally. Hypopygium rather complicated.

*Larva* (more than 30 specimens). *Fourth instar* (fullgrown). Length 4.7–5.5 mm., breadth 1.3–1.5 mm. Body slender, neck-pieces conspicuous. Dorsal side obscure yellowish brown, except the rather yellowish first body-segment. Ventral side white. First body-segment nearly circular. Antennae three jointed,  $1/3$  the first body-segment. Thoracic spot rather large,  $\infty$ -shaped, with two pairs of black, lateral stripes. Six rather stout thorns on each first seven abdominal segments, and two warts on the eighth segment. Feelers rather small, strongly chitinized, with a sharp dorsal thorn. Last two body-segments distinct. Seventh body-segment with a pair of rather conspicuous lateral appendages apically bristled. Caudal margin undulated, with a pair of rather conspicuous, semicircular rudiments of appendages strongly chitinized. Segmental gill-tuft with five, rather thick filaments and a short stem. Anal gill rather large. Suckers rather small.

*Third instar*. Length 3–4 mm. Body slender, neck-pieces conspicuous. Dorsal side obscure brownish yellow all over, ventral white. Antennae equally two jointed. Six rather small thorns on each first seven abdominal segments. Feelers small, with a thorn-like dorsal branch. Last two body-segments distinct. Caudal margin semicircular, chitinized brownish black. Segmental gill-tuft with three small filaments.

*Pupa*. Length 3.6–4.8 mm., breadth 2.1–3 mm. Body oval and flat, slightly pointed posteriorly. Dorsal side yellowish brown. Pupal horns rudimentary, the bases entirely contiguous in  $\infty$ -shape. Each horn with four lamellae; first and fourth lamellae larger, apical membranous parts of which quite rudimentary; second and third lamellae nearly semicircular, separated each other. Head large, elongated posteriorly. Scattered granulation of very small brownish dots on the prothorax, limited V-shaped part of mesothorax, most part of metathorax and whole abdomen, but the granulation on the marginal parts of the body inconspicuous. Pads nearly circular. No residuum of segmental gill-tuft.

*Habits*: polygeneric, hygropetric summer-type.

*Locality*: Mt. Kongô in Chosen (Korea).

***Philorus vividis* sp. nov.**

(Pl. XV, figs. 72-80, text-figs. 1, 2, A, 9).

*Male* (numerous specimens): body 3.5 mm., wing 4.5 mm. *Female* (numerous specimens): body 4.5 mm., wing 5.5 mm. Head rather small, vertex and frons yellowish brown with scattered setae. Ocelli yellowish, ocellar protuberance black. Eyes small, dichoptic and bisected in both sexes, but the upper parts quite rudimentary with but a few facets; facets on both parts small, blackish brown. Antennae much elongated, twelve jointed; scapal joints subspherical, slightly setaceous; first flagellar joint cylindrical and much elongated, subequal to the vertical height of the head, or nearly twice the second joint, but the basal half of which rather narrow and glabrous, apical half pubescent and dark brown; succeeding joints tapering apically, each swollen proximally and narrowed distally. Labrum with praelabrum slightly longer than the vertical height of the head. Maxillary palpi five

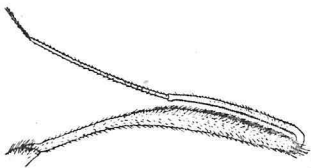


Fig. 9. *Philorus vividis* sp. nov., right mid-leg of female, showing the tibial denticles,  $\times 12$ .

jointed; third and fourth joints subequal, swollen apically; last joint slender and pale, nearly twice the preceding one in male, but subequal in female. Wings large and broad, veins brown. Venation: Sc rudimentary, not attaining the base of Rs; Rs very long;  $R_{2+3}$  short, slightly longer than  $1/2$  the straight part of Rs, and slightly curved forwards;  $R_{4+5}$  nearly in alignment with the straight part of

Rs and rather shorter than it, strongly divergent from  $R_{2+3}$ ; r-m sinuous slightly longer than the basal deflection of Rs; so-called m-cu rudimentary, almost vanished at the media-side; An thin, not attaining the wing margin. Each hind tibia with a terminal spur only. Claws conspicuous, but no denticles. Middle legs of female shortest of all: femur club-shaped and slightly curved, with dense setae at the inner margin of apical half; tibia  $1/2$  the femur in length, with many black denticles at the inner margin, which generally in contact with the apical half of the femur; first tarsal joint slender, slightly longer than the tibia. Male hypopygium rather small. Dorsal-plate very small, dark orange. Ventral-plate large, nearly trapezoidal, posterior mar-

gin concave. Guard-plate rather large, conversed V-shape, dark orange with setae. Claspers bilobed; dorsal lobe rather small, with stout setae at the inner margin; ventral lobe nearly contiguous one another, apical part of which slightly swollen forwards.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 5-6 mm., breadth 1.4-1.6 mm. Body slender, neck-pieces conspicuous. Dorsal side yellowish brown, except the rather light third body-segment; ventral side white. Antennae three jointed, slightly longer than  $\frac{1}{3}$  the first body-segment. Thoracic spot  $\infty$ -shaped, with two pairs of dark transverse stripes. Six stout thorns on each abdominal segment, but the eighth segment with two thorns. Feelers rather elongated rod-like, dorsal branch very rudimentary or wanting. Last two body-segments rather distinct. Caudal margin rather convex, median part of which chitinized and slightly projected. Segmental gill-tuft directed antero-laterally, with a conspicuous stem and five, slender, curved filaments visible in dorsal aspect.

*Third instar*. Body slender, measured 2-4 mm. Dorsal side dark brown throughout, ventral white. Antennae subequally two jointed. Six thorns on each abdominal segment. Caudal margin convex, median part of which slightly projected. Segmental gill-tuft with a stem and three, slender, curved filaments.

*Second instar*. Body slender, measured 1-2 mm. Dorsal side dark brown throughout, ventral white. Antennae unequally two jointed. Six thorns on each abdominal segment. Feelers small and simple. Caudal margin slightly convex and chitinized, with four prominent bristles. Segmental gill-tuft with a unique slender filament.

*First instar*. Body slender, segmentation distinct, 0.8-1.2 mm. in length. Dorsal side dark yellowish, ventral white. First body-segment oval, sharpened anteriorly. Antennae jointless, very short and black, with small protuberances at the tip. Head very large. Two transverse rows of black thornlets on the dorsal side of thorax and each abdominal segment. Feelers and claws wanting; but a small conical lobe with a long, laterally directed bristle, and a tuft of about eight short bristles present. Seventh abdominal segment with a pair of conical appendages with a long bristle. Caudal margin nearly semicircular with four, very short setae. No segmental gill-tuft. Anal gill and suckers normal.

*Pupa* (numerous specimens). Length 3.5-4.5 mm., breadth 2-2.5 mm. Body typically oval, much flattened. Dorsal side light yellowish brown. Pupal horns rudimentary, the bases of which contiguous

in  $\infty$ -shape. Each horn with four lamellae of different size, chitinized proximally, apically membranous and grey. First and fourth pairs of lamellae laterally contiguous; second and third pairs rather small, separated before and behind. Head large, elongated posteriorly. Prothorax without granulation. Granulation of small brown dots scatteredly on the V-shaped median part of mesothorax, the most metathorax and the median half of abdomen. Marginal half of abdomen without granulation yellowish. Pads small and subcircular. No residuum of segmental gill-tuft.

*Habits*: polygeneric, hygropetric summer-type, dominating at the highest temperature of habitat; locomotion very vivid.

*Localities*: Kibune, Kurama, Atago and Kumogahata near Kyoto; Sakamoto and Anô near Otsu; Yamada and Arima near Kobe; Tokugô, Agematu and Suhara in Province of Sinano; Minobu in Province of Tôtdômi; Huzibasi, Syômyô and Oze in Province of Ettyû; Iya in Sikoku; Yunohira near Beppu in Kyûsyû.

Genus *Parablepharocera* nov.

(Pl. XVI, figs. 87-94. Pl. XVII, figs. 95-102).

*Imago*. Eyes holoptic or dichoptic, bisected in both sexes; upper parts with large brown facets when holoptic, when dichoptic with small blackish facets; lower parts with small blackish facets. Antennae fifteen jointed; flagella in male rather long, in female very short. Mandibles saw-like, present in female only. Maxillary palpi five jointed. Venation: Rs long, at least twice the r-m;  $M_3$  incomplete; no m-cu. Each hind tibia with one or two terminal spurs; claws conspicuous, empodia rudimentary. Male hypopygium conspicuous; ventral-plate larger than the dorsal-plate; guard-plate bilobed, but not conspicuous; claspers bilobed.

*Larva. Fourth instar* (fullgrown). Body flat, neck-pieces distinct. Antennae rather short, two jointed. Thoracic spot V-shaped or obscured. A pair of rod-like feelers with many apical setae at the lateral margin of each first six abdominal segments. Claws normal. No chitinous thorns or warts on the dorsal side of the body. Last two body-segments distinct. Caudal appendages conical and with apical setae. Segmental gill-tuft with seven, slender and white filaments directed anteriorly.

*Third instar*. Antennae equally two jointed. Feelers, claws and caudal appendages normal. Segmental gill-tuft with four filaments.

*Second instar.* Antennae unequally two jointed. Feelers rudimentary, of which the posterior feeler resembling a bundle of setae. Claws large and conical. Caudal appendages rudimentary. Segmental gill-tuft with a unique filament.

*First instar.* Body slender, first body-segment elliptic. Antennae short and jointless. Eyes large and brown. Three transverse rows of thornlets on the dorsal side of thorax, and two rows on each first seven abdominal segments. Feelers and claws absent, but a retractile hooked appendage present. Seventh abdominal segment with a pair of conical appendages. Caudal margin slightly convex, but no appendages. No segmental gill-tuft. Anal gill and suckers normal.

*Pupa.* Body oval, slightly convex; dorso-median part of abdomen upheaved; outer margin of the body slightly undulated. Pupal horns elongated, bases of which separated; each horn with four, apically pointed lamellae arranged before and behind. Prothorax and mesothorax without granulation. Thick granulation on the most metathorax and whole abdomen. Residuum of segmental gill-tuft with seven filaments. Genotype:— *Parablepharocera shirakii* (Alexander).

***Parablepharocera esakii*** Alexander (1924).

(Pl. XVII, figs. 95-102).

*Male* (4 specimens): body 7 mm., wing 9 mm. Females taken out from the mature pupal cases. Head transverse, vertex and frons dark brown, with setae. Ocelli yellowish brown, ocellar protuberance dark brown. Eyes holoptic, bisected in both sexes; upper parts in female larger than those in male, with large brown facets; lower parts larger than the upper parts, with small blackish brown facets. Antennae fifteen jointed; scapal joints subspherical or pear-shaped and with setae; flagella in male long and thick, in female short and thin. Flagellar joints cylindrical, tapering apically; last joint long and slender, nearly twice the preceding joint in both sexes. Labrum with prae-labrum longer than the vertical height of the head. Maxillary palpi five jointed; joints subequal in female, but the last joint of the male slender and pale, more than thrice the fourth joint. Wings broad, veins dark brown. Venation: Sc rudimentary, ending beyond the base of Rs; Rs very long, nearly thrice the r-m or five or six times the basal deflection of  $R_{1+5}$ ;  $R_{2+3}$  and  $R_{4+5}$  nearly parallel proximally, divergent apically. Each hind tibia with a pair of terminal bristled spurs, of which one is rudimentary. Claws conspicuous, but no denticles. Hypopygium of male rather small, directed dorsally. Dorsal-

plate rather small and quadrilateral; ventral-plate large, narrowed anteriorly, posterior margin of which concave and with a notch at the middle. Guard-plate very small and bilobed, dark brown, with setae. Claspers bilobed; dorsal lobe small, blackish, with setae; ventral lobe large, proximal part of which dark brown, distal part yellowish and directed anteriorly.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 9-12 mm., breadth 2.5-3 mm. Body flat, neck-pieces not conspicuous. Dorsal side dark yellowish brown, ventral brownish grey. Antennae short, two jointed,  $1/5$  the first body-segment. Thoracic spot obscured, but the pupal horns already formed under the skin in V-shape. No chitin protuberances on the dorsal side of the body. Feelers conspicuous and cylindrical, chitinized blackish brown with many slender setae at the tip. Anterior feeler nearly similar to the posterior one. Claws conical and well chitinized, slightly larger than the feelers. Seventh abdominal segment with a pair of well chitinized conical appendages. Caudal appendages conical and short, well chitinized. Segmental gill-tuft with seven, slender and white filaments directed anteriorly. Posterior filaments of anal gill small and subspherical. Suckers rather large. Body densely covered with setae and often coated by algae.

*Third instar*. Length 3-6.5 mm. Body flat. Dorsal side dark brownish, ventral grey. Antennae equally two jointed and apically pointed. No thorns or warts on the dorsal side. Anterior feeler slightly larger than the posterior one. Caudal appendages blackish with bristles. Segmental gill-tuft with four filaments directed anteriorly.

*Second instar*. Length 1.6-3.5 mm. Body slender. Dorsal side dark greenish. Antennae thick, unequally two jointed. Thorax with three transverse rows of setae. No thorns or warts on the dorsal side. Feelers rudimentary, posterior feeler resembling but a tuft of setae. Caudal appendages small and conical. Segmental gill-tuft with a unique filament. Anal gill large and greenish.

*Pupa* (more than 20 specimens). Length 6-7.5 mm., breadth 3.5-4.4 mm. Body oval, rather flattened, outer margin slightly undulated. Dorso-median part of abdomen upheaved. Dorsal side blackish brown. Pupal horns erect, the bases separated. Each horn with four, subsimilar black lamellae apically pointed. Head nearly semicircular. Prothorax and mesothorax with no granulation. Thick granulation of very small black dots on the most metathorax and whole abdomen. Third abdominal segment broadest of all. Pads large and elliptic. Residuum of segmental gill-tuft with seven filaments.



*Habits*: monogeneric, submersed winter-type, hibernating in fourth larval stage.

*Localities*: Kibune and Kurama near Kyoto; Seryô and Hattyo in Province of Tanba; Katayama near Gihu; Inamati and Iida in Province of Sinano; Iya in Sikoku.

***Parablepharocera shirakii* (Alexander) (1922).**

(Pl. XVI, figs. 87-94).

*Male* (numerous specimens): body 4-5 mm., wing 5.5-6 mm.  
*Female* (numerous specimens): body 6.5-7.5 mm., wing 7-8 mm.  
 Head transverse, vertex and frons blackish brown, with setae. Ocelli yellowish, ocellar protuberance black. Eyes dichoptic in male, holoptic in female, bisected in both sexes. Upper parts in male very small,  $1/5$  the lower parts, with small blackish brown facets. Upper parts in female with large brown facets larger than the lower parts with small black facets. Antennae fifteen jointed; flagella long and thick in male, in female short and thin; flagellar joints subequal cylindrical, dark brown and pubescent, but the last joint in male nearly  $1/2$  the preceding joint, in female slightly longer. Labrum with praelabrum nearly one and half the vertical height of the head. Maxillary palpi five jointed; second to fourth joints subequal, last joint slender and pale, nearly twice the preceding joint in male, in female subequal. Wings broad, veins black. Venation: Sc rudimentary, ending at the base of Rs; Rs long, twice the r-m or thrice the basal deflection of  $R_{4+5}$ , the base of which subhyaline;  $R_{2+3}$  nearly in alignment with Rs, spical part slightly curved forwards;  $R_{1+5}$  nearly parallel to  $R_{2+3}$ , but divergent apically; r-m slightly sinuous. Each hind tibia with a single terminal spur, without setae. Claws conspicuous, but no denticles. Hypopygium in male conspicuous, directed dorsally. Dorsal-plate rather large, hind margin concave. Ventral-plate very large, posterior margin strongly concave, but the median part of which slightly convex. Guard-plate bilobed, lobes rather broad and with dense setae. Claspers bilobed; dorsal lobe large elliptic, blackish brown; ventral lobe slender, dark brown proximally, apically yellowish, the tip nearly contiguous one another.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 7.5-8.5 mm., breadth 2-2.5 mm. Body flat, neck-pieces conspicuous. Dorsal side greenish brown, ventral white. Antennae two jointed,  $1/3$  the first body-segment. Thoracic spot V-shaped, dark brown till black.

No thorns or warts on the dorsal side of the body, except a small black dot on the lateral side of each abdominal segment. Feelers rather small and slightly chitinized, with slender setae at the tip. Anterior feeler larger than the posterior one. Claws much larger than the feelers. Seventh abdominal segment broadened posteriorly, with a pair of conical appendages distally chitinized. Caudal appendages chitinized black, apically pointed, with setae. Segmental gill-tuft with seven, small and white filaments directed anteriorly. Suckers rather small. Ventral side of abdomen with scattered short setae.

*Third instar.* Length 3-5 mm. Body flat. Color greenish yellow on the dorsal side, except the white marginal parts. Antennae subequally two jointed. No thorns or warts on the dorsal side. Anterior feeler rather large and chitinized, but the posterior one very small and slightly chitinized. Caudal appendages small. Segmental gill-tuft with four filaments directed anteriorly. Anal gill slightly yellowish.

*Second instar.* Length 1.5-3 mm. Body flat. Dorsal side yellowish. Antennae unequally two jointed. No thorns or warts on the dorsal side. Feelers very rudimentary, of which posterior one resembling but a tuft of setae. Claws large and conical. Caudal appendages rudimentary, with a pair of bristles respectively. Segmental gill-tuft with a unique filament.

*First instar.* Length ca. 1.4 mm. Body slender and yellowish grey. Antennae jointless and black, with small prominences at the tip. Thorax with three transverse rows of thornlets, and each abdominal segment with two rows. Feelers and claws wanting; but a retractile hooked appendage and two small setae present. Seventh abdominal segment slightly projected postero-laterally with two small setae on each side. Caudal margin rather convex and with small setae. No segmental gill-tuft. Anal gill and suckers normal.

*Pupa* (numerous specimens). Length 4.5-6 mm., breadth 2.5-3.6 mm. Body oval and flat, outer margin smooth; dorso-median part of abdomen slightly upheaved. Dorsal side yellowish or dark brown. Pupal horns separated one another; each horn with four, nearly similar, apically pointed lamellae. Head nearly semicircular. Prothorax and mesothorax without granulation. Thick granulation of very small black dots on the most metathorax and whole abdomen. Pads elliptic. Residuum of segmental gill-tuft with seven filaments.

*Habits:* polygeneric, submersed summer-type, dominating at the highest temperature of habitat.

*Localities*: Kibune, Kurama and Atago near Kyoto; Sakamoto and Anô near Otsu; Agematu, Suhara, Azikawa and Kosibu in Province of Sinano.

Genus *Blepharocera* Macquart (1843).

*Blepharocera japonica* sp. nov.

(Pl. XV, figs. 81-83, Pl. XVI, figs. 84-86, text-fig. 4).

*Male* (6 specimens): body 2.8-3 mm., wing 3.5 mm. *Female* (3 specimens): body 4 mm., wing 4.2 mm. Head transverse; vertex broad, blackish brown; frons narrow, yellowish brown. Ocelli yellowish brown, ocellar protuberance black. Eyes very large, but rather dichoptic, bisected in both sexes, but the upper parts rudimentary; facets small, blackish brown, but on the upper parts slightly lighter. Antennae fifteen jointed; flagella of male with cylindrical joints longer than those of female with subspherical joints; first joint rather long, succeeding ones subequal, but the last joint pale and nearly twice the preceding one. Labrum with praelabrum subequal to the vertical height of the head. Maxillary palpi five jointed; last joint slender and pale, nearly twice the preceding one. Wings much broadened, veins obscure brown. Venation: Sc quite rudimentary; Rs slightly longer than r-m;  $R_{2+3}$  nearly straight, the tip slightly curved forwards; r-m rather long, slightly sinuous; incomplete  $M_3$  very short. Each hind tibia without terminal spur; claws conspicuous, without denticles. Male hypopygium rather small, slightly turned dorsally. Dorsal-plate very small, dark brown, with setae. Ventral-plate large, posterior margin concave, but the median part of which slightly convex and dark brown. Guard-plate small and bilobed, dark brown, with setae. Claspers bilobed; dorsal lobe larger and blackish brown; ventral lobe brown, with setae.

*Larva* (numerous specimens). *Fourth instar* (fullgrown). Length 5-6.5 mm., breadth 1.7-2 mm. Body strongly flattened; first body-segment rather small, third and fourth broadest. Dorsal side greenish brown except the whitish marginal parts of abdomen, ventral side white. Antennae two jointed, the tips pointed,  $1/3$  the first body-segment. Thoracic spot V-shaped, blackish brown. No chitinous thorns or warts on the dorsal side. Feelers absent. Claws conspicuous, basal part of which yellowish brown, distal part conical with chitinized ventral side and bristled dorsal surface. Last two body-segments distinct. Seventh abdominal segment posteriorly broadened, with a pair of conical appen-

dages apically bristled. Caudal margin trapezoidal, rather chitinized black, with two pairs of bristles. Segmental gill-tuft with seven, small and white filaments anteriorly directed. Ventral side of the body with very short setae scatteredly.

*Third instar.* Length 2-3 mm. Body flat. Dorsal side dark brownish. Antennae subequally two jointed. No chitinous protuberances on the dorsal side. Feelers absent; claws conspicuous. Seventh abdominal segment with a pair of conical appendages apically bristled. Caudal margin trapezoidal with two pairs of bristles. Segmental gill-tuft with four filaments.

*Second instar.* Length 1.2-1.6 mm. Body flat. Dorsal side obscure brownish. Antennae thick and short, unequally two jointed. Stout setae on the dorsal side of thorax and abdomen. Feelers absent; claws rather small. Seventh abdominal segment with a pair of conical appendages. Caudal margin trapezoidal and black, with two pairs of setae. Segmental gill-tuft with a unique filament.

*Pupa* (numerous specimens). Length 2.4-4 mm., breadth 1.5-2.2 mm. Body elliptic, strongly convex, outer margin much undulated. Dorsal side yellowish brown. Pupal horns separated one another; each horn with four subsimilar lamellae apically pointed. Head small, semicircular. Prothorax and mesothorax without granulation. Thick granulation of very small black dots on the most metathorax and whole abdomen. Fourth abdominal segment broadest of all. Pads large and elliptic. Residuum of segmental gill-tuft with seven filaments.

*Habits:* polygeneric, submersed summer-type, dominating at the highest temperature of habitat.

*Localities:* Kibune, Kurama and Atago near Kyoto; Yamada and Arima near Kobe; Kosibu in Province of Sinano; Mt. Sugoroku in Province of Hida.

Genus *Curupira* Osten-Sacken (1895).

*Curupira uenoi* nov. sp.

(Text-fig. 10).

More than 10 specimens presumably belonging to the *fourth instar* just after moulting. Generic position of this species rather problematical, but certainly different from the genus *Blepharocera*.

Length 3.4-4 mm., breadth 1.4-1.5 mm. Body flat, neck-pieces rather conspicuous. Dorsal side brownish black till black, ventral white, except the obscure marginal parts. Antennae subequally two jointed,  $1/3-1/4$  the first body-segment. Polsters of the mouth-parts

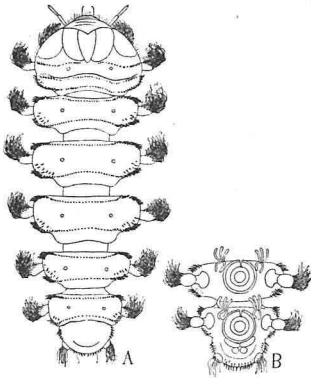


Fig. 10. Larva of *Curupira uenoi* sp. nov., A. dorsal view,  $\times 10$ ; B. ventral view of hind body-segments,  $\times 10$ .

very conspicuous. Sharp thornlets on the dorsal side of each first six abdominal segments. Thornlets distributed densely on the marginal parts, but on the median part scatteredly, forming a pair of transverse rows of blunted tubercles. Feelers absent, but the claws very conspicuous. Distal part of the claw broadened ellipsoidal, with short thornlets and many long stout bristles at the dorsal side. Last two body-segments slightly separated. Seventh body-segment nearly semicircular, with a pair of conical appendages apically bristled. Caudal margin semicircular, with many sharp thornlets. Segmental gill-tuft with five, slender, white filaments, of which three directed anteriorly, and two

posteriorly. Anal gill thick and short, posterior pair of filaments subspherical. Suckers very large.

*Habits*: presumably monogeneric, submersed winter-type.

*Locality*: Nakabusa in Province of Sinano.

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EXPLANATION OF PLATES.

Plate VIII.

*Bibiocephala infuscata* (Matsumura).

- Fig. 1. Fullgrown larva; dorsal view, × 5.  
 2. „ ; antenna, × 60.  
 3. „ ; last three body-segments, ventral view, × 8.

4. „ ; first body-segment, showing the pupal respiratory lamellae formed, × 8.
5. „ ; fourth body-segment; posterior view, × 8.
6. Male hypopygium, drawn from mature pupa; dorsal view, × 15.
7. „ ; ventral view, × 15.
8. Part of wing, drawn from mature pupa, × 15.
9. Larva from Hayatuki; dorsal view, × 7.
10. „ ; ventral view, × 7.
11. Residuum of larval segmental gill-tuft of pupa, × 30.

## Plate IX.

*Bibiocephala infuscata* var. *minor* nov.

- Fig. 12. Fullgrown larva; dorsal view × 9.
13. „ ; last three body-segments; ventral view, × 9.
14. Pupa; dorsal view, × 9.

*Bibiocephala japonica* Alexander.

- Fig. 15. Fullgrown larva; dorsal view, × 8.
16. „ ; last three body-segments, ventral view, × 9.
17. „ ; mouth-parts, × 60.  
Lr: labrum, Ml: maxillary-lobe, Ca: cardo, St: stripes,  
Mp: maxillary-palp, Man: mandible, Po: Polster, Li: labium.
18. „ ; feeler of third abdominal segment; dorsal view, × 60.
19. „ ; „ ; ventral view, × 60.

## Plate X.

- Fig. 20. Pupa; dorsal view, × 10.  
Pm: pupal mattress.
21. „ ; ventral view, × 10.  
A: antenna, E: compound-eye, Lr: labrum, Mn: mandible,  
Mp: maxillary-palp, Li: labium, W: wing-sac, P: pad,  
G: residuum of gill-tuft, f: fore-leg, m: mid-leg, h: hind-leg.
22. Wing, × 10.
23. Male hypopygium; dorsal view, × 30.
24. „ ; ventral view, × 30.

*Bibiocephala montana* sp. nov.

- Fig. 25. Fullgrown larva; dorsal view, × 10.
26. „ ; last three body-segments; ventral view, × 15.
27. Larva from Hayatuki; dorsal view, × 10.
28. „ ; ventral view, × 10.

## Plate XI.

- Fig. 34. Wing, × 10.
35. Male hypopygium; dorsal view, × 30.
36. „ ; ventral view, × 30.

*Bibiocephala montana* var. *bispina* nov.

- Fig. 29. Fullgrown larva; dorsal view, × 10.
30. „ ; last three body-segments; ventral view, × 15.

- 31. „ ; feeler of third abdominal segment; ventral view,  $\times 45$ .
- 32. „ ; „ ; dorsal view,  $\times 45$ .
- 33. Pupa; dorsal view,  $\times 10$ .

*Philorus bilobatoides* var. *longispina* nov.

- Fig. 37. Fullgrown larva; dorsal view,  $\times 15$ .
- 38. „ ; last three body-segments; ventral view,  $\times 15$ .
- 39. „ ; side view,  $\times 15$ .
- 40. „ ; feeler of third abdominal segment; dorsal view,  $\times 60$ .
- 41. „ ; „ ; side view,  $\times 60$ .

*Philorus bilobatoides* sp. nov.

- Fig. 42. Feler of third abdominal segment of fullgrown larva; dorsal view,  $\times 60$ .
- 43. „ ; ventral view,  $\times 60$ .

Plate XII.

- Fig. 44. Pupa; dorsal view,  $\times 10$ .
- 45. Part of wing, drawn from mature pupa,  $\times 15$ .
- 46. Male hypopygium, drawn from mature pupa; dorsal view,  $\times 15$ .
- 47. „ ; ventral view,  $\times 30$ .

*Philorus alpinus* sp. nov.

- Fig. 48. Fullgrown larva; dorsal view,  $\times 8$ .
- 49. „ ; last three body-segments; ventral view,  $\times 10$ .
- 50. „ ; antenna,  $\times 45$ .
- 51. „ ; segmental gill-tuft,  $\times 30$ .
- 52. Pupa; dorsal view,  $\times 10$ .
- 53. Wing,  $\times 10$ .
- 54. Male hypopygium; dorsal view,  $\times 30$ .
- 55. „ ; ventral view,  $\times 26$ .

Plate XIII.

*Philorus ezoensis* sp. nov.

- Fig. 56. Fullgrown larva; dorsal view,  $\times 10$ .
- 57. „ ; ventral view,  $\times 10$ .
- 58. Pupa; dorsal view,  $\times 10$ .

*Philorus kibunensis* sp. nov.

- Fig. 59. Last three body-segments of immature fourth instar; side view,  $\times 15$ .

*Philorus kuyaensis* sp. nov.

- Fig. 60. Fullgrown larva; dorsal view,  $\times 10$ .
- 61. „ ; ventral view,  $\times 10$ .
- 62. Pupa; dorsal view,  $\times 10$ .

Plate XIV.

- 63. Wing,  $\times 10$ .
- 64. Male hypopygium; dorsal view,  $\times 30$ .
- 65. „ ; ventral view,  $\times 30$ .



*Philorus longirostris* sp. nov.

- Fig. 66. Fullgrown larva; dorsal view,  $\times 10$ .  
 67. „ ; ventral view (third and fourth body-segments omitted),  $\times 10$ .  
 68. Pupa; dorsal view;  $\times 10$ .  
 69. Male hypopygium; dorsal view,  $\times 30$ .  
 70. „ ; ventral view,  $\times 30$ .  
 71. Wing,  $\times 10$ .

## Plate XV.

*Philorus vividis* sp. nov.

- Fig. 72. Fullgrown larva; dorsal view,  $\times 15$ .  
 73. „ ; first two body-segments; ventral view,  $\times 15$ .  
 74. „ ; last two body-segments; ventral view,  $\times 15$ .  
 75. Lupa; dorsal view,  $\times 15$ .  
 76. Head of male; front view,  $\times 15$ .  
 77. Wing,  $\times 10$ .  
 78. Basal part of wing,  $\times 15$ .  
 79. Male hypopygium; dorsal view,  $\times 30$ .  
 80. „ ; ventral view,  $\times 30$ .

*Blepharocera japonica* sp. nov.

- Fig. 81. Fullgrown larva; dorsal view,  $\times 10$ .  
 82. „ ; ventral view,  $\times 10$ .  
 83. Pupa; dorsal view,  $\times 10$ .

## Plate XVI.

- Fig. 84. Wing,  $\times 10$ .  
 85. Male hypopygium; dorsal view,  $\times 40$ .  
 86. „ ; ventral view,  $\times 40$ .

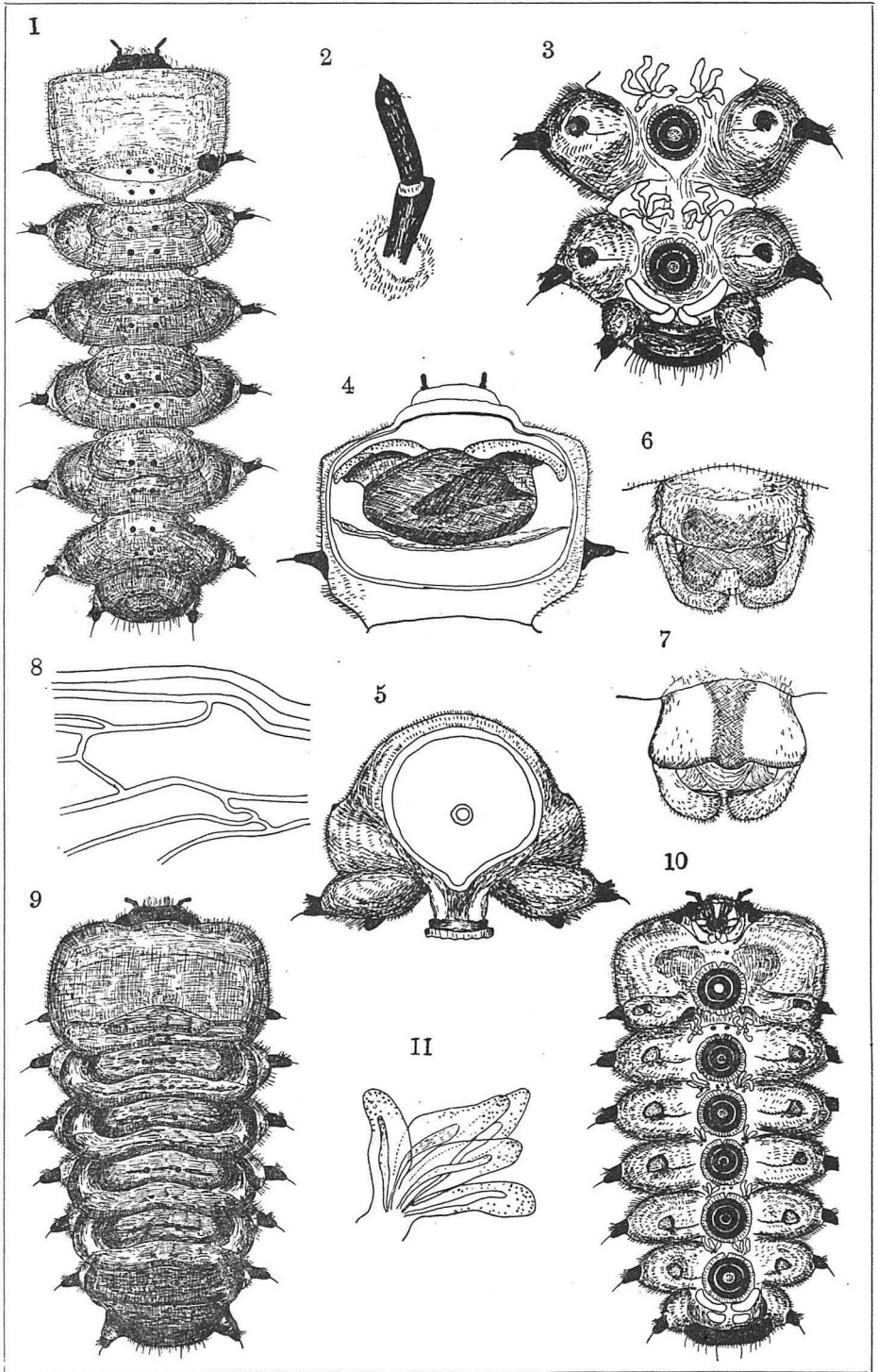
*Parablepharocera shirakii* (Alexander).

- Fig. 87. Fullgrown larva; dorsal view,  $\times 10$ .  
 88. „ ; ventral view,  $\times 10$ .  
 89. Last three body segments of second instar; dorsal view,  $\times 50$ .  
 90. Last three body-segments of first instar; dorsal view,  $\times 50$ .  
 91. Pupa; dorsal view,  $\times 10$ .  
 92. Wing,  $\times 10$ .  
 93. Male hypopygium; dorsal view,  $\times 30$ .  
 94. „ ; ventral view,  $\times 30$ .

## Plate XVII.

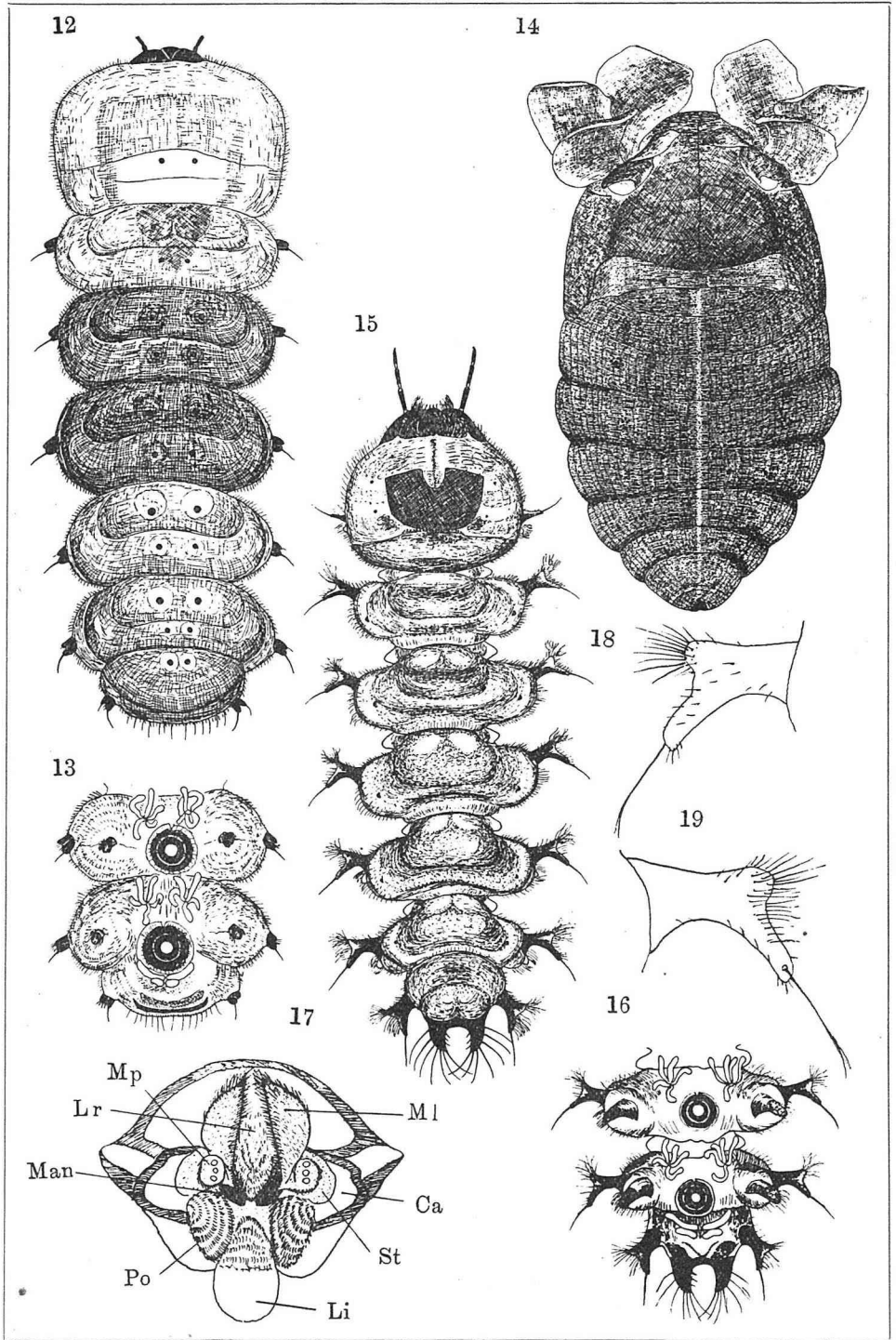
*Parablepharocera asakii* (Alexander).

- Fig. 95. Fullgrown larva; dorsal view,  $\times 10$ .  
 96. „ ; ventral view,  $\times 10$ .  
 97. „ ; feelers and claw of second abdominal segment; dorsal view,  $\times 30$ .  
 98. „ ; „ ; ventral view,  $\times 30$ .  
 99. Pupa; dorsal view,  $\times 10$ .  
 100. Part of wing, drawn from mature pupa,  $\times 15$ .  
 101. Male hypopygium drawn from mature pupa; dorsal view,  $\times 30$ .  
 102. „ ; ventral view,  $\times 30$ .



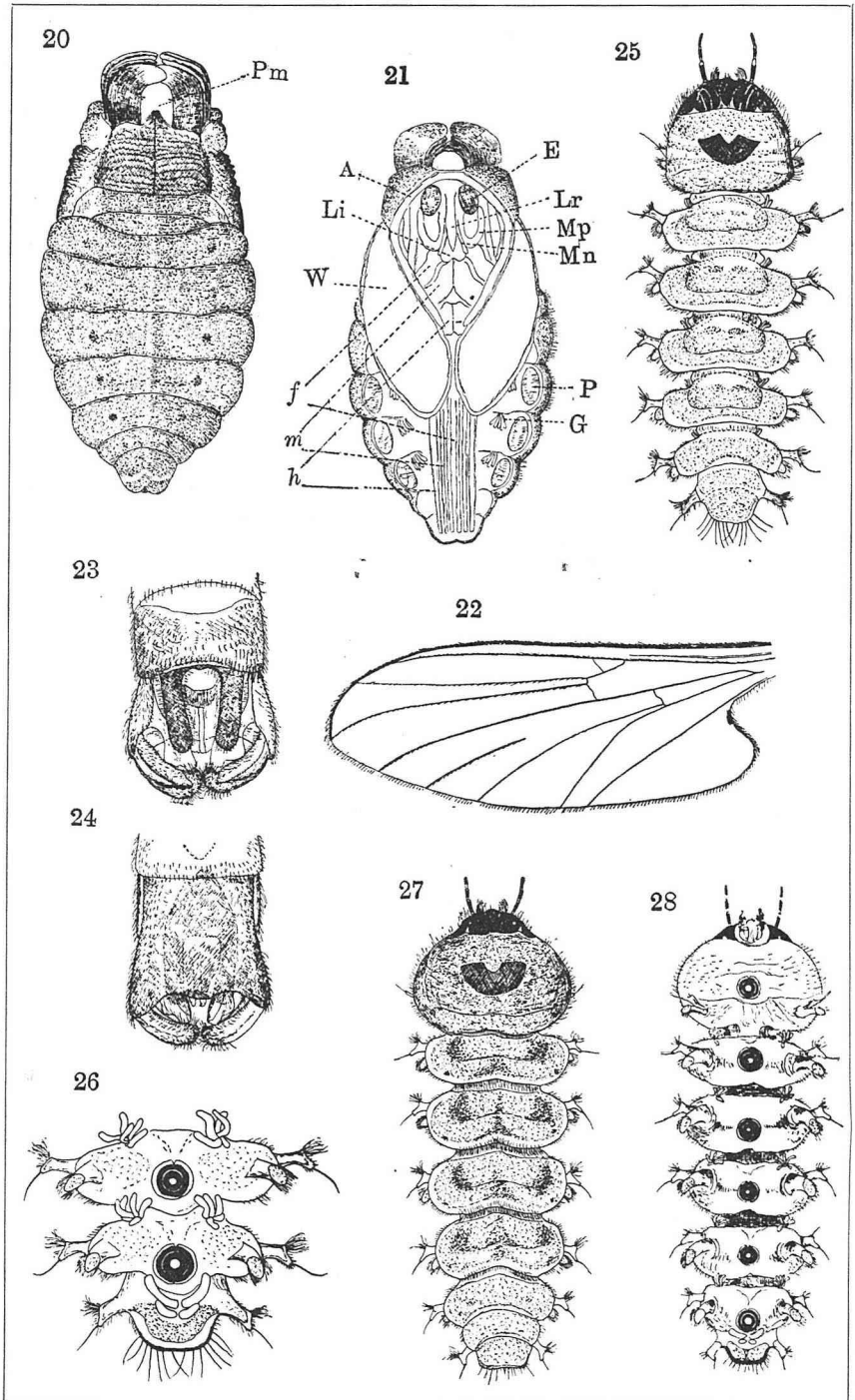
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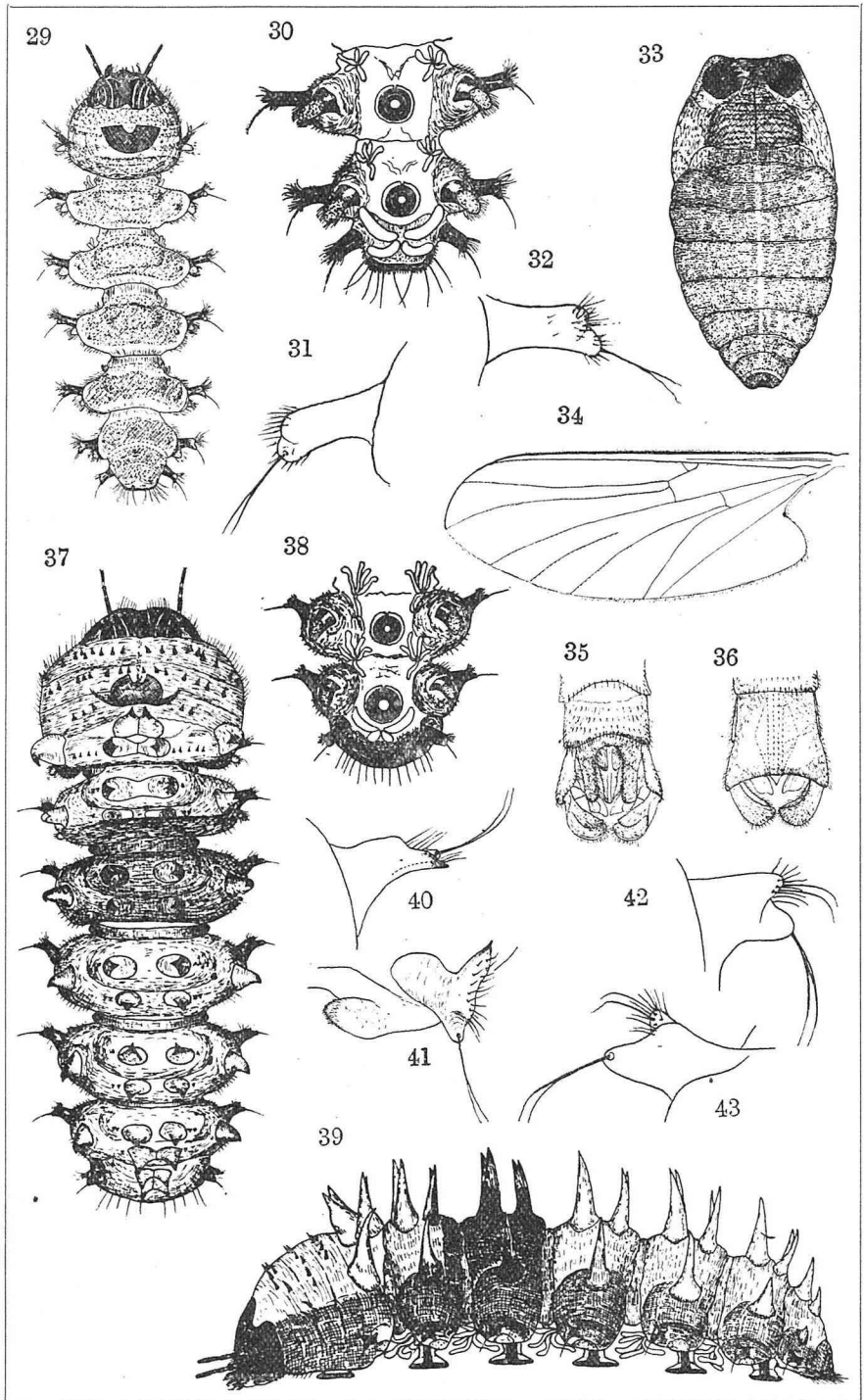
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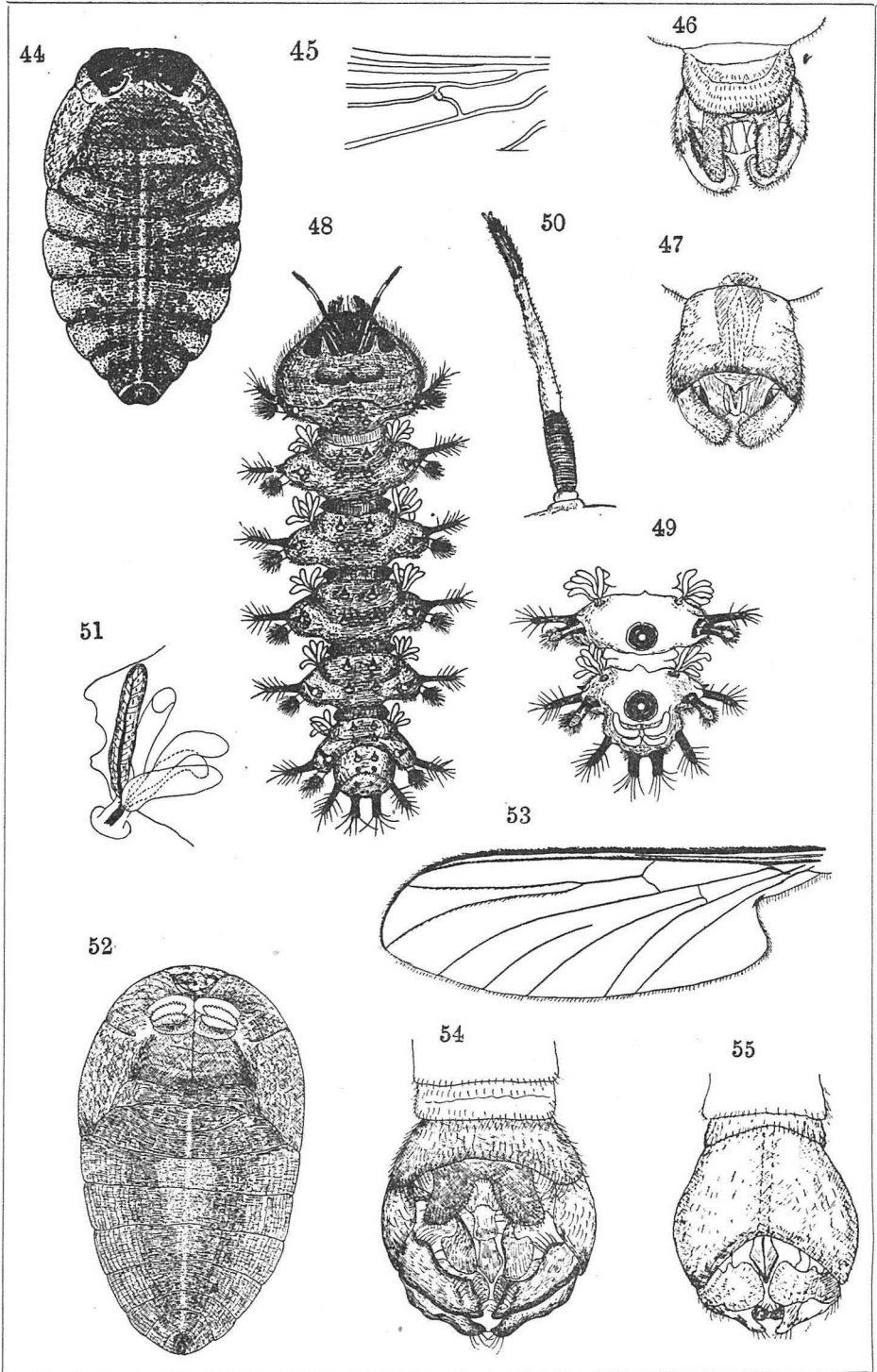
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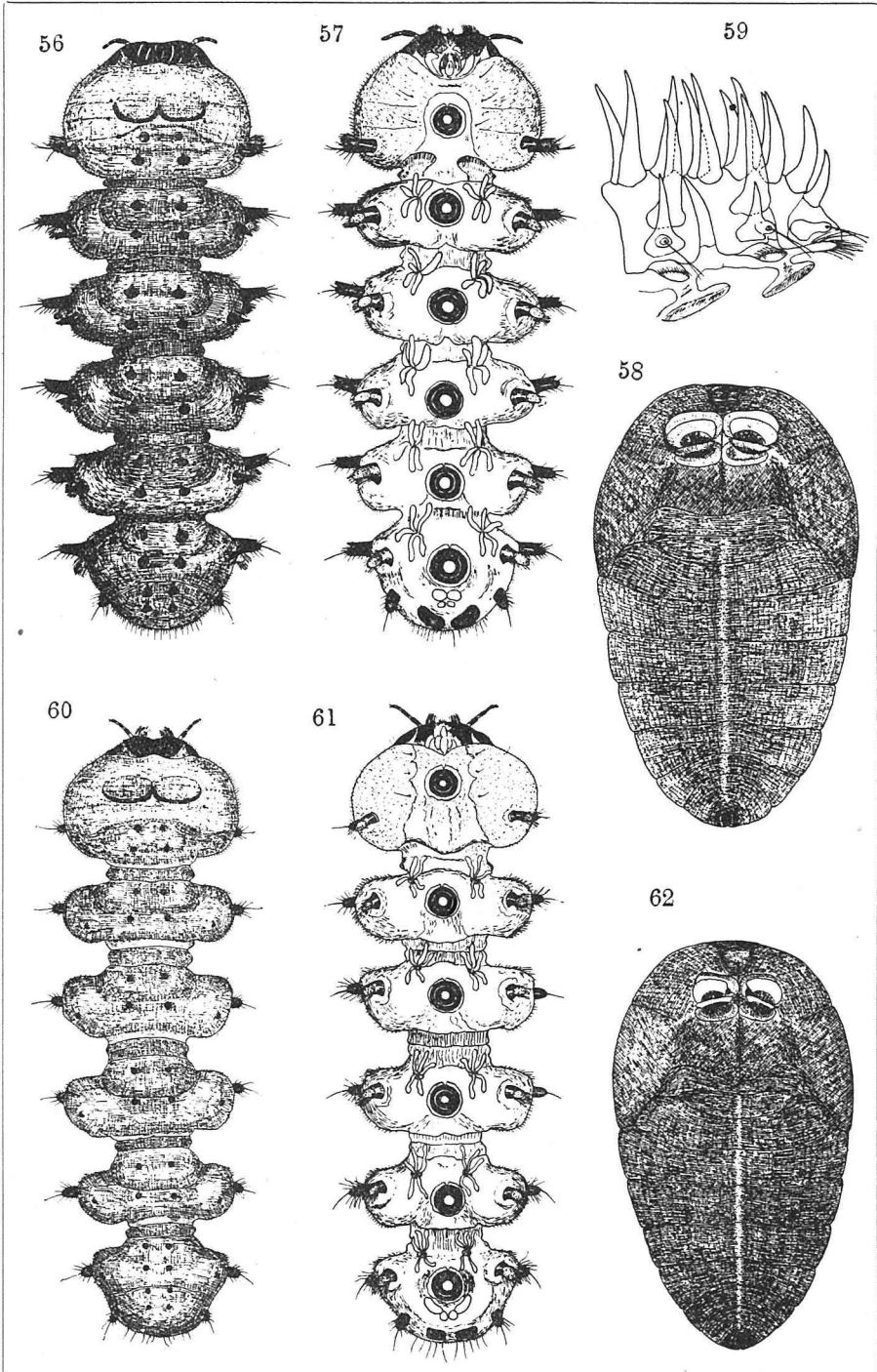
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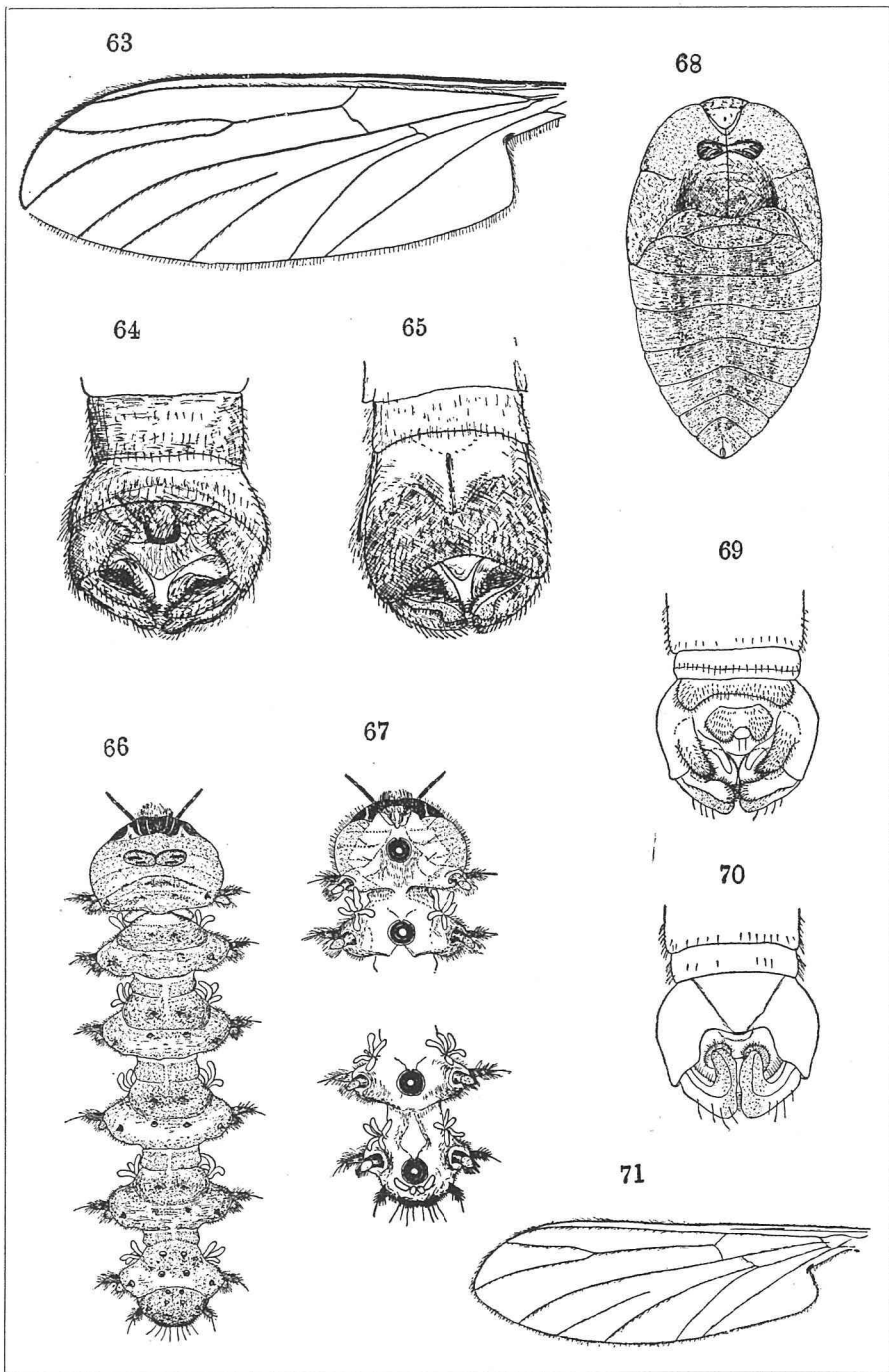
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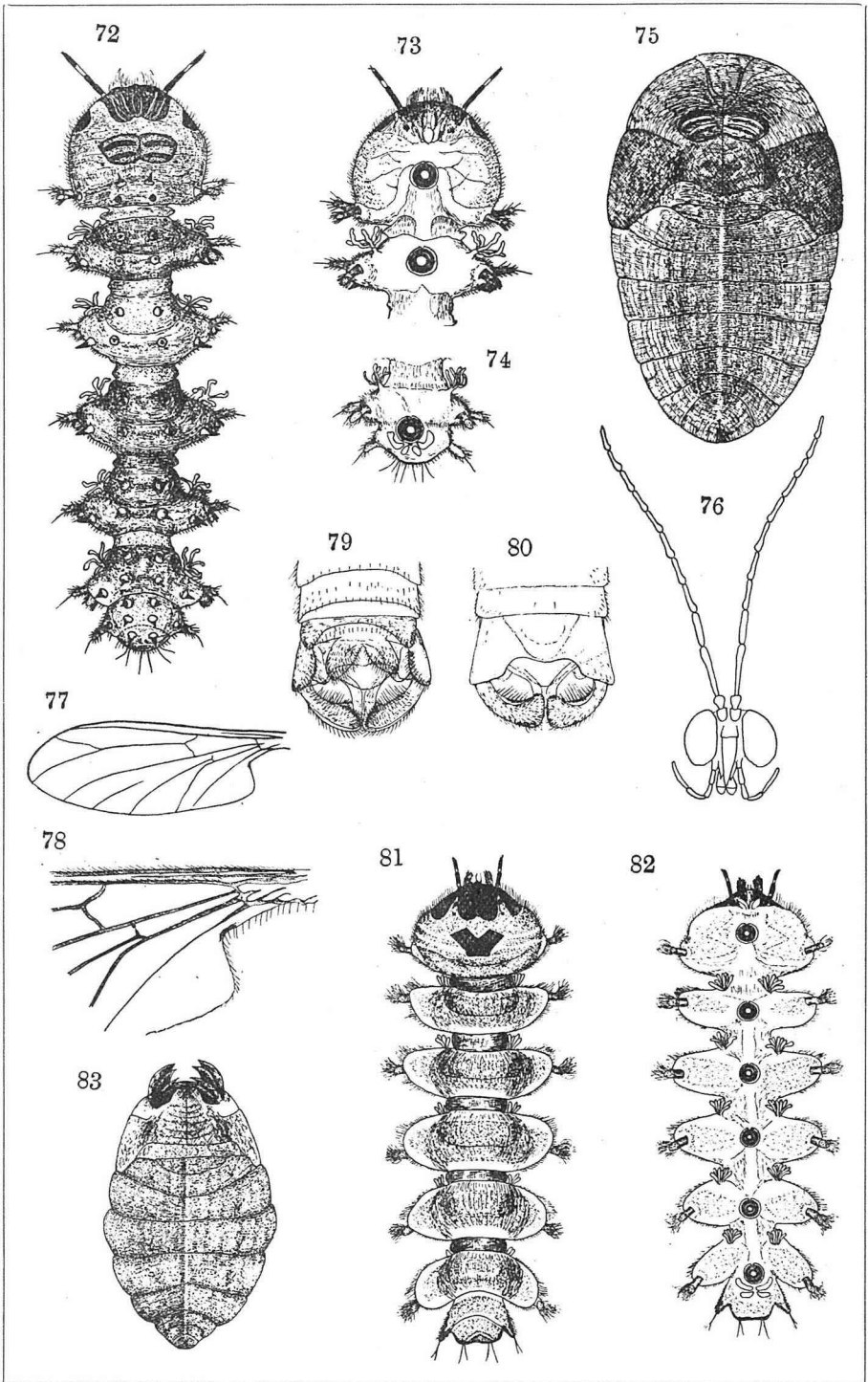
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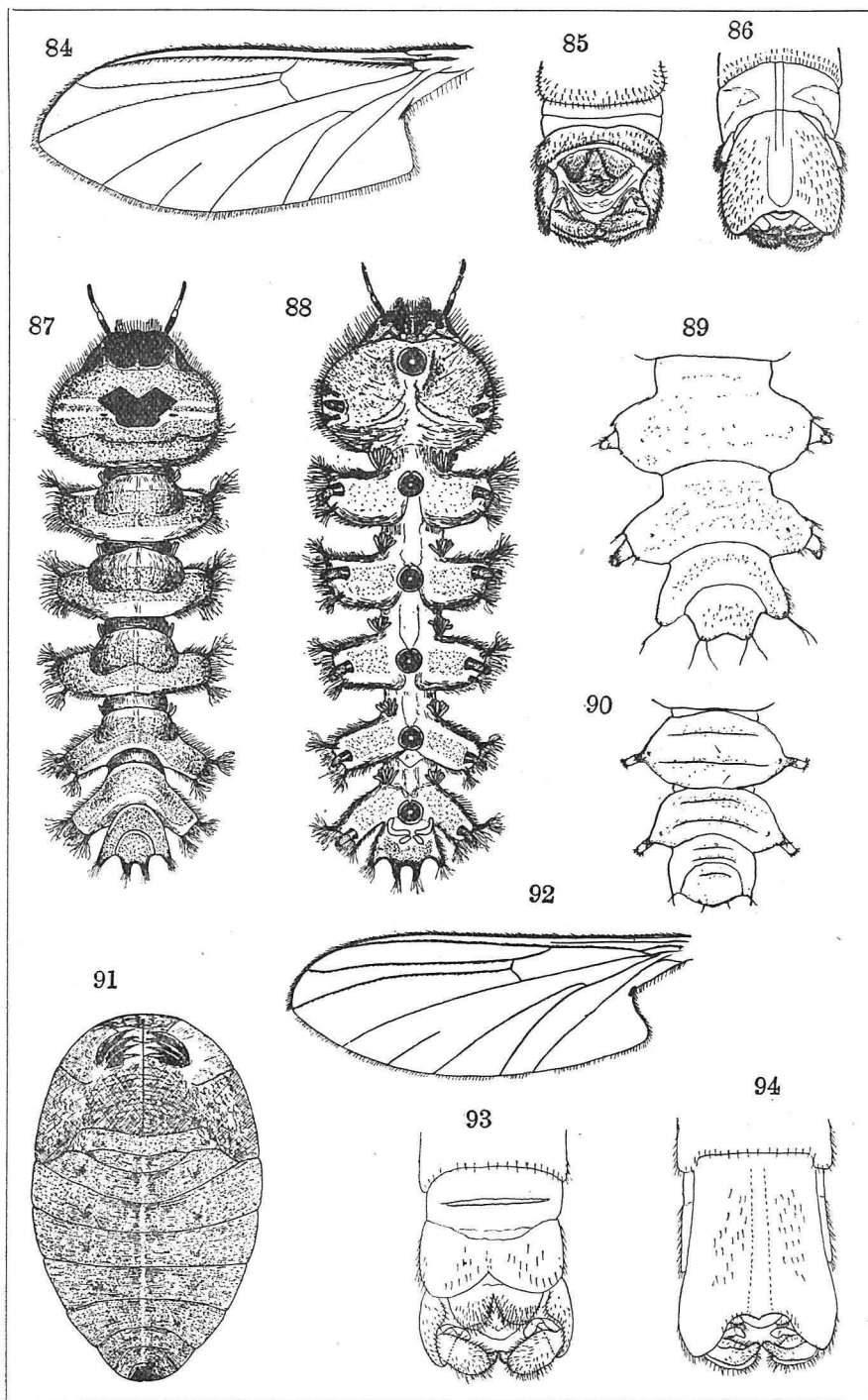
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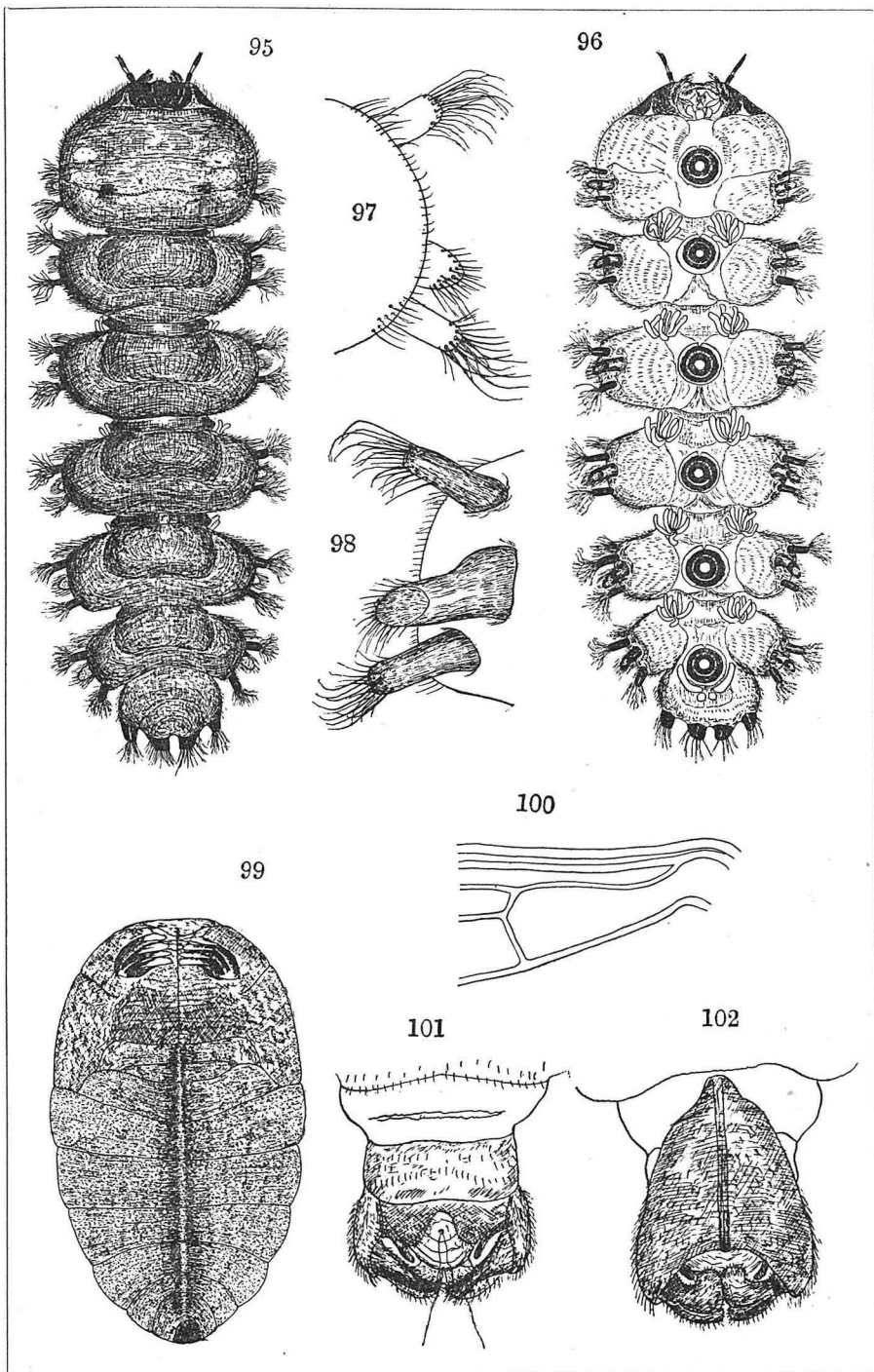
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