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MAYFLIES FROM JAPANESE TORRENTS  
VI. NOTES ON THE GENERA *ECDYONURUS* AND  
*RHITHROGENA*<sup>1</sup>

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ONE PLATE

(Received August 25, 1936)

This paper deals with the remaining genera of the family Ecdyonuridae, viz. *Ecdyonurus* and *Rhithrogena*. It is aimed also to report on the nymphal characters which distinguish the nymphs of *Ecdyonurus* from those of *Heptagenia* and this will be conveniently begun with the description of the nymph of *Heptagenia kihada* Matsumura, which is the only species with well-determined nymph of those belonging to the genus *Heptagenia* hitherto reported from our Empire.

Full descriptions are given of two new species of the genus *Ecdyonurus* and five new species of the genus *Rhithrogena*, and also of *Rhithrogena japonica* Uéno, the male imago of which is reported here for the first time.

All these new species being included, I am now able to enumerate 35 species of Japanese mayflies belonging to the family Ecdyonuridae. A compiled list of these species with some revisional notes will appear in near future as another paper.

I wish to finish my notes on the family Ecdyonuridae by expressing my sincere thanks to Prof. T. Kawamura and Dr. M. Uéno of the Otsu Hydrobiological Station, Kyoto Imperial University, to Prof. Dr. C. Harukawa and Mr. M. Tokunaga of the Entomological Laboratory, Kyoto Imperial University for their constant encouragement and useful suggestions, and also to Mr. Y. Takahashi for his kindness in lending me some important type specimens.

Description of the nymph of *Heptagenia kihada*

General colour brownish; head flattened; labrum 2.5 times as wide

<sup>1</sup> Contribution from the Otsu Hydrobiological Station, Kyoto Imperial University.  
Contributions from the Entomological Laboratory, Kyoto Imperial University, No. 58.

as its length; inner canine of right mandible about  $3/4$  as long as the outer one; inner canine of left mandible about as long as the outer one; left mandible with a single hair on its lacinial region; joints of maxillary palpus subequal; glossae of labium rather convergent at their tips. Thorax brownish with irregular paler markings; lateral margin of the pronotum dilated and fused with the antero-lateral margin of the mesonotum, which is also dilated. Legs yellowish; each femur with two obscure brownish bands on its outer surface; tibia slightly shorter than the femur; tarsus about one-third of the tibia; tarsal claw with a spine and pectinations. Abdomen above brownish with paler markings; each of the tergites 2-10 with two pairs of small spots which may coalesce into one pair; each of the tergites 4-9 with one obscure spot on its postero-mesal portion; each of the tergites 1-8 with a paler portion along its lateral margin and also with an obscure paler spot at the inner side of this paler portion; each of the tergites 1-9 with a spine on its postero-lateral corner; each sternite with two pairs of paler spots, but these are often obscure on the anterior and posterior segments. Gills present on segments 1-7; each gill-lamella tapered and distinctly pointed on its apex; each of the gill-lamellae 1-6 with respiratory filaments on its ventral side; 7th gill-lamella similar in form to the preceding ones but smaller and slender, without respiratory filaments; tracheae fuscous, distinct in all gills. Median caudal filament present; cerci and median caudal filament pale yellowish. Length of body 9.0-12.0 mm; length of cercus 10.0-15.0 mm.

Distinction of *Ecdyonurus* from *Heptagenia* in  
their nymphal characters

Adult mayflies of the genus *Heptagenia* are easily distinguishable from those of the genus *Ecdyonurus* by the following criterion: in the genus *Heptagenia* 1st segment of the hind tarsus is shorter than its 2nd segment, although in *Ecdyonurus* 1st segment of the hind tarsus is longer than or subequal to its 2nd segment. But in the classification of the nymphs, the discrimination of the genus *Ecdyonurus* from its allied genus *Heptagenia* has long been questionable and in this respect even Schoenemund's opinion<sup>2</sup> does not seem to hold good in our species. After examining the mouth parts of one species of the genus *Heptagenia*, viz., *Heptagenia kihada* and three species of the genus *Ecdyonurus*, viz., *E. yoshidae* Takahashi, *E. tobiironis* Takahashi

<sup>2</sup> Schoenemund, E. 1930 Die Unterscheidung der Eph.-Gatt. *Heptagenia* und *Ecdyonurus*. Zool. Anz., Bd. 90, S. 45-48.

and *E. kibunensis* n. sp. which will be described in the following pages, it convinced me that these nymphal characters, as far as these Japanese species are concerned, can be adopted as follows for classifying these two allied genera:

1. in *Ecdyonurus*, each mandible with a chitinized area continuous on its dorsal side to the molar surface; in *Heptagenia*, each mandible without such a chitinized area,
2. in *Ecdyonurus*, glossae of labium widely separated from each other and paraglossae blunt at their tips; in *Heptagenia*, glossae of labium closely situated and paraglossae pointed at their tips.

Genus: *Ecdyonurus* Eaton, 1868

1. *Ecdyonurus kibunensis* n. sp.

This species is similar to *E. flavus* Takahashi, but differs from it in type of genitalia.

Measurement:	Male	Female
Body, length	6.5 mm	7.0 mm
Fore wing, length	7.5	9.0
Cercus, length	14.5	11.0

Description. Male:—General colour yellowish. Eyes holoptic, in living specimens greenish; each ocellus ringed with a dull greenish band. Thorax lemon yellow; pronotum without reddish brown marks as in *E. flavus*. In the fore leg femur brownish, fuscous at its tip; joining of tibia and tarsus, and the first tarsal segment infuscated; femur: tibia: tarsus = 6.6:7.9: 11.5, tarsal joints rank 2, 3, 4, 5 = 1; hinder legs yellowish; in the hind leg, femur: tibia: tarsus = 6.5:5.0: 3.0, tarsal joints rank 5, 1, 2, 3, 4; last tarsal segment and claws infuscated in all legs; claws dissimilar in all legs. Wings hyaline, pterostigmatic portion obscured, veins whitish. Abdomen yellowish, segments 1-6 translucent; tergites 1-5 shaded with reddish brown; each of the tergites 1-9 with a narrow brownish band on its posterior margin; tergites 7-10 appearing somewhat pruinose; posterior margin of sternite 10 incised at the base of forceps, produced backward into two subtriangular lobes between the forceps with an emargination at median area. Penis-lobes united at their bases, apically separated by a  $\Lambda$ -shaped incision, spinulated on its ventral side; titillators distinct; forceps, cerci whitish.

Female:—Similar to the male. General colour light ochraceous.

Eyes dichoptic, greenish; the distance between the eyes: the breadth of the head = 0.37; each ocellus ringed with a brownish band. In the fore leg, femur brownish and its distal end dark brownish; other parts pale yellowish; femur: tibia: tarsus = 7.4:5.8:6.1, tarsal joints rank 2, 3, 4  $\approx$  5  $\approx$  1. Hinder legs pale yellowish; in the hind leg, femur: tibia: tarsus = 7.4:5.5:2.5, tarsal joints rank 5, 1, 2, 3, 4; claws dissimilar in all legs. Wings hyaline, veins pale greenish to brownish. Abdomen appearing reddish due to eggs contained within; segments 8-10 appearing pruinose; sternite 9 not notched on its posterior margin; cerci whitish.

Subimago:—Similar to the imago, but general colour much brownish; wings subhyaline; length of fore wing, male 7.0 mm, female 7.0-8.0 mm; other measurements are not mentioned here as all specimens examined are shrunk in some degree.

Nymph:—General colour brownish with lighter markings; head with two obscure spots on the middle portion of its frontal margin; pronotum brownish, paler along its lateral margin, with a rather big mark near its antero-lateral corner and 3 or 4 small spots on either side of the mid-dorsal line; mesonotum with a somewhat large mark at the end of the mid-dorsal line and also 4 or 5 spots on either side of it. Legs yellowish; each femur with a brownish spot on each end and two irregular brownish bands on its middle portion. Abdomen brownish; each of the tergites 4-5 with a U-shaped mark, tergites 3 and 6 with a pair of small marks, and tergites 7-9 broadly pale on its middle portion; each tergite with also a round mark on its side, a mark also near the point of attachment of the gill-lamella. Gill-lamellae ovoid except 1st and 7th which are lanceolate; 7th lamella tapering at the tip and curved inward, with no respiratory filament; cerci paler. Length of body 5.0-6.0 mm, length of cercus 4.0-6.5 mm in the full grown nymphs.

Holotype:—Male

Allotype:—Female

Type locality:—Nishigamo, Kyoto. Specimens: alcoholic; nymphs collected for the first time in Kibune on May 31, 1930; imagines obtained on May 22-24, 1935 by rearing nymphs from the type locality.

## 2. *Ecdyonurus tigris* n. sp.

This species is similar to *E. kibunensis*, but is easily distinguishable from it by the parallel brownish stripes on the side of body.

Measurement :	Male	Female
Body, length	7.0- 7.5 mm	6.0- 7.0 mm
Fore wing, length	7.0- 8.0	8.0
Cercus, length	15.0-16.0	12.0-13.0

**Description.** Male:—General colour pale yellowish with brownish markings. Eyes holoptic, greenish, intersected by a darker band; each ocellus ringed with a dull greenish band. Thorax above brownish; mesonotum broadly dark brownish along the median line; pleuron with some six parallel oblique brownish stripes, the first one of which extends from the base of the fore wing to the fore coxa always conspicuous. Legs yellowish; each femur brownish on its apical end, with 4 brownish speckles on the middle portion of its outer side, but with only one faint brownish spot at the middle portion of its inner side; in the fore leg, femur: tibia: tarsus = 7.5:9.4:12.2, tarsal joints rank 2, 3, 4, 5, 1, each tarsal joining infuscated; in the hind leg, femur: tibia: tarsus = 8.0:6.2:2.4, tarsal joints rank 5, 1, 2, 3, 4; claws dissimilar in all legs. Wings hyaline, costal and subcostal areas somewhat obscured; veins whitish; humeral brace-vein with a fuscous spot; vein Sc also with a fuscous dot on its middle portion. Each of the abdominal tergites 1-9 with a brownish band on its posterior margin; each of the tergites 1-7 with a pair of brownish markings situated on its middle portion, those on the tergite 6 being U-shaped; each of the tergites 8 and 9 also with a pair of brownish markings near its lateral margins; each of the tergites 2-7 with two pairs of brownish markings, one near the antero-lateral corners, the other near the postero-lateral corners; as the former combines with the latter of the preceding segment and the latter extends further to the sternite, these sets of markings form six parallel stripes on the side of body. Sternite 10 shallowly emarginate on its posterior margin; penis-lobes rather similar to those of *E. flavus*; titillators distinct; cerci whitish, joinings blackish or brownish; median caudal filament rudimentary.

Female:—Similar to the male. Eyes dichoptic, greenish, intersected by a brownish band; the distance between the eyes: the breadth of the head: = 0.34. Thorax and abdomen with parallel brownish stripes on their sides as in the male; also femur with brownish stripes on their sides as in the male; also femur with brownish speckles and humeral brace-vein with a fuscous spot as in the male. In the fore leg, femur: tibia: tarsus = 7.3:7.0:5.0, tarsal joints rank 2, 3, 5, 4 = 1,; in the hind leg, femur: tibia: tarsus = 9.0:8.0:2.5, tarsal joints rank 5, 1, 2, 3, 4; claws dissimilar in all legs. Wings hyaline; veins, C, Sc and

R greenish, other veins greenish to brownish; crossveins bordered with faint brown. Sternite 9 not notched on its posterior margin.

Subimago:—Similar to the imago. Wings greyish, subhyaline; the fuscous spot on humeral brace-vein and brownish speckles on femur distinct; parallel stripes on the side of body not so conspicuous as in the imago in some specimens. Length of body, female 7.0 mm; length of fore wing, female 7.5-8.5 mm; length of cercus, female 9.5-11.0 mm.

Nymph:—General colour pale yellowish or pale greenish; head without markings; thorax dark yellowish shaded with small brownish speckles; lateral margin of the pronotum heavily dilated but not produced behind to unite with antero-lateral margin of the mesonotum; each femur with brownish speckles as in the imago and subimago; each of the abdominal tergites with a brownish band on its posterior margin; each of the tergites 1, 2, 3 and 6 with a pair of brownish markings; those of the tergite 6 coalescent with the brownish band on the posterior margin forming a U-shaped marking as in the imago; each of the tergites 8 and 9 also with markings as in the imago; each of the gill-lamellae 2-5 ovoid in shape, its apex pointed; each of the gill-lamellae 1, 6 and 7 oblong and tapering to the apex; tracheae brownish; respiratory filaments whitish; 7th lamella without respiratory filaments; lateral spines present on segments 4-8. Length of body 8.0-10.5 mm, length of cercus 16.0-18.5 mm in the full grown nymphs.

Holotype:—Male

Allotype:—Female

Paratopotypes:—Males and females

Type locality:—Ichihara, Kyoto. Specimens: alcoholic; nymphs collected for the first time in the type locality on May 15, 1935; imagines obtained on July 22-26, 1936 by rearing nymphs from the same locality.

Genus: *Rhithrogena* Eaton, 1881

1. *Rhithrogena japonica* Uéno, 1928

*Rhithrogena japonica* Uéno: 1928. Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B. 4, p. 26.

Measurement:	Male	Female
Body, length	9.0-9.5 mm	8.5-10.5 mm
Fore wing, length	10.0-11.0	10.5-12.5
Cercus, length	27.0-30.0	15.0-19.0

Description. Male:—General colour brownish; eyes dark greyish, not touched to each other; the distance between the eyes: the breadth of the head = 0.04-0.07; each ocellus ringed with a fuscous band.

Thorax light brownish, hinder margins of meso- and metanotum, dark brownish. Fore legs brownish, hinder legs pale yellowish; each femur with a conspicuous black speckle on the middle portion and a black streak on the basal portion of its outer side; in the fore leg, femur: tibia: tarsus = 8.4:16.5:21.8, tarsal joints rank 2, 3, 4, 5, 1, 1st tarsal joint: 2nd tarsal joint = 1:7.4; in the hind leg, femur: tibia: tarsus = 9.0:7.6:3.0, tarsal joints rank 5, 1, 2, 3, 4; claws dissimilar in all legs. Wings hyaline, pterostigmatic portion obscured, veins light brownish. Abdomen brownish; each of the tergites 2-9 with a darker median stripe, but tergite 10 with two darker stripes; each of the tergites 1-7 with a pair of small paler spots; tergites 9 and 10 appearing pruinose on their sides; sternites paler without any marking; sternite 10 emarginate between the forceps. Penis-lobes widely separated; each lobe with a spine on its dorsal side; forceps brownish, cerci brownish.

Female:—Similar to the male but general colour paler than it. Eyes black, dichoptic; the distance between the eyes: the breadth of the head = 0.34—0.37; each ocellus ringed with a fuscous band. Legs pale yellowish; each femur with two fuscous speckles as in the male; in the fore leg, femur: tibia: tarsus = 8.0:10.0:5.8, tarsal joints rank 2, 3, 5, 4 = 1; in the hind leg, femur: tibia: tarsus = 9.6:8.2:4.0, tarsal joints rank 5, 1 = 2, 3, 4; claws dissimilar in all legs. Wings hyaline, veins pale brownish. Sternite 7 with a large brownish fleck, subgenital plate semicircular, brownish on its posterior margin; sternite 9 notched on its posterior margin; cerci brownish, paler distally.

Subimago. Male:—Similar to the imago; general colour pale yellowish; each femur with two fuscous speckles as in the imago; mesopleuron with a fuscous spot at the base of the fore wing and metapleuron also with one but much smaller fuscous spot at the base of the hind wing; wings subhyaline; penis-lobes characteristic for this species. Length of body 8.5-9.0 mm, length of the fore wing 8.5-9.0 mm, length of cercus 10.0-13.0 mm. Female:—Like the male subimago in general; fuscous speckles on each femur and on meso- and metapleuron also distinct as in the male subimago; sternite 7 without any brownish fleck, and not prolonged as in the imago. Length of body 8.5 mm, length of fore wing 10.5-11.0 mm, length of cercus 11.0-12.0 mm.

Nymph:—For detailed description, see Uéno 1928.

## 2. *Rhithrogena magawana* n. sp.

This species is similar in form to *R. japonica* Uéno but is larger in size and eyes of the male are holoptic.

Measurement :	Male	Female
Body, length :	10.5 mm	9.0-11.0 mm
Fore wing, length	12.0	11.0-14.0
Cercus, length	25.0 +	18.5-20.0

Description. Male:—General colour brownish; eyes holoptic. Thorax brownish; hind margins of meso- and metathorax dark brownish; venter paler without any markings. Fore legs brownish, hinder legs pale yellowish; each femur with 2 fuscous markings as in *R. japonica*; in the fore leg, femur: tibia: tarsus = 10.4:17.5:22.7, tarsal joints rank 2, 3, 4, 5, 1, 1st tarsal joint: 2nd tarsal joint = 1.3:8.3; in the hind leg, femur: tibia: tarsus = 9.0:9.5:4.0, tarsal joints rank 5, 1  $\Rightarrow$  2  $\Rightarrow$  3, 4; claws dissimilar in all legs. Abdomen above brownish, each of the tergites 2-10 with a pair of paler round markings which is obscure in the tergites, 1, 9 and 10. Each of the penis-lobe with a small lateral spine and two dorsal spines of which the inner one is stronger; forceps and cerci brownish.

Female:—General colour luteous; eyes black, each ocellus ringed with a fuscous band; the distance between the eyes: the breadth of the head = 0.33. In the fore leg, femur: tibia: tarsus = 8.5:11.1:7.5, tarsal joints rank 2, 3, 5, 4  $\Rightarrow$  1; in the hind leg, femur: tibia: tarsus = 12:11:4. tarsal joints rank 5, 1  $\Rightarrow$  2, 3, 4; claws dissimilar in all legs. Wings hyaline, veins pale brownish. Each of the abdominal tergites reddish brown, but faded towards the anterior and lateral margins; subgenital plate semicircular, sternite 9 notched on its posterior margin; cerci brownish, paler distally.

Nymph:—Unknown

Holotype:—Male

Allotype:—Female

Type locality:—Magawa, Northern Japanese Alps, altitude ca. 1600 mtrs. Specimens: alcoholic; types collected by K. Imanishi, on June 10, 1934.

### 3. *Rhithrogena tateyamana* n. sp.

This species is similar to *R. magawana*, but is distinguishable from it by the following points: 1, penis-lobe with only one dorsal spine; 2, each femur with only one fuscous speckle.

Measurement :	Male
Body, length	7.5- 9.0 mm
Fore wing, length	8.5-10.0
Cercus, length	20.0-22.0



Description. Male:—General colour brownish; eyes holoptic, or nearly touched to each other, blackish; each ocellus ringed with a fuscous band. Thorax above brownish; legs pale brownish, each femur with only one fuscous spot; in the fore leg, femur: tibia: tarsus = 6.5:13.0:16.0, tarsal joints rank 2, 3, 4, 5, 1, 1st tarsal joint: 2nd tarsal joint = 1:8.6; in the hind leg, femur: tibia: tarsus = 8:7:3, tarsal joints rank 5, 2  $\approx$  1  $\approx$  3, 4; claws dissimilar in all legs. Wings hyaline, pterostigmatic portion obscured, veins pale brownish. Abdomen pale brownish; paired small round marks of the tergites not so conspicuous as in *R. japonica*. Penis-lobes separated; each of them somewhat widened at the apex in its ventral aspect, with only one dorsal spine; forceps brownish; cerci brownish, paler distally.

Female:—Unknown

Nymph:—Unknown

Holotype:—Male

Paratopotypes:—Males

Type locality:—Tateyamagawa, Northern Japanese Alps, altitude ca. 1000 mtrs. Specimens: alcoholic; types collected by K. Imanishi, on Oct. 5, 1933.

#### 4. *Rhithrogena minazuki* n. sp.

This species is similar to *R. tateyamana* but the penis-lobes are widely divergent in this species, while those of *R. tateyamana* are nearly parallel on their inner margins.

Measurement:	Male
Body, length	8.5 mm
Fore wing, length	8.0
Cercus, length	21.0

Description. Male: General colour ochraceous, not brownish; eyes large, holoptic; each ocellus ringed with a brownish band. Hinder margins of meso- and metanotum appearing pruinose, not brownish nor dark brownish; each femur with a single fuscous speckle on its middle part, but in some specimen each femur also with a faint fuscous streak; in the fore leg, femur: tibia: tarsus = 7.0:13.0:20.4, tarsal joints rank 2, 3, 4, 5, 1, 1st tarsal joint: 2nd tarsal joint = 1:6.9; in the hind leg, femur: tibia: tarsus = 7.6:7.7:2.5, tarsal joints rank 5, 1  $\approx$  2  $\approx$  3, 4; claws dissimilar in all legs. Wings hyaline, pterostigmatic portion obscured, veins whitish. Abdominal segments 1-6 translucent; each of

the tergites 1-8 infuscated on its posterior margin; there are no paired marks as in *R. japonica*. Penis-lobes widely separated, divergent distally; each lobe with one lateral spine and one dorsal spine; forceps and cerci whitish.

Female:—Unknown

Nymph:—Unknown

Holotype:—Male

Paratopotypes:—Males

Type locality:—Kibune, Kyoto. Specimens alcoholic; types collected by K. Imanishi, on June 30, 1932.

5. *Rhithrogena satsuki* n. sp.

A small-sized species with peculiarly shaped penis-lobes which serve to distinguish it from the above-mentioned species.

Measurement:	Male
Body, length	6.0 mm
Fore wing, length	7.0
Cercus, length	13.0

Description. Male:—General colour whitish; eyes large, holoptic. Thorax: notum ochraceous, pleura and sternum paler; legs pale brownish, without markings on each femur; in the fore leg, femur: tibia: tarsus = 6.0:8.0:12.5, tarsal joints rank 2, 3, 4, 5, 1, 1st tarsal joint: 2nd tarsal joint = 1:4.2; in the hind leg, femur: tibia: tarsus = 6.0:4.0:2.8, tarsal joints rank 5 = 1, 2, 3, 4; claws dissimilar in all legs. Wings hyaline, stigmatic area obscured, veins whitish. Abdominal segments 2-6 translucent, each tergite with a brownish band on its posterior margin; sternite 10 with a triangular projection at the inner side of each forceps base; penis-lobes widely divergent apically, each of them with a small round tubercle near the end of its inner margin; forceps slightly brownish, cerci whitish.

Female:—Unknown

Nymph:—Unknown

Holotype:—Male

Type locality:—Kibune, Kyoto. Specimen: alcoholic; collected by K. Imanishi, on May 31, 1930.

### EXPLANATION OF PLATE 39

- Fig. 1. Nymphal labium, palpi being omitted, of *Heptagenia kihada* Matsumura.  
Fig. 2. Nymphal labium, palpi being omitted, of *Ecdyonurus yoshidae* Takahashi.  
Fig. 3. Nymphal labium, palpi being omitted, of *E. tobiironis* Takahashi.  
Fig. 4. Nymphal labium, palpi being omitted, of *E. kibunensis* n. sp.  
Fig. 5. End of the abdomen of *Ecdyonurus kibunensis* n. sp., male, ventral view.  
Fig. 6. End of the abdomen of *E. tigris* n. sp., male, ventral view.  
Fig. 7. End of the abdomen of *E. flavus* Takahashi, male, ventral view, drawn from holotype by courtesy of Mr. Y. Takahashi.  
Fig. 8. End of the abdomen of *Rhithrogena minazuki* n. sp., male, ventral view.  
Fig. 9. End of the abdomen of *R. tateyamana* n. sp., male, ventral view.  
Fig. 10. End of the abdomen of *R. magawana* n. sp., male, ventral view.  
Fig. 11. End of the abdomen of *R. japonica* Uéno, male, ventral view.  
Fig. 12. End of the abdomen of *R. japonica* Uéno, male, lateral view.

