

# MAYFLIES FROM JAPANESE TORRENTS

## IV. NOTES ON THE GENUS *EPEORUS*<sup>1</sup>

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ONE PLATE AND ONE TEXTFIGURE

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In this paper I wish to deal with the genus *Epeorus* of the family Ecdyonuridæ. I enumerate nine species belonging to this genus from Japan, of which three species are new to science. On the other genus of the same family I will report in the next paper.

There are many difficult problems in connection with the taxonomy of the family Ecdyonuridæ, and if one deals with the genus *Epeorus*, he will meet with at least two of these problems. The first one is how to distinguish this genus from its allied genus *Iron*.

Ulmer<sup>2</sup> followed Eaton's standard work, but Schönemund<sup>3</sup> pointed out the weakness of their system, mostly relied upon the ratio of the lengths of tarsal joints. The structure of the first gill-lamella in the nymphal stage has long been looked upon as if the only indisputable character discriminating the two genera and it was adopted by Needham<sup>4</sup>. But Schönemund even denied the validity of this diagnosis. Uéno<sup>5</sup> followed Needham's system in our country, but my studies based on the life history and on reared nymphs have led me to a conclusion which supports Schönemund's opinion. For instance, in the nymphs of *Epeorus aesculus* there exist two types of the first gill-lamella (see the textfigure). In one type it is large, kidney-shaped, and convergent,

<sup>1</sup> Contributions from the Otsu Hydrobiological Station, Kyoto Imperial University. No. 52. Contributions from the Entomological Laboratory, Kyoto Imperial University. No. 42.

<sup>2</sup> Ulmer, G. 1929 Ephemeroptera, in: Tierwelt Mitteleuropas, etc.

<sup>3</sup> Schönemund, E. 1930 Ephemeroptera, in: Tierwelt Deutschlands.

<sup>4</sup> Needham, J. G. and P. R. 1927 A guide to the study of fresh-water biology, etc.

<sup>5</sup> Uéno, M. 1931 Contributions to the knowledge of Japanese Ephemeroptera, Annot. Zool. Japon., vol. 13.

these features being also the characteristics of the nymphs of *Iron*, while in the other type, it is small, more or less triangular, and not convergent. The size of the gill-lamellæ is apparently of ecological

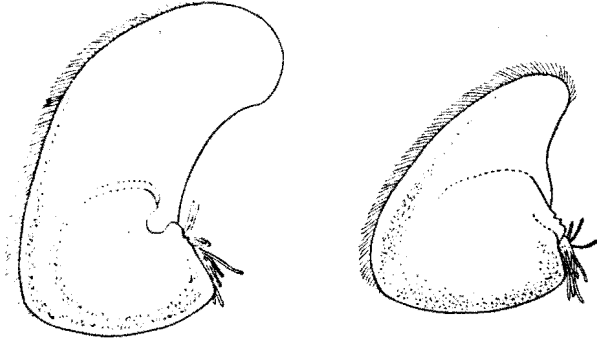


Fig. 1.—Two types of the first gill lamella of *Epeorus aesculus*, dorsal view.

significance. The species in this family inhabiting rapid streams generally possess large-sized lamellæ and those in slow moving waters have small-sized ones. The fact that in *E. aesculus* there are individuals possessing both large and small lamellæ may be interpreted as indicating the species under consideration being in the transitional stage in regard to its habitat selection. If this be true, the size of the lamellæ is a character only of a cenogenetic significance and not of any palinogenetic importance. Consequently, this nymphal character cannot have much importance in the classification of the related genera. Although in the European species of the genus *Epeorus* the tarsal claws are similar in structure in the fore legs, none of the Japanese *Epeorus* species, so far as yet known, possesses this feature of the tarsal claws. I consider this to be an interspecific difference within the genus and not of a distinctive value in separating the two genera, *Epeorus* and *Iron*. In short, I have decided to deal with all Japanese species hitherto known as *Epeorus* and reported in this paper as belonging to this genus.

The next problem is how to distinguish *Epeorus* from other genera of the Ecdyonuridæ excluding *Iron*. Here Schönemund also adopted the relative length of the tarsal joints of the fore leg; namely, in *Epeorus* the first and the second tarsal joints of the fore leg being subequal, but in *Heptagenia*, *Rhithrogena* and *Ecdyonurus* the first tarsal joint being always shorter than the second. Unfortunately both sexes of *E. hiemalis*, *E. curvatulus* and the female of *E. ikanonis*, *E. aesculus* are not in accord with the above mentioned character of the genus,

and rather seemed to belong to the genus *Ecdyonurus*. However the nymphs of *E. curvatulus*, *E. ikanonis* and *E. aesculus* do not possess the median caudal filaments which are characteristic of *Ecdyonurus* and therefore it is not safe to transfer these species to that genus, at least in the present state of our knowledge. The life history of *E. hiemalis* is not known and therefore the standing of this species remains more or less questionable. Further discussions on this problem will be critically presented in my next paper.

Genus: *Epeorus* Eaton, 1881

1 *Epeorus uenoi* (Matsumura), 1933

*Iron* sp.? Eaton: Uéno, 1928. Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, 4, p. 28.

*Iron uenoi* Imanishi: Matsumura, 1933. Ill. Common Ins. Japan, vol. 5, p. 98.

Measurement:	Male	Female
Body, length	11.0-13.0 mm	11.5-13.0 mm
Fore wing, length	11.5-13.0	13.0-14.0
Cercus, length	34.0-36.0	29.0

Description. Male:—General colour light ochraceous. Eyes large, holoptic; in living specimens pale greenish, intersected in the lower portion by a brownish band; anterior margin of the frons brownish. Thorax light testaceous; hinder margins of meso- and metanotum fuscous in the middle part. Legs pale yellowish to pale yellowish brown; each femur with a dark brownish speckle near its middle; in the fore leg the junction of tibia and tarsus, and that of each tarsal joint infuscated; distal end of the last tarsal joint and claws of each leg also infuscated; claws dissimilar in all legs; in the fore leg femur: tibia: tarsus = 12.1:15.5:18.2, tarsal joints rank 1, 2, 3, 4, 5; in the hind leg femur: tibia: tarsus = 11:11:5.5, tarsal joints rank 5, 1, 2, 3, 4. Wings hyaline, pterostigmatic portion obscured; humeral brace-vein tinted fuscous, other veins whitish; hind wing with a fuscous spot on its base. Abdomen: tergites 1-7 semitranslucent, each of the tergites 1-9 with a narrow brownish band on its posterior margin which curves anteriorly at the side. Posterior margin of the sternite 10 incised at the base of forceps-limbs. Penis-lobe not widened at its apex; forceps-limbs whitish, junctions of segments 2-3 and segments 3-4 brownish. Cerci whitish, junctions of a few proximal segments light yellowish brown.

Female:—General colour ochraceous. Eyes dichoptic, light greenish with a fuscous band; the breadth of the head: the distance between the eyes = 40:15; hinder margin of the occiput bordered brownish. In the fore leg femur:tibia:tarsus = 11.0:12.3:9.8, tarsal joints rank 1, 2, 5, 3, 4; in the hind leg femur:tibia:tarsus = 12.8:10.0:6.3, tarsal joints rank as in the male. In the fore wing C, Sc and R greenish, other longitudinal veins pale greenish to whitish, cross-veins pale brownish; in the hind wing all veins pale brownish to whitish. Abdomen appearing reddish in which eggs are present; markings on the tergites indistinct in some specimens. Subgenital plate quadrate; posterior margin of the sternite 9 shallowly notched at its apex.

Subimago. Male:—Duller coloured than in the imago. Pronotum with a pair of brownish spots; mesonotum with a pair of brownish markings on the side of scutellum. Wings greyish, subhyaline; fuscous markings on the humeral brace-vein and the base of hind wing conspicuous; fuscous fleckle on the femur also conspicuous. Abdomen not semitranslucent on tergites 1-7. Length of body 11-12 mm, length of cercus 19.5-20.0 mm. Female:—Very much like the male subimago in general colour and markings. Length of body 10 mm, length of cercus 19 mm.

Nymph:—For detailed description, see Ueno 1928.

This species is one of the commonest *Epeorus* in the Kyoto district. The emergence of imago from June to October. I first obtained imagines in 1932 by rearing nymphs and subimagines from Kibune and Yase, each locality being the upper branch of the Kamo River, Kyoto.

## 2. *Epeorus aesculus* n. sp.

Measurement :	Male	Female
Body, length	9.0-13.0 mm	9.5-11.5 mm
Fore wing, length	10.0-13.5	12.0-14.0
Cercus, length	27.0-39.0	20.0-23.0

Description. Male:—General colour ochraceous. Eyes holoptic, in life greenish; no distinct darker band on the border between upper and lower portions; each ocellus ringed with a brownish band. Thorax light brownish, hinder margins of meso- and metanotum fuscous. Propleuron with a distinct fuscous spot. Legs pale yellowish; in the fore leg tibia dark brownish on its proximal half, junction of tibia and tarsus also dark brownish; each femur with a brownish speckle on its

middle portion, the one on the hind femur being sometimes obscured. Claws brownish, dissimilar in all legs; in the fore leg femur:tibia:tarsus = 49:87:111, tarsal joints rank 1, 2, 3, 4, 5; in the hind leg femur:tibia:tarsus = 8.5:8:4.5, tarsal joints rank 5, 1, 2, 3, 4. Wings hyaline, pterostigmatic portion obscured; veins greyish except the basal parts of S, Sc, R and M, which being pale yellowish. Abdomen: above pale brownish, each of the tergites 1-9 with a narrow darker band on its posterior margin; also each of the tergites 1-7 with a distinct brownish streak on each laterocaudal corner. Venter paler; sternite 10 produced into a convexed shape between the forceps. Pehis-lobe broadened on its outer margin, with a spine upon it. Cerci dark brownish, paler distally, median caudal filament rudimentary.

Female:—Similar to the male. Eyes dichoptic; the breadth of head: the distance between the eyes = 25:10. Legs pale greenish, tibia of the fore leg not dark brownish on its proximal half as in the male, junction of tibia and tarsus also not dark brownish; in the fore leg femur:tibia:tarsus = 9.5:10.7:11.5, tarsal joints rank 2, 3 = 1, 5, 4; in the hind leg femur:tibia:tarsus = 10.9:9.8:5.2, tarsal joints rank 5, 1, 2, 3, 4. Wings hyaline, pterostigmatic portion tinted somewhat greenish. Veins pale greenish to brownish. Subgenital plate semicircular; sternite 9 deeply notched on its posterior margin.

Subimago:—Duller coloured than in the imago. Wings greyish, subhyaline. The fuscous spot of propleuron distinct; the fuscous streaks on the laterocaudal corners of the tergites 2-7 also distinct. Length of body, male 9.0-10.0 mm, female 12.0 mm; length of fore wing, male 11.5-14.0 mm; length of cercus, male 19.0-20.0 mm.

Nymph:—Similar to *Epeorus uenoi* but different from it as follows:

<i>aesculus</i>	<i>uenoi</i>
1. Frontal margin of head paler, with a darker median stripe.	Frontal margin of head darker with 4 paler spots on it, of which the inner 2 being smaller than the outer 2.
2. Propleuron with a fuscous spot.	Propleuron without a fuscous spot.
3. Each of the abdominal segments 2-7 with 2 lateral spines.	Each of the abdominal segments 2-7 with 3 lateral spines.
4. Each of the tergites 1-7 with a distinct brownish streak on its laterocaudal corner.	Each of the tergites 1-7 without any distinct streak on its laterocaudal corner.
5. Length of body, 9-12 mm; length of cercus 9.5-12.5 mm.	Length of body 11-14 mm; length of cercus 15-18 mm.

Holotype:—Male

Allotype:—Female

Type locality:—Gorôsa, the Kurobe River, Northern Japanese Alps, altitude ca 2400 mtr.; type-specimens: alcoholic; collected by K. Imanishi, on Aug. 7-15, 1931.

Other localities:—Kyoto (the Kamo River, the Ôyi River). Shiga (the Hira River). Toyama (the Wada River, the Jôganji River).

This species resembles *Epeorus uenoi* but the humeral brace-veins are not tinted fuscous as in *E. uenoi*. The fuscous spot on the propleuron and the peculiar shape of the penis-lobe easily distinguish this species from its allied species.

The emergence of imago in May, earlier than that of *E. uenoi* in the Kyoto district. Its distribution seems to be wider than in *E. uenoi* and the time of its emergence is influenced by altitude; namely, emergence in June at 1000-2000 mtr., in July and August at 2000-2500 mtr. I obtained imagines in 1933 by rearing nymphs from Kibune as already mentioned.

### 3. *Epeorus nipponicus* (Uéno), 1931

*Iron nipponicus* Uéno: Uéno, 1931. Annot. Zool. Japon., vol. 13, p. 94.

*Iron nipponicus* Uéno: Uéno, 1932. Icon. Ins. Japon., p. 1959.

### 4. *Epeorus hiemalis* n. sp.

Measurement:	Male	Female
Body, length	11.5-13.0 mm	11.0 mm
Fore wing, length	15.0	17.0
Cercus, length	38.0-40.0	31.0

Description. Male:—General colour brownish; eyes greyish, scarcely touched each other; head and thorax dark brownish; mesonotum with a paler area anterior to the scutellum. Fore legs brownish; middle and hind legs paler; femur often with a darker streak on the outer side of its proximal half; in the fore leg femur:tibia:tarsus = 44:59:82, tarsal joints rank 2, 1=3, 4, 5; in the hind leg femur:tibia:tarsus = 48:48:29, tarsal joints rank 5, 2=1, 3, 4. Claws dissimilar in all legs. Wings hyaline, veins light brownish, pterostigmatic portion tinted brownish. Abdomen light brownish, segments 2-7 semitranslucent; each tergite with a paler median stripe and a pair of paler round markings; in the tergites 3-4, this stripe surrounded by darker stripes on its border, therefore the paler markings distinct, but in other segments those being not so conspicuous owing to irregular

shadings; each tergite also with a dark brownish band on its posterior margin; sternites paler; sternites 8–10 sometimes appearing pruinose; sternite 9 dark brownish along its sides; posterior margin of the sternite 10 not incised at the base of forceps–limbs; forceps–limbs pale brownish, segment 2 longer than segments 3 + 4; penis–lobes widely divergent; each lobe not widened at its apex but notched shallowly on its caudal end, with a spine on its antero–mesal corner. Cerci brownish, median caudal filament rudimentary.

Female:—Similar to the male. Eyes dichoptic; the breadth of the head: the distance between the eyes = 39:17; in the fore leg femur: tibia:tarsus = 12.4:12:10.2 tarsal joints rank 2, 5 = 1 = 3, 4; in the hind leg femur:tibia:tarsus = 13:11.8:6.3, tarsal joints rank 5, 1 = 2, 3, 4. Abdomen: paired paler markings on the tergites indistinct; each of the tergites 2–9 with a darker marking on each side of the median stripe near its caudal margin. Sternite 7 with a pair of small dark triangular markings; subgenital plate broadly dark brownish along its posterior margin which is round as in *E. ikanonis*; sternite 9 prolonged, its shape rather similar to that of *E. uenoi*, with a pair of darker markings on its anterior portion and its posterior end shallowly notched.

Nymph:—Undetermined.

Holotype:—Male.

Allotype:—Female.

Paratopotypes:—Males.

Type locality:—Kibune, Kyoto. Specimens: alcoholic; collected by K. Imanishi, on Dec. 1, 1932.

##### 5. *Epeorus ikanonis* Takahashi, 1924

*Epeorus ikanonis* Takahashi: Takahashi, 1924. Dôbutsugaku Zasshi, vol. 35, p. 379.

*Epeorus hanazononis* Matsumura: Matsumura, 1931. 6000 Ill. Ins. Japan. Emp. p. 1477.

*Epeorus ikanonis* Takahashi: Matsumura, 1933. Ill. Common Ins. Japan, vol. 5, p. 94.

Measurement:	Male	Female
Body, length	14.0 mm	11.5–14.5 mm
Fore wing, length	15.0–16.0	15.0–18.0
Cercus, length	39.0–42.0	22.0–36.0

Description. Male:—General colour brownish; eyes greyish, divergent; the breadth of the head: the distance between the eyes = 17:1. Head and thorax, above blackish brown; legs brownish; each femur with a dark brownish speckle on its middle part. In the fore leg femur:tibia:tarsus = 13:14:26, tarsal joints rank 1, 2, 3, 4, 5; in the hind leg femur:tibia:tarsus = 14:12.5:4, tarsal joints rank 5, 1, 2, 3, 4; claws dissimilar in all legs. Wings hyaline, pterostigmatic portion infuscated; veins brownish, those in the anal area pale brownish to whitish. Abdomen: above brownish, side paler with a pale yellowish stripe on its lateral margin; each of the tergites 2-8 with a dark brownish median stripe and a dark brownish band along its hinder margin which does not reach its lateral margin; tergite 10 with a fuscous median stripe. Venter usually paler; sternite 10 not produced backward on its side, and its posterior end being linear or a little convex. Penis-lobes broad, somewhat oviform; forceps-limbs brownish, two caudal segments paler; cerci brownish; median caudal filament rudimentary.

Female:—Similar to the male; eyes small, the breadth of the head: the distance between the eyes = 13:5. In the fore leg femur:tibia:tarsus = 72:79:49, tarsal joints rank 5, 2, 1, 3, 4; in the hind leg femur:tibia:tarsus = 82:78:29.5, tarsal joints rank 5, 1, 2, 3, 4. Veins of the hind wing almost whitish; markings of the abdomen, especially the median brownish stripe not distinct as in the male; some specimen appearing purplish owing to the ova contained within; tergite 10 with a fuscous stripe as in the male; subgenital plate semicircular, covering about half of the sternite 8; sternite 9 produced backward, covering sternite 10 completely and its caudal end deeply notched.

Subimago. Male:—General colour paler and duller than in the imago. Wings greyish, subhyaline; fore wing with 6, hind wing with 3 darker transverse stripes; veins brownish; joint of femur and tibia brownish, each femur with a brownish speckle as in the imago. Abdomen: the median brownish stripe and the posterior brownish band of each of the tergites 2-8 not distinct; median fuscous stripe of the tergite 10 sometimes conspicuous. Each tergite with a brownish shading on its laterocaudal portion. Penis-lobes well representing imago's peculiar form. Length of body 12.0-14.0 mm, length of fore wing 14.0-16.0 mm, length of the cercus 16.0-19.0 mm. Female:—Like the male subimago in general colour and markings, the median brownish stripe more distinct than in the male subimago; sternite 7 and sternite 9 prolonged as in the imago. Length of body 14.0-19.0 mm, length of fore wing



16.0–22.5 mm, length of cercus 16.0–19.0 mm.

Nymph:—General colour brownish. Head small and not so flattened as in other *Epeorus* species, appearing rather like some of *Ecdyonurus* species; anterior portion of head brownish, with 4 paler round markings, the inner two being small and not extending to the frontal margin, the other two being large, extending from the bases of antennæ to the lateral margin of the head. Legs pale yellowish; femur with two brownish bands, tibia with one brownish band as in *Epeorus latifolium*, but in general this species having much duller coloration than in *E. latifolium* or *E. uenoi*; tarsus and claws brownish. Abdomen: each of the tergites 3–9 with a median dark brownish marking which is often inconspicuous in the tergite 6; each of the segments 2–7 with two conspicuous lateral spines. Gill-lamellæ whitish, but sometimes pale brownish along their external margins, without spotted markings on them; first gill-lamella not enlarged; respiratory filament numerous, whitish to greyish. Length of body, male 13–17 mm, female 11.5–20.0 mm; length of cercus, male 13.5–17.5 mm, female 12.0–12.5 mm.

This species is common in the Kyoto district. The emergence of imago takes place in March and April, and it swarms in a sunny valley often with other early spring mayflies like *Ameletus costalis* or *Paraleptophlebia spinosa*. I obtained imagines in 1933 by rearing nymphs and subimagines from the Kamo River, Kyoto.

#### 6. *Epeorus psi* Eaton, 1885

*Epeorus psi* Eaton: Eaton, 1885. Trans. Linn. Soc. London, Zool., 3, p. 242.

N.B. Ulmer reported this Himalayan species from Formosa from Sauter's collection. (Ent. Mitt. I, 1912. p. 369)

#### 7. *Epeorus latifolium* Uéno, 1928

*Epeorus latifolium* Uéno: Uéno, 1928. Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B. 4, p. 34.

*Epeorus latifolium* Uéno: Uéno, 1931. Annot. Zool. Japon., 13, p. 192.

*Epeorus L-nigrum* Matsumura: Matsumura, 1931. 6000 Ill. Ins. Japan-Emp., p. 1477.

*Epeorus latifolium* Uéno: Uéno, 1932. Icon. Ins. Japon., p. 1959.

*Epeorus latifolium* Ueno: Matsumura, 1933. Ill. Common Ins. Japan, vol. 5, p. 96.

Emergence of imago in the Kyoto district occurs from April to November. Specimens captured in early spring and late autumn are different from the typical form as follows: 1) size larger, length of body 13 mm: 2) coloration of head, thorax, cerci much darker, mesothorax with sometimes dark brownish markings similar to those of the next species.

8. *Epeorus napaesus* n. sp.

Measurement:	Male	Female
Body, length	14.0-16.0 mm	15.0 mm
Fore wing, length	15.0-16.0	18.0-19.0
Cercus, length	43.0-49.0	32.0-34.0

Description. Male:—General colour brownish; eyes holoptic, in life greyish green; each ocellus ringed with a greyish band. Mesonotum light ochraceous with a broad brownish median stripe and broadly brownish along its outer margin; scutellum fuscous. Fore legs brownish, other legs pale yellowish; each femur with two fuscous speckles on its outer side, one near the base, the other at the middle part; in the fore leg femur:tibia:tarsus = 16:23:37, tarsal joints rank 1, 2, 3, 4, 5; in the hind leg femur:tibia:tarsus = 15:13.8:7.8, tarsal joints rank 1, 2, 5, 3, 4; claws dissimilar in all legs. Wings hyaline, pterostigmatic portion obscured; veins brownish except those in the anal area which are paler; humeral brace-vein with a distinct fuscous dot between Sc and R; veins of the hind wing pale brownish to whitish. Abdomen pale brownish; each of the tergites 2-9 with a brownish band on its posterior margin; tergite 9 with a pair of brownish streaks on its anterior part; tergite 10 with a median brownish stripe; sternites paler, without any marking; sternite 9 somewhat brownish; posterior margin of the sternite 10 protruded at the base of forceps-limbs as in *Epeorus latifolium* but never terminated as a sharp triangle between the bases of forceps-limbs. Forceps-limbs light brownish; penis-lobes similar to that of *E. latifolium*; cerci brownish, darker at the base, paler distally; median caudal filament rudimentary.

Female:—Similar to the male, but general colour paler than in the male; eyes dichoptic, the breadth of the head: the distance between the eyes = 59:22. In the fore leg femur:tibia:tarsus = 17:15:13.2, tarsal joints rank 1, 2, 5, 3, 4; in the hind leg femur:tibia:tarsus = 18:

13.5:7.5, tarsal joints rank 1, 2, 5, 3, 4. Abdomen above appearing somewhat greenish due to eggs contained within; tergites 8-9 appearing somewhat pruinose; subgenital plate similar to that of *E. latifolium*, brownish, widened at its laterocaudal corners; sternite 9 shallowly notched on its posterior end; rudimentary median caudal filament much conspicuous than in the male.

Subimago:—Similar to the imago but general colour paler and duller; wings subhyaline; fuscous dot on humeral brace-vein and fuscous speckles on femur conspicuous as in the imago. Length of body, male 13.5 mm, female 16.0 mm; length of fore wing, male 15.0 mm, female 19.0 mm; length of cercus, male 24.0 mm.

Nymph:—Very similar to the nymph of *Epeorus latifolium* but distinguishable from it by the larger size in this species (the length of body of *E. latifolium* always under 13.0 mm). General colour brownish, much darker than in *E. latifolium*. Frontal margin of head with four pale yellowish markings as in *E. latifolium*, but they are confluent at the bases of antennæ, so that there appears one continuous marking on each side of the head; legs pale yellowish, each femur with three brownish bands on its outer side, each tibia with one brownish band on its middle part. Abdomen: each of the tergites 3-10 with a pair of dark brownish spots, of which those on tergites 6, 8 and 9 sometimes obscured; venter without markings; each of the segments 2-7 with three lateral spines, of which the inner one smallest, the upper one of the other two longest and sharp, the lower one stout but blunt at its tip; gill-lamellæ with purplish spots as in *E. latifolium*; 1st gill-lamellæ not enlarged. Length of body 14.0-18.5 mm, length of cercus 15.0-21.0 mm, median caudal filament rudimentary.

Holotype:—Male.

Allotype:—Female, types obtained on April 23-27, 1931 by rearing nymphs.

Type locality:—Kibune, Kyoto; specimens: alcoholic.

This is the largest mayfly of the genus and is common in the upper branches of the Kamo River. The emergence of imago in April and May in the Kyoto district, in June in the Japanese Alps. Swarming observed in the afternoon on lanes of forest or over the torrent.

This species seems to be closely allied to *E. latifolium* but it is easily distinguishable from it by the following points: 1) in this species size large, constitution stout, coloration dark, while in *E. latifolium* size small, constitution delicate, coloration light (length of body 14-16 mm in this species, 8-13 mm in *E. latifolium*): 2) in the male

the posterior margin of the sternite 10 between the bases of forceps-limbs not forming a sharp angle as in *E. latifolium*: 3) in the female the posterior margin of the sternite 9 shallowly notched in this species, while in *E. latifolium* it is usually terminated in a straight line: 4) in this species fore wing with a simple fuscous spot along the humeral brace-vein, while in *E. latifolium* it is stained fuscous in the shape of a Z-like marking near the base of radius.

9. *Epeorus curvatulus* Matsumura, 1931

*Epeorus curvatulus* Matsumura: Matsumura, 1931. 6000 Ill. Ins. Japan-Emp., p. 1477.

*Epeorus curvatulus* Matsumura: Matsumura, 1933. Ill. Common Ins. Japan., vol. 5, p. 97.

Measurement:	Male	Female
Body, length	9.5-10.5 mm	9.5-13.0 mm
Fore wing, length	11.0-13.0	11.0-16.0
Cercus, length	25.0-31.0	23.0-28.0

Description. Male:—General colour whitish; eyes holoptic, greyish, intersected in the lower portion by a brownish band; each ocellus ringed with a greyish band; antennæ light brownish. Thorax: above brownish, below paler; legs whitish; each femur with three brownish bands which are conspicuous in the fore leg, fainter in the posterior legs; each femur also with a conspicuous fuscous speckle in the middle; in the fore leg femur:tibia:tarsus = 10:16:20.6, tarsal joints rank 2, 1, 3, 4, 5; in the hind leg femur:tibia:tarsus = 9:8.2:6.3, tarsal joints rank 1, 2, 5, 3, 4; last tarsal joint and claws of each leg infuscated, claws dissimilar in all legs. Wings hyaline, pterostigmatic portion semi-hyaline, veins whitish; fore wing with a conspicuous fuscous line along its humeral brace-vein and the basal support of anal veins; hind wing with a fuscous spot near its base. Abdomen: segments 1-7 translucent; each of the tergites 1-9 with a faint brownish band on its posterior margin; each of the tergites 3-9 with a median brownish stripe on its posterior portion which is indistinct in some specimens. Sternite without markings. Posterior margin of the sternite 10 incised at the base of forceps-limbs; forceps-limbs whitish, penis-lobes widened at its apex; cerci whitish, slightly brownish at the base.

Female:—Similar to the male. General colour testaceous; eyes small, dichoptic, in life light apple green; the breadth of the head: the distance between the eyes = 43:19; ocelli ringed with dark green.

In the fore leg femur:tibia:tarsus = 11.9:12.1:12.4, tarsal joints rank 2, 3, 1, 5, 4; in the hind leg femur:tibia:tarsus = 13.2:11.3:7.0, tarsal joints rank 5, 1, 2, 3, 4; each femur with a conspicuous brownish spot on its middle part. Wings hyaline, veins brownish. Abdomen appearing reddish owing to eggs contained within. Subgenital plate as in *E. latifolium*; sternite 9 shallowly notched on its posterior margin.

Subimago:—Similar to the imago. General colour pale and dull, wings subhyaline, fuscous line along the humeral brace-vein conspicuous.

Nymph:—General colour brownish. Frontal part of the head with a pair of paler C-shaped markings, situated oppositely. Legs pale yellowish; each femur with three light brownish bands; each tibia with one brownish spot; each femur with a fuscous spot on its middle in some specimens, but it is fainter or often indistinct in other specimens, especially those on the middle and hind femur being indistinct. Abdomen: tergites 2-10 with a brownish median line; tergites 3-8 with a pair of brownish spots, which are sometimes obscure in the tergite 6; tergites 3, 4, 7 and 8 usually darker; each of the segments 2-7 with two lateral spines as in *E. ikanonis*. Gill-lamellæ whitish, first gill-lamellæ not enlarged; respiratory filaments numerous, whitish to greyish. Length of body 10.0-14.0 mm, length of cercus 13.0-17.0 mm.

Emergence of imago in the Kyoto district from May to November. I first obtained imagines by rearing nymphs from Kibune on May 31, 1930.

This species is one of the commonest mayflies in summer, mostly associated with *E. latifolium*. There is a considerable difference of length between individuals from different localities. The individuals from Hira are always larger and stouter than those from Kibune, average length of body in the former being 14 mm, largest individual 16 mm, while that of the latter, 12 mm, largest being 14 mm. The description shown above was based on the specimens from Kibune. Prof. Matsumura's type specimen is a larger one, so that the small and delicate forms from Kibune may be a local variety, or subspecies. But as far as I have examined, I cannot find any specific difference between those two forms, so I would like to treat them in this paper as belonging to one and the same species.

## PLATE 18

- Fig. 1. End of abdomen of *Epeorus aesculus* n. sp., male, ventral view.
- Fig. 2. End of abdomen of *Epeorus uenoi* (Matsumura), male, ventral view.
- Fig. 3. End of abdomen of *Epeorus curvatulus* Matsumura, male, ventral view.
- Fig. 4. End of abdomen of *Epeorus napaesus* n. sp., male, ventral view.
- Fig. 5. End of abdomen of *Epeorus ikanonis* Takahashi, male, ventral view, drawn from holotype by courtesy of Mr. Y. Takahashi.
- Fig. 6. End of abdomen of *Epeorus hiemalis* n. sp., male, ventral view.

