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Basin. 1. Imagines (Ephemeroptera: Ephemerellidae)

by O. Ya Baikova

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K poznaniyu podenok basseina Amura

1. Imagines (Ephemeroptera: Ephemerellidae).

Contribution to the knowledge of the may-flies of the Amur  
basin. 1. Imagines (Ephemeroptera: Ephemerellidae).

By: O. Ya. Baikova

During their flight period may-flies are the most  
readily available food for fishes and therefore a knowledge  
of their biology is of both practical as well as theoretical  
interest.

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In spite of the various studies on the systematics  
and geographical distribution of may-flies (Chernova, 1952;

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\* The figures in the right-hand margin indicate the corres-  
ponding pages in the original text.

Baikova, 1962, 1965, 1965a, 1967a; Kazlauskas, 1963\*), many questions connected with the study of their imaginal phases have been very poorly elucidated in the literature up to the present time. With regard to the eastern Asiatic species, the winged insects of this group have scarcely been studied at all. In her study on the may-flies of the Amur basin O. A. Chernova mentions 14 species of the genus Ephemerella and provides a description of the imago for only two of these species.

The present study presents the results of observations on the life of the winged insects in the rivers Khor and Bira, which in the majority of cases had been reared from larvae during the period from 1950 to 1960. <sup>For the first time</sup> ~~First~~ there is provided a description of the imaginal forms of the may-flies which were known previously only from the larvae (Chernova, 1952); figures are provided of the genitalia of rare and unknown species; data are presented on the size relationships of the tarsal segments, tibiae and femora of individuals of the studied genus and on quantitative indices characterizing the size and weight of the winged insects. For practical aims the size and weight of the species are brought together into a common table, which to a considerable extent facilitates the determination of their recovered weights from the stomachs of fishes. Moreover, the description of Ephemerella taeniata Tshern. is given in comparison with the similar species E. aurivillii Bengtsson (imago and larvae), collected in the

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\* May-flies are also mentioned in other studies that are not devoted to the study of this group (Baikova, 1954, 1967; Volovik, 1964; Krykhtin, 1962; Kokhmenko, 1962, 1964; Levanidov, 1964; Yukhimenko, 1963).

Vilyuy (middle reaches) and Yenisey rivers. The larvae of E. sibirica and the adult insects reared from these were compared by us with E. ignita Poda, which were kindly made available to the present author by Doctor M. Keffermuller (Polish People's Republic) and privatdozent R. S. Kazlauskas (Lithuanian SSR). In addition, we also examined several specimens of E. aurivillii and E. ignita from the collection of the Zoological Institute of the USSR Academy of Sciences.

The imagos were reared from the larvae in laboratory conditions and also in cages (for rheophilic species) that were set up in small streams. The fecundity was determined by means of a direct count of the eggs in the last instar larvae before the emergence of the winged forms. Below is presented a description of the winged forms of the may-flies and of some aspects of their biology.

1. Ephemerella rufa Iman., 1937, (Figures 1a, b - 4).

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This species was described for Japan by Imanishi (1937). The drawing of the penis was not given in sufficient detail: there were not depicted the spines on the lobes of the penis, which are present in E. rufa. We are therefore adding to the description of the imaginal stage of this species.

MALE IMAGO (in alcohol). Wings with fine cross veins; tibia of foreleg almost twice as long as femur, tibia 1.6 times as long as tarsus; first segment of tarsus longer than the second, first tarsal segment 1.5 times as long as third and fourth tarsal segments taken together, the fourth tarsal segment is the smallest - the third segment is 1.7 times as long

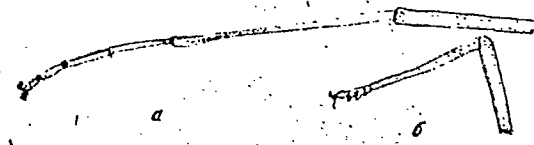


Рис. 1. Ноги самца имаго  
(р. Хор, нижнее течение Ус-  
сури): а — передняя нога,  
б — задняя нога

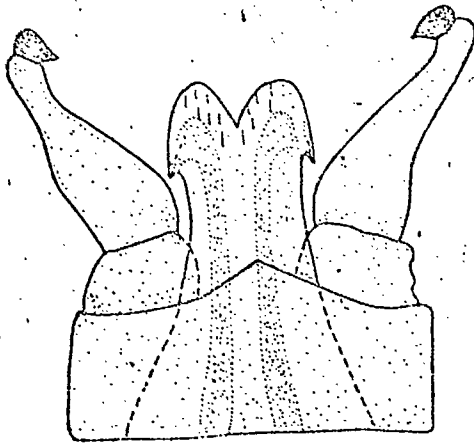


Рис. 2. Половые придатки  
имаго.

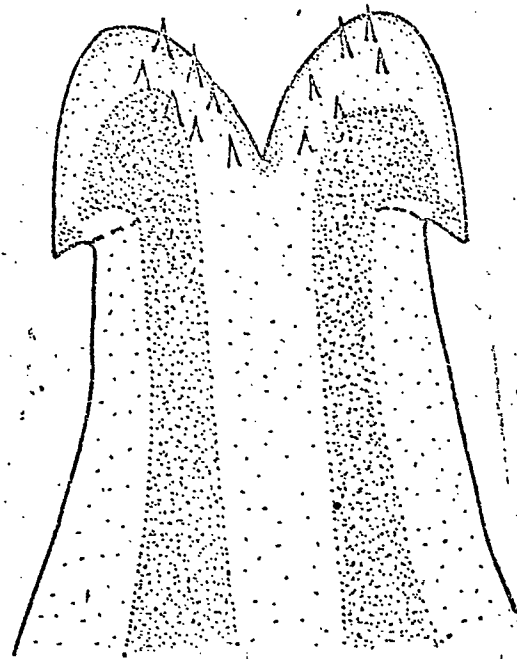


Рис. 3. Penis самца имаго

Figure 1. Legs of male imago (river Khor, lower reaches of the Ussuri):  
a - fore-leg, b - hind-leg.

Figure 2. Genitalia of imago.

Figure 3. Penis of male imago.

as the fourth segment. Tibia of hind-leg 1.2 times as long as the femur and 2 times as long as the tarsus (Figures 1a, b). Forceps with a very small third segment, which is apically pointed; the second segment of the forceps is considerably narrowed in its apical portion. Penis almost straight, it is split at the tip (to approximately one sixth of its length); each lobe has a rounded apex and is furnished (on the outer side) with one wide spine that is directed downwards (Figures

24, 25\*); on the surface of each lobe on the inner side there are present small spinules.

The general coloration of the body is brownish, with a reddish tinge; the head and thorax are reddish-brown; the upper part of the eyes is orange-coloured, the lower part is dark with a greyish tinge; the antennae are light-coloured; wings transparent with pale-brownish longitudinal veins; the cross veins are fine, colourless; in the costal and subcostal areas (tip of the wing) there is a matt coloration; the anterior pair of legs is light-brown, the second and third pairs are pale-yellow with dark claws.

Coloration of abdomen from a light-brown to to a brownish reddish-brown; posterior edges of abdominal segments light-coloured. Forceps yellowish, darker at the base; the caudal filaments are light-coloured, with bright red annulations.

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Female unknown.

MALE SUBIMAGO (in alcohol). Wings smoky, fringed; costal and subcostal veins yellowish-grey; cross veins greyish; anterior pair of legs pale-yellow, second and third pairs - light-coloured; thorax and abdomen light-brown to reddish-brown above, completely light-coloured below. Genitalia light-coloured (Figure 4).

Length of body of male imagos 6.5 - 7.5 mm, length of wing 7.0 - 7.8 mm, length of caudal filaments - 7 mm.

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\* Translator's note. Sic. Should surely be: (Figures 2, 3).

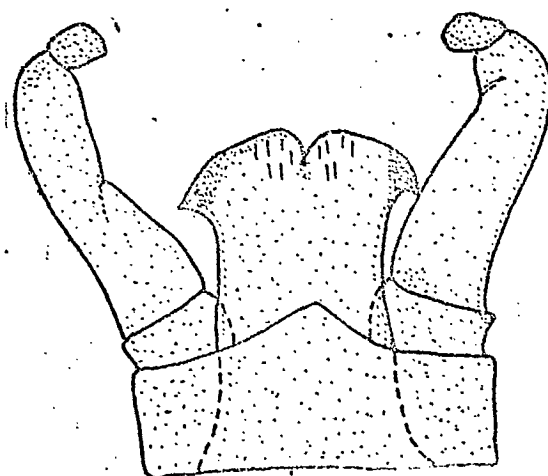


Рис. 4. Половые придатки самца субимаго (р. Бира, среднее течение Амура)

Figure 4. Genitalia of male subimago (river Bira, middle reaches of the Amur).

MATERIAL. Lower reaches of the Ussuri: river Khor, Bol'shaya branch, 21, VI and 17, VII - 1951, 1 male imago and 2 males subimagos; same locality, 19, VI - 1960, 1 male imago; middle reaches of the Amur: river Bira in the region of the Teplovskii fish hatchery, 10, VIII - 1954, reared from larva 1 male subimago. Author's collection.

2. Ephemerella thymalli Tshern., 1952 (Figures 5a, b - 6).

The species was described by O. A. Chernova (1952) from the larva. The description of the imaginal stage is presented for the first time.

MALE IMAGO (in alcohol). Wings with fine cross veins; tibia of fore-leg almost twice (1.8) as long as femur, tarsus longer than tibia; first segment of tarsus a little shorter than the second, the third and fourth segments taken together

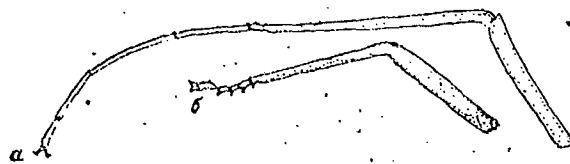


Рис. 5. Ноги самца имаго (р. Бира, среднее течение Амура), а — передняя нога,  
б — задняя нога

Figure 5. Legs of male imago (river Bira, middle reaches of the Amur):

a - fore-leg,            b - hind-leg.

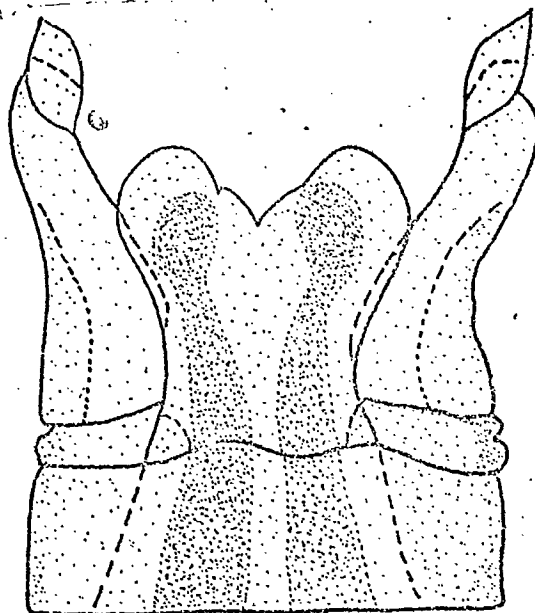


Рис. 6. Половые придатки самца имаго

Figure 6. Genitalia of male imago.

are 1.1 times as long as the first segment; the fourth tarsal segment is the smallest, it is two thirds the length of the third segment; the tibia of the hind-leg is barely longer than the femur and is 2.7 times as long as the tarsus (Figures 5a, b). Forceps with very small first and third segments; the second segment becomes gradually narrower towards its apex, its third segment is slightly elongated with a pointed

tip. The penis is very wide, becoming somewhat narrower before the expanded apex and with a fairly deep notch above (Figure 6).

The general coloration of the body is brownish, the head and thorax are dark-brown; the upper part of the eyes is orange-coloured, the lower part is black, with a greyish tinge; antennae yellowish with two brown segments at the base; wings transparent; costal vein brown, radial vein dark; cross veins pale-yellow; anterior pair of legs light-brown, second and third pairs - yellowish. Abdomen from reddish-brown to brown with light patches at the intersegmental joints; last tergites of abdomen dark-brown; 9th and 10th sternites of abdomen brown; caudal filaments light-coloured with dark annulations at the joints.

Female unknown.

Length of body of male imago 9 mm, length of wing - 8.5 mm, length of caudal filaments - 9.5 mm.

MATERIAL. Middle reaches of the river Amur: river Bira, Staraya branch, 21, VII - 1960, 2 males imagos. Adult insects reared from larvae by the author.

3. Ephemerella ignita Poda, (1861) (Figures 7a, b - 16).

Synonym: E. sibirica Tshernova (1952).

The species E. sibirica was described from a larva, from the Amur basin, by O. A. Chernova (1952). Below there is presented a description of a male imago that was reared from a larva of E. sibirica (river Bira, middle reaches of the Amur).

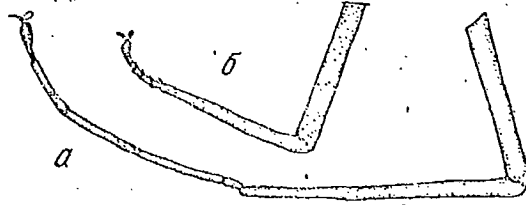


Рис. 7. Ноги самца имаго (р. Бира, среднее течение Амура). а — передняя нога.  
б — задняя нога

Figure 7. Legs of male imago (river Bira, middle reaches of the Amur):

a - fore-leg,

b - hind-leg.

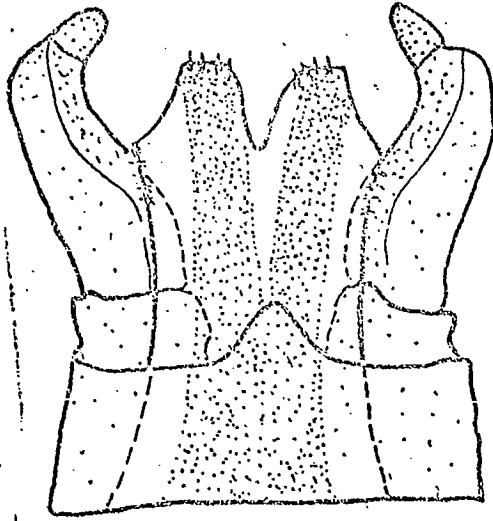


Рис. 8. Половые придатки самца имаго

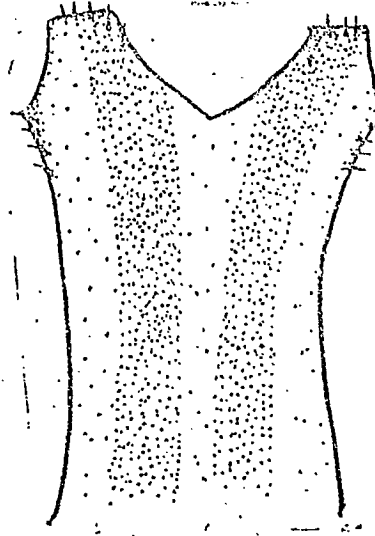


Рис. 9. Penis самца имаго

Figure 8. Genitalia of male imago.

Figure 9. Penis of male imago.

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MALE IMAGO (in alcohol). Wings with fine cross veins; tibia of fore-leg 1.9 times longer than femur, tarsus a little shorter than tibia; first segment of tarsus longer than the second, the third and fourth segments taken together are just a little bit shorter than the first or equal in length to this;

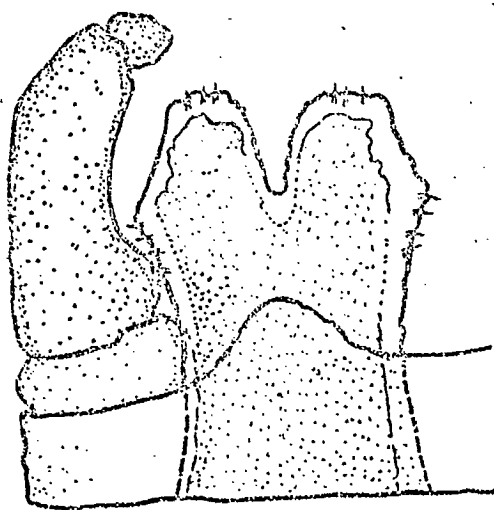


Рис. 10. Половые придатки самца субимаго

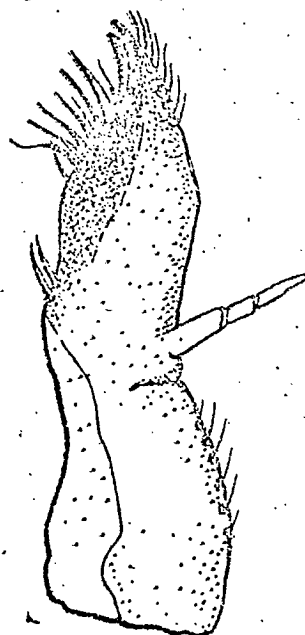


Рис. 11. Левая нижняя челюсть

Figure 10. Genitalia of male subimago.

Figure 11. Left maxilla.

the fourth tarsal segment is the smallest, it is half the length of the third. Tibia of hind-leg 1.2 times as long as the femur and 2 times as long as the tarsus (Figure 7). Forceps with a very small third segment; its second segment is greatly widened in the basal portion and narrows abruptly towards the end; penis wide, almost straight, slightly split at the tip into two lobes; the lateral edges of each lobe are sheared on the outer side (Figures 8, 9, 10). On the outer and inner sides of each process there are present small spinules.

The general coloration of the body is from a dark-brown with a reddish tinge to a yellowish-brown; the head

and thorax of a chestnut-ochreous colour, while individual sections on the notum are brown; upper part of eyes in the living specimens are bright-orange, lower part - black with a greyish tinge. Wings transparent with colourless cross veins and longitudinal veins, only the bases of the costal and subcostal veins are brownish-yellow; at the tip of the wing in the costal and subcostal areas there is a matt coloration; the anterior pair of legs is brown, the second and third pairs are yellowish.

The coloration of the abdomen is brownish to reddish-brown, in some specimens a more reddish reddish-brown or a reddish-brown with a yellowish tinge; on each abdominal sternite, close to the mid-line, there are two dark lines running from its upper edge and under each of these there are two dark maculae; genitalia yellowish, caudal filaments light-yellow with dark annulations, in some specimens these rings have a reddish tinge.

FEMALE IMAGO (in alcohol). The coloration of the body of the females is paler than that of the males; the anterior pair of legs is brown, the middle and posterior pairs are pale-yellow; wings transparent with light-coloured veins, only the costal, subcostal and radial veins are yellowish-brown at the base; abdomen light-brown or of a reddish-brown to yellow colour; tergites of last segments of a reddish-brown to brown colour. Forceps and caudal filaments yellowish.

MALES AND FEMALES OF SUBIMAGO (in alcohol). Wings not markedly transparent, smoky-white, fringed; veins pale without shading; anterior pair of legs pale-yellow, middle

and hind pairs white; abdomen a yellowish to reddish-brown colour; its sternites with dark lines at the lateral margins; caudal filaments white.

Sizes, in mm:	of male	of female
Length of body	6.0-8.2	6.3-8.9
Length of fore-wing	6.5-8.5	6.8-9.0
Length of caudal filaments	5.0-6.0	5.0-7.5

REMARKS. In comparing the larvae of E. sibirica Tshernova from the Amur basin with E. ignita Poda from bodies of water in Poland and Lithuania no morphological differences between these species were found (Figures 11, 13, 16). The coloration of the larvae, however, is very variable. Thus, for example, the larvae collected in the river Bira, even in a single biotope, had the most varied coloration, from a completely light-colour to black with small light-coloured lines and maculae.

The winged insects reared from the larvae of E. sibirica also vary considerably in their coloration, while the form of the lobes changes with retraction of the penis (see Figures 8, 9). As a result of this, several authors (Eaton, 1883-1888; Schoenemund, 1930), describing one and the same species, give differing illustrations of the genitalia (Figures 12 - 14).

In comparing the reared males of E. sibirica Tshernova with the species E. ignita Poda from bodies of water in Poland, which were kindly made available to me by Doctor M. Keffermuller (Polish People's Republic), it was made clear that E. sibirica is identical to E. ignita (Figures 8, 9, 10, 15).

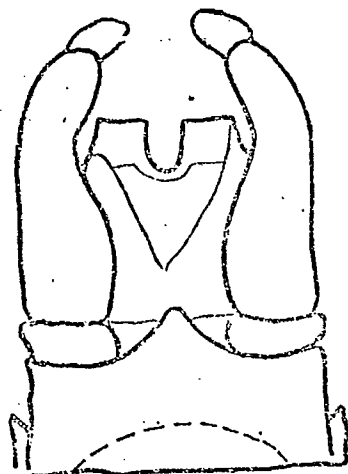


Рис. 12. Половые придатки самца имаго (по Eaton, 1883-1888).

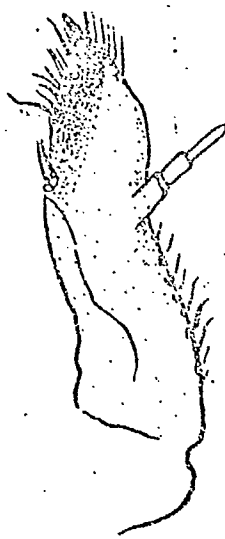


Рис. 13. Левая нижняя челюсть личинки (по Eaton, 1883-1888)

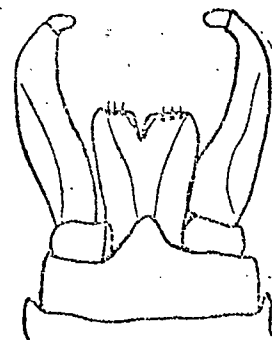


Рис. 14. Половые придатки самца имаго (по Schoenemund, 1930).

Figure 12. Genitalia of male imago (according to Eaton, 1883-1888).

Figure 13. Left maxilla of larva (according to Eaton, 1883-1888).

Figure 14. Genitalia of male imago (according to Schoenemund, 1930).

**MATERIAL.** Middle reaches of the Amur: river Bira, region of the Teplovskii fish-hatchery, 7, VII and 10-22, VIII - 1954, 35 males subimagos; same locality, 9, VI - 1956, 2 males subimagos; same locality, 20, VIII - 1959, 1 male subimago; same locality, Staraya branch, 22, VII - 1960, 3 males imagos (author's collection). There were reared from larvae 1 male imago and 3 males and 2 females of the subimagos.

The flight of this species commences at the beginning of June and continues to the end of September. The flight of

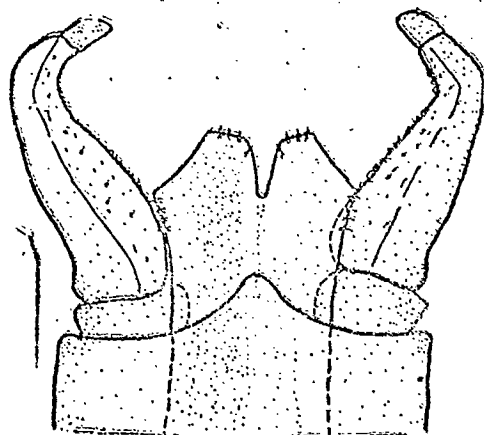


Рис. 15. Половые придатки самца  
имаго (Польская Народная Респуб-  
лика).

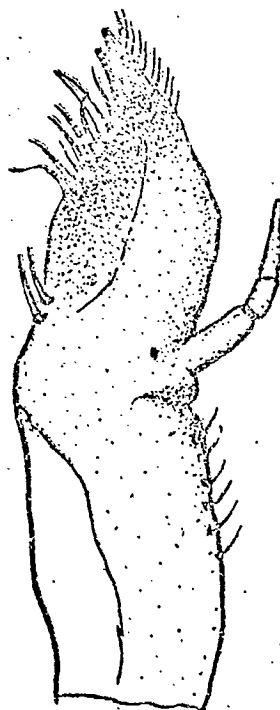


Рис. 16. Левая нижняя челюсть.  
лячки (Литовская ССР)

Figure 15. Genitalia of male imago (Polish People's Republic).

Figure 16. Left maxilla of larva (Lithuanian SSR).

the winged insects occurred in massive numbers from the 6th to the 12th of July. A considerable number of adult individuals was also caught during 4th - 10th August. The emergence flight mainly coincides with the early morning hours (5-6 a.m.). The duration of the eclosion of the subimago from the nymph lasts for 45 - 70 seconds. Before the emergence flight of the subimago the larva crawls out of the water onto stones near the shore or onto sunken stumps. The duration of the subimago stage is 19 to 35 hours. The moult of the subimago occurs in the course of 1.5 minutes.

4. Ephemerella aurivillii Bengtsson, 1908 (Figures 17 - 23a, b, v).

Synonyms: E. aroni, Eaton, 1908: 149.

E. norda McDunnough, 1924: 223.

E. concinnata Traver, 1934: 221.

E. taeniata Tshernova, 1952: 279. New synonym.

The species E. taeniata was described by O. A. Chernova (1952) for the Amur basin on the basis of the larva. Below is given a description of the male imago, reared from a larva of E. taeniata (river Khor, lower reaches of the Ussuri).

MALE IMAGO (in alcohol). Wings transparent with dark-brown longitudinal veins; cross veins light-brown at the base and yellowish in the apical portion. Tibia of fore-leg is 1.3 - 1.4 times as long as the femur, the tarsi are twice as long as the tibiae; the first segment of the tarsus is shorter than the second, the third and fourth segments taken together are 1.4 times as long as the first; the fourth tarsal segment is the smallest, the third is 2.3 times as long as the fourth; the tibia of the hind-leg is 1.2 times as long as the femur and 2.4 - 2.5 times as long as the tarsus (Figures 23a, b, v). Forceps with a very small, apically rounded third segment; the second segment of the forceps is markedly thickened in the apical portion. Penis elongated, split almost in half into two lobes. The lobes of the penis are widely set apart and towards their apex they are abruptly narrowed into a narrow process (Figures 21, 22); on the inner side of each lobe there are found small spinules or bristles. The

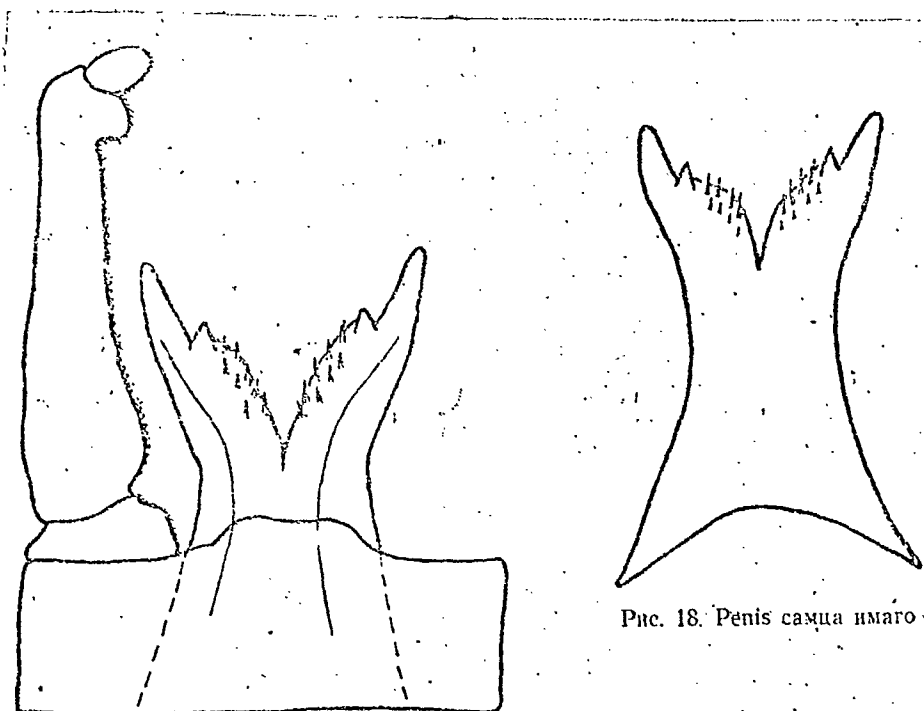


Рис. 17. Половые придатки самца  
имаго (р. Плитняжная, среднее те-  
чение Енисей).

Рис. 18. Penis самца имаго.

Figure 17. Genitalia of male imago (river Plitnyazhnaya, middle reaches of the Yenisey).

Figure 18. Penis of male imago.

coloration of the thorax is reddish-brown; the upper part of the eyes in living individuals is bright orange, the lower part is black with a greyish tinge, the antennae are brown; the anterior pair of legs is dark-brown, the second and third pairs are of a lighter colour, yellowish brown with dark claws.

Abdomen reddish-brown, sometimes pale-reddish-brown; along the mid-line of the abdominal tergites there runs a weakly expressed dark band, bordered on both sides by lighter coloured bands (as in the larva); in some individuals the abdominal tergites are monochromatic; on each abdominal

Рис. 19. Penis самца  
имago (по Bengtsson,  
1930)

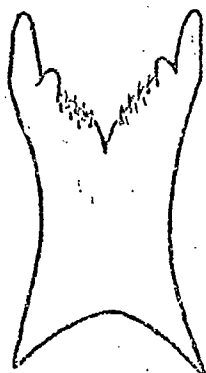


Рис. 20. Половые придатки  
самца субимаго (р. Хор, ниж-  
нее течение Уссури)

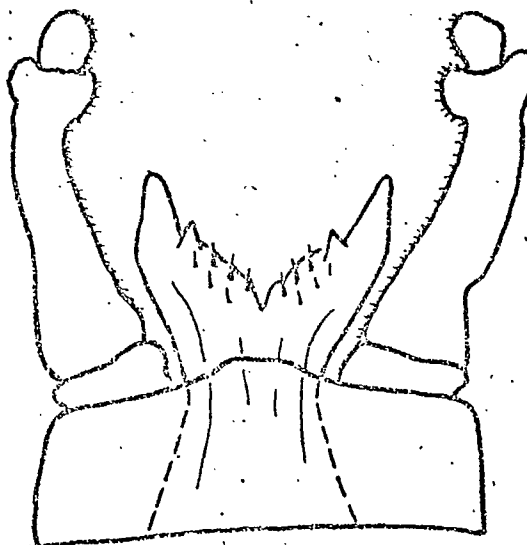


Figure 19. Penis of male imago (according to Bengtsson, 1930).

Figure 20. Genitalia of male subimago (river Khor, lower reaches of the Ussuri).

sternite, close to the mid-line, there are situated two light-coloured lines, running from its upper edge. The caudal filaments are dark-brown at the base and of a lighter colour in the apical portion.

FEMALE IMAGO (in alcohol). The thorax is of a lighter coloration than in the males; the anterior pair of legs is light-brown, the middle and hind legs are yellowish; the abdominal tergites are of a yellowish to reddish-brown colour; the 9th and 10th tergites are darker with a reddish tinge; the light-coloured lines on the abdominal sternites are weakly expressed; caudal filaments of a light-brown colour; only the four basal segments are dark-brown.

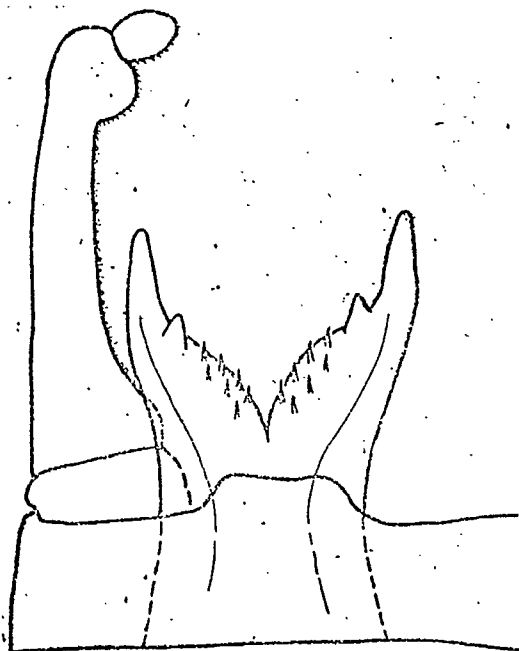


Рис. 21. Половые придатки самца имаго  
(р. Бира, среднее течение Амура)

Figure 21. Genitalia of male imago (river Bira, middle reaches of the Amur).

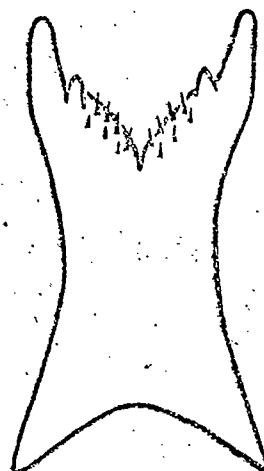


Рис. 22. Penis самца  
имаго

Figure 22. Penis of male imago.

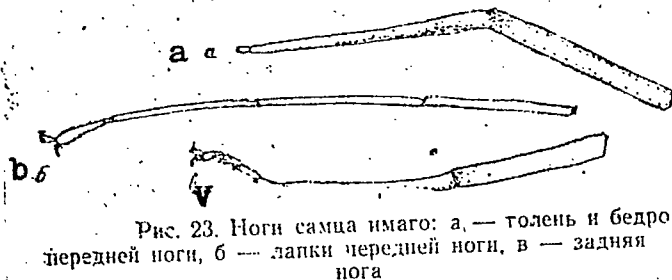


Рис. 23. Ноги самца имаго: а — голень и бедро  
передней ноги, б — лапки передней ноги, в — задняя  
нога

Figure 23. Legs of male imago: a - tibia and femur of fore-  
leg, b - tarsus of fore-leg, v - hind-leg.

MALES AND FEMALES OF SUBIMAGO (in alcohol). Wings grey, fringed, with reddish-brown longitudinal veins; thorax of a gingerish to reddish-brown colour; anterior pair of legs pale-yellow, middle and posterior pairs yellow, middle and posterior pairs white\*; abdomen of a reddish-brown to yellow

\* Translator's note. Sic. Phrase repeated, yellow then white.

colour, in the females it is of a lighter colour than in the males; along the mid-line of the abdominal tergites of the males is a wide light-coloured band, which is scarcely at all expressed in the females on account of the lighter coloration of the abdomen. The genitalia of the males are yellowish, with well expressed bristles on the lobes (Figure 20), caudal filaments of a white colour.

Dimensions, mm	of male	of female
Length of body	10.3-13.8	11.0-14.5
Length of wing	10.5-14.0	12.5-15.0
Length of caudal filaments	11.0-14.5	10.0-13.0

The flight of the imagos commences in the last days of May or at the beginning of June and continues to the first days of September. We found last instar larvae before emergence throughout the whole of May. We were able to observe the eclosion of the subimago from the nymphal integument under experimental conditions. Initially the thorax and head are freed, then the legs, wings and abdomen. The caudal filaments are freed last of all. The whole process of eclosion from the nymphal skin takes from 60 to 85 seconds. Before moulting the larvae crawled out of the water on the wall of the tank to a height of 15 - 30 mm and moulting commenced after 5 - 8 seconds. Duration of the subimago - from 1.5 to 2 days; the moulting of the subimago takes 2 - 3 minutes. The insects acquire their coloration towards the end of the second day after the moult.

REMARKS. Winged insects were reared from the larvae of E. taeniata. As a result of comparisons of the larvae and the imago of the males of E. taeniata with the species E. aurivillii Bengtss. from the rivers Vilyuy and Yenisey, and also with the illustration of the male imago in Bengtsson (1930), it became clear that Ephemerella taeniata Tshern. is identical with E. aurivillii Bengtsson. Considering the representation of the genitalia of both species (Figures 17 - 22), we see a difference only in the form of the disposition of the processes on the lobes of the penis. Under high magnification under the microscope there is clearly evident the second row of spinules, which is poorly expressed in the drawings made with a lesser magnification (Figures 18, 19, 22). Examination of extensive material on the winged stages of this family showed that the form of the lobes of the penis varies considerably. This phenomenon was also noted by K. A. Brodskii (1930). Furthermore, as our observations have shown, the size of the femora, tibiae and tarsal segments and the coloration of the insects are also variable in one and the same species (Table 1). It is very characteristic that the coloration of the body depends exclusively on the duration for which the winged form is held after its last moult.

MATERIAL. Middle reaches of the Amur basin: river Bira, in the region of the Teplovskii fish-hatchery, 10, VII - 1954, 1 male subimago; same locality, Staraya branch, 18, VI - 1955, 1 male subimago; same locality, 31, V and 13-15, VI - 1956, 1 male subimago and 2 female imagos; same locality, 17-20, VII - 1960, 2 male subimagos. Lower reaches

of the Ussuri: river Khor, Pavlenovskaya branch, 2, VI - 1950, 1 female and 1 male subimago; same locality, Bol'shaya branch, 25-29, VIII - 1960, 1 male imago and 1 male subimago (author's collection). 3 females and 2 males of the subimago and 1 female imago were reared from larvae.

5. Ephemerella basalis Imanishi, 1937 (Figures 24a, b, v - 26).

The original description of the winged form was given by Imanishi (1937) for Japan. The figure of the penis differs somewhat from that in the species which were collected in the Amur basin. As was shown by observations, the form of the penis sometimes varies. O. A. Chernova (1952) gives a short description of the body coloration of the males, without providing a drawing of the genitalia. Since winged individuals (males and females) were reared by us from the larvae, no doubt arises that the imago belongs to this species.

MALE IMAGO (in alcohol). Wings with brown longitudinal and cross veins, and moreover the costal, subcostal and radial veins range from a dark-brown to a quite black colour. The bases of the fore-wings, for about a quarter of their length, are of a brown colour, sometimes this coloration is weakly expressed or even completely absent; hind-wings brown all over; anterior pair of legs almost black, middle and hind legs - brown; tibia of fore-leg 1.2 times as long as the femur, tarsus longer than tibia; first segment of tarsus a little shorter than the second, the third and fourth segments taken together are 1.1 times longer than the first; the fourth tarsal segment is the smallest, it is half the length

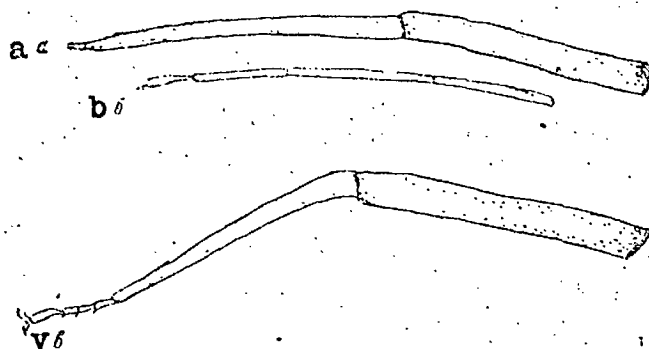


Рис. 24. Ноги самца имаго (р. Хор, нижнее течение Уссури). а — голень и бедро передней ноги, б — лапка передней ноги, в — задняя нога

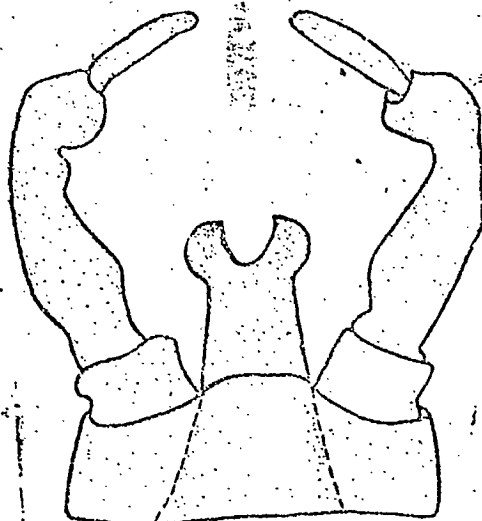


Рис. 25. Половые придатки самца имаго

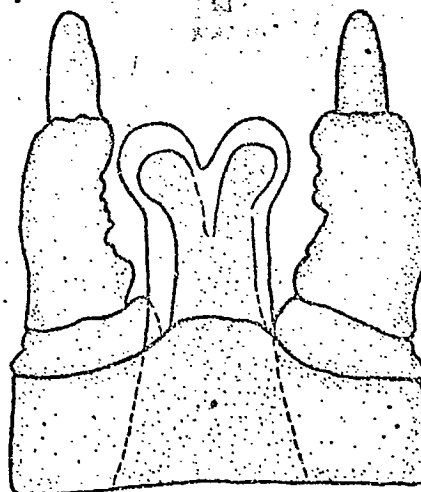


Рис. 26. Половые придатки самца субимаго (р. Хор, нижнее течение Уссури)

Figure 24. Legs of male imago (river Khor, lower reaches of the Ussuri): a - tibia and femur of fore-leg, b - tarsus of fore-leg, v - hind-leg.

Figure 25. Genitalia of male imago.

Figure 26. Genitalia of male subimago (river Khor, lower reaches of the Ussuri).

of the third; tibia of hind-leg a little bit shorter than the femur and 2.3 times as long as the tarsus (Figure 24).

The coloration of the body is very striking, the head and thorax range from a dark-brown to a lustrous black colour; the eyes are orange above and a black-grey below; the abdomen

is of a red to reddish-brown colour with the last segments being dark-brown. The 4th to 7th abdominal tergites each have two large, transversely elongated, dark maculae. The genitalia are light-brown; the basal segment of the forceps is the smallest; the second segment of this is bent and has two constrictions: at the base and before the expanded apex (Figure 25); the last segment of the forceps is narrow and long, the second segment is only 2.5 times as long as the third; the penis is almost straight and narrows slightly before its expanded apex; the notch on the tip of the penis is relatively deep; the caudal filaments are brown.

FEMALE IMAGO (in alcohol). The coloration of the body is paler than in the males; thorax dark-brown; fore-wings transparent, hind-wings of a pale-brown colour, sometimes the base of the wing is not coloured<sup>1</sup>; abdomen reddish-brown; caudal filaments brown.

MALE SUBIMAGO (in alcohol). Wings greyish-brown, fringed<sup>2</sup>; head of an ochre colour; eyes of a rusty reddish-brown with a greyish tinge in the lower portion; thorax brownish to reddish-brown; abdomen of an ochre colour with the brown pattern of the imago on the tergites; fore-legs dark-chestnut, middle and hind-legs yellowish; genitalia light-yellow, forceps and penis thicker and shorter than in the imago (Figure 26), caudal filaments brown.

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1 It is very interesting that in our material there are present females of E. basalis with completely transparent hind-wings and females with coloured wings. The wing coloration of the females is paler than in the males.

2 On the first day after the moult from the subimago to the imago, in the males reared from larvae, the wings were completely transparent and it was only towards the end of the second day, and in some individuals - on the third day, that the bases of the wings acquired their brown colour.

Dimensions, mm	of male	of female
Length of body	11.5-16.2	12-17
Length of wing	13.0-17.0	14-21
Length of caudal filaments	12.0-16.0	13-14

The flight of this species is prolonged: the first specimens appear at the end of May or in the first days of June. Mass emergence flights of E. basalis were observed on the river Khor (Bol'shaya branch) from the 5th to 15th of June in 1950 and 1951. At the end of June the population numbers of this species drop markedly and in July the winged insects are very rarely found, although in 1952 there were caught 2 male imagos as late as the 15th of August. During the period of the mass flight, males predominated over the females. The emergence flight mainly coincides with the early morning hours; according to our observations over the course of several years, the highest numbers of emerging insects were noted up to 11 a.m. The mating flight generally occurs after the hottest part of the day (5-6 o'clock) and continues to the onset of darkness.

The process of eclosion from the nymph takes 1.5 - 2 minutes, the duration of the subimago is from 25 hours up to two days (under experimental conditions); the moulting of the subimago takes 2 - 3 minutes. The wings of the males and also the whole body darken (acquire a more striking coloration) on the second to third day.

The fecundity of E. basalis is 6081 eggs (average from 3 last instar larvae before the emergence flight). The eggs are oval in form. One end is narrowed and has a cap-like structure; the larger diameter of the egg is 0.24 mm, the

smaller diameter is 0.17 mm; the form of the egg batch is round, with a diameter of 0.4 cm, of a dark muddy-green colour. From 1112 to 1500 eggs are found in the egg batches. It was not possible to establish the number of egg batches, but it may be assumed that the females produce several batches (2-3); at the time of oviposition the female bends the end of her abdomen, where the egg batch is retained, around in a circular manner.

MATERIAL. Lower reaches of the river Ussuri: river Khor, Bol'shaya branch, July 1950 - 1952, 700 males and 200 females imagos; same locality, 18, VII and 13, VIII - 1951, 15 males and 2 females; same locality, 16, VIII - 1952, 2 male imagos; same locality, 2, VII - 1953, 9 males and 7 females subimagos; same locality, 19, VI - 1960, 30 males and 10 females imagos. Middle reaches of the Amur: river Bira, Staraya branch, 15 and 24, VI - 1955, 5 males and 5 females imagos; same locality, 19, VI - 1956, 3 males and 1 female subimagos; same locality, 24, VI - 1960, 1 male imago.

6. Ephemerella tricantha\* Tshern., 1949 (Figures 27a, b - 29).

Synonym: E. trispina "Na" Iman.

O. A. Chernova described this species on the basis of the larva from tributaries of Lake Telettskoe. The winged form is described for the first time.

MALE SUBIMAGO (in alcohol). Wings of a reddish-brown-grey colour, fringed; longitudinal veins dark-grey, cross veins poorly contrasted; thorax brownish to reddish-brown, anterior pair of legs of a light-reddish-brown colour, middle

\* Translator's note. Sic. Pbly. E. triacantha.

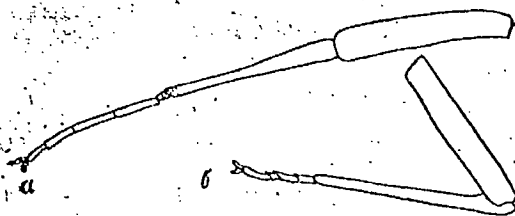


Рис. 27. Ноги самца субимаго (р. Хор, нижнее течение Усури). а — передняя нога, б — задняя нога

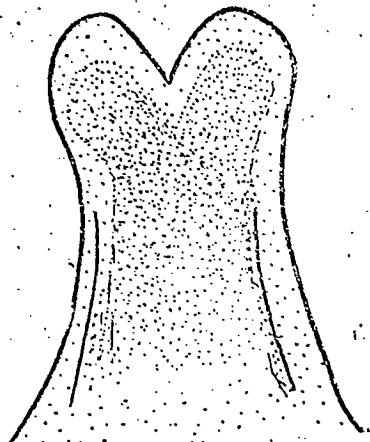


Рис. 29. Penis самца субимаго

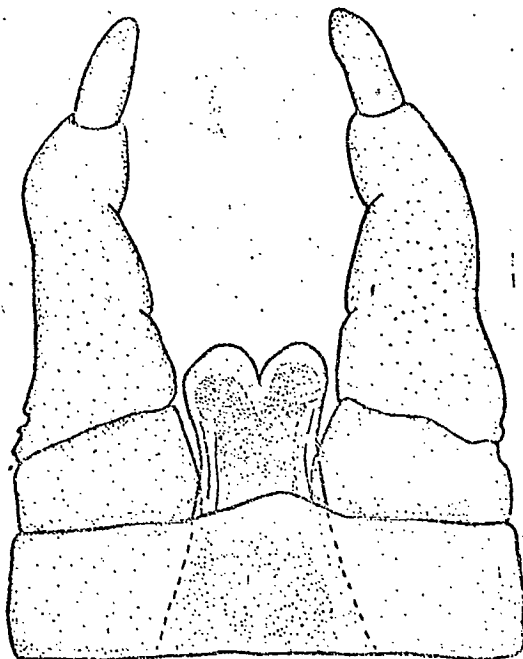


Рис. 28. Половые придатки самца субимаго

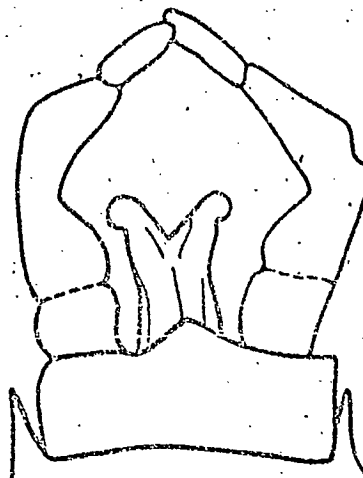


Рис. 30. *E. trispina* Ueno. Половые придатки самца имаго (по Ueno, 1931)

Figure 27. Leg of male subimago (river Khor, lower reaches of the Ussuri): a - fore-leg, b - hind-leg.

Figure 28. Genitalia of male subimago.

Figure 29. Penis of male subimago.

Figure 30. *E. trispina* Ueno. Genitalia of male imago (according to Ueno, 1931).

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and hind legs of a pale pinkish colour; tibia of fore-legs equal to femur or just barely longer than it, tarsus shorter than tibia; first segment of tarsus equal to the second,

the third and fourth segments taken together are 1.1 times as long as the first; the fourth tarsal segment is the smallest, the third is 1.3 times as long as the fourth (Figure 27); tibia of hind-leg barely shorter than the femur and 3.3 times as long as the tarsus. Abdomen reddish-brown, its last segments are more striking, of a darker red-brown colour; genitalia yellowish; first and second segments of forceps wide, third segment narrow, the second segment is more than 2.5 times as long as the third (Figure 28); penis almost straight, at the apex it is split (to approximately one third) into two lobes, each lobe has a slight swelling on its outer side (Figure 29); caudal filaments pale-yellow.

FEMALE SUBIMAGO (in alcohol). Head pale-brown with a red tinge; thorax of a light-ochreous-brown colour; wings as in the male; femora of all legs of a pale-pinkish-yellow colour; abdomen of a walnut colour with a greenish tinge, last segments of abdomen and bases of caudal filaments of a reddish colour.

Dimensions, mm	of male	of female	192
Length of body	9.0-10.0	9.5	
Length of wing	9.0- 9.5	10.0	
Length of caudal filaments	7.8	8.7	

REMARKS. E. triacantha Tshern. and E. trispina Ueno are very similar species and differ (the larvae) by the development of the spinules on the tergites of the abdomen, which are absent in E. triacantha (Chernova, 1952). It is very interesting that in our collection there are present larvae with spinules developed on the abdominal tergites, as in E. trispina, and completely without these.

We have reared winged insects from larvae in which these spinules were lacking. On the basis of the male subimago it was not possible to elucidate the relationship of these two species, although already in the subimago there is noted a certain similarity in the structure of the genitalia (Figures 28, 29, 30). It is quite possible that when the genitalia of the imagos of these species are studied they will turn out to be identical.

Larvae of the last instar, before the emergence of the winged forms, were found in large numbers in June, July and August. Unfortunately, we were unable to obtain the imagos, since the reared subimagos of this species died after a few hours. The process of eclosion of the subimago from the nymphal integument takes from 60 to 88 seconds.

MATERIAL. Lower reaches of the Ussuri: river Khor, Bol'shaya branch, 12, VI - 1960, 2 males and 1 female subimagos; middle reaches of the Amur: river Bira, region of the Teplovskii fish-hatchery, 16, VIII - 1959, 1 male, female subimago.

7. Ephemerella orientalis Tshern., 1952 (Figures 31a, b - 32).

The species was described by O. A. Chernova on the basis of the winged stage from the Sudzukhinskii reservation (Primorye Territory). The above mentioned author does not give a description of the subimago of the male and female. We found 2 males and 2 females of the subimago in the lower reaches of the river Ussuri, the description of which is presented below.

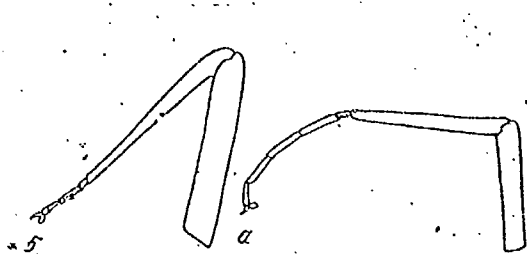


Рис. 31. Ноги самца субимаго (р. Хор, нижнее течение Усури). а — передняя нога самца, б — задняя нога самца

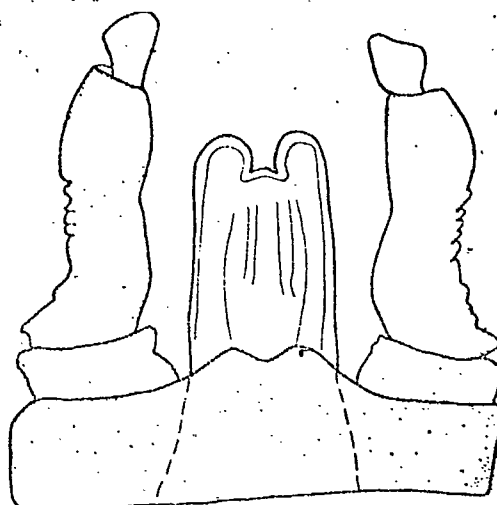


Рис. 32. Половые придатки самца субимаго.

Figure 31. Legs of male subimago (river Khor, lower reaches of the Ussuri): a-fore-leg of male, b-hind-leg of male.

Figure 32. Genitalia of male subimago.

MALE SUBIMAGO (in alcohol). Head dark reddish-brown; eyes orange with dark-grey shadings in the lower portion; wings dark with a light yellowish tinge, fringed; longitudinal and cross veins well contrasted; thorax brownish-grey, the light-coloured places are yellow; legs light-yellow (Figures 31a, b); general coloration of abdomen of a muddy-brown colour with yellow lighter patches at the intersegmental joints; on each abdominal tergite, closer to the lateral margins, there are two light-coloured (yellow) maculae (one on each side); along the mid-line of the abdominal sternites there runs a dark band; on each sternite, closer to the mid-line, there are two light-coloured obliquely directed lines; the sclerite of the tenth sternite is dark; forceps with very short third segments, which are rounded at their ends; penis wide, almost straight, with a small notch at the apex (Figure 32). Caudal filaments yellow.

FEMALE SUBIMAGO (in alcohol). Coloration of wings and thorax as in the males; coloration of abdomen paler than in the males and the pattern on the abdominal tergites is less strongly expressed. Legs and caudal filaments completely white.

Dimensions, mm	of male	of female
Length of body	11	9-12
Length of wing	12	11-14
Length of caudal filaments	12-15	

MATERIAL. Lower reaches of the Ussuri: river Khor, Bol'shaya branch, 15, VI - 1951, 2 males subimagos; same locality, 27, V - 1950, female subimago. This species is noted for the first time for the Amur basin.

8. Ephemerella kozhovi Bajkova, 1967 (Figures 33a, b, v - 34).

This species was described on the basis of the winged stage and the larva, and was named after Professor M. M. Kozhov. The imagos were reared from the larvae. The larvae are similar to E. aurivillii Bengtsson, but differ by several morphological features. The winged insects are clearly distinguishable by the structure of the genitalia (see Figures 17, 19 and 34). This ~~isxx~~ widely distributed mass species of the mountain and foothill tributaries of the Amur basin has been found in the rivers of the Southern Primorye and the Okhotsk coastland.

The imagos were collected in large numbers in the lower reaches of the river Ussuri, river Khor, Pavlenovskaya

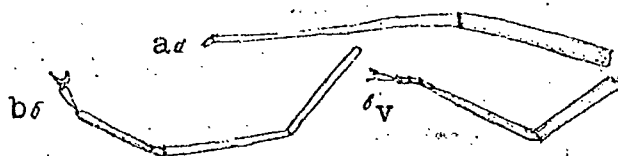


Рис. 33 Ноги самца имаго (р. Хор, нижнее течение Усури): а — голень и бедро передней ноги, б — лапка передней ноги, в — задняя нога

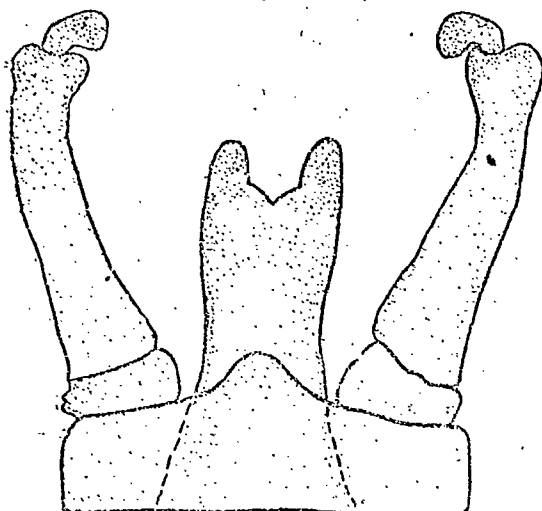


Рис. 34. Половые придатки самца имаго

Figure 33. Legs of male imago (river Khor, lower reaches of the Ussuri): a - tibia and femur of fore-leg, b - tarsus of fore-leg, v - hind-leg.

Figure 34. Genitalia of male imago.

branch; middle reaches of the Amur: river Bira, region of the Teplovskii fish-hatchery, river Kur, Birakanskaya branch.

The flight is markedly extended. It commences in the middle ten-day period of June and continues until the end of September. The mass emergence flights occur in July (5 - 15, VII). The process of eclosion of the larvae\* from the nymphal integument takes from 60 to 90 seconds. According to our observations the duration of the subimago ranges from 20 to 40 hours.

\* Translator's note. Sic. Should be subimago.

9. Ephemerella zapekinae Bajkova, 1967 (Figures 35 - 36a).

The species was described on the basis of the winged stage and the larva from the Amur basin. The imago was reared from the larva. The winged insects are similar to E. ignita Poda, but are distinguishable by the form of the genital appendages (see Figures 8-16 and 35). The larvae of these species are especially easily distinguishable.

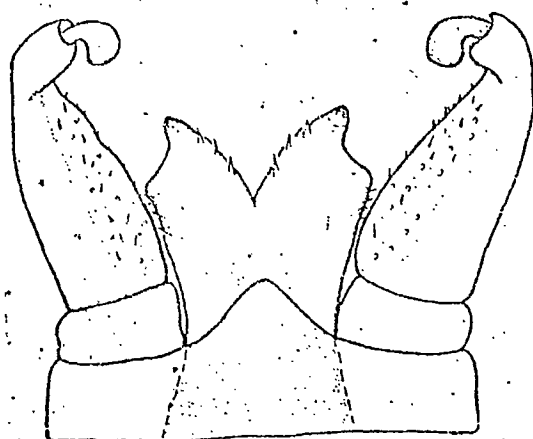


Рис. 35. Половые придатки самца имаго (р. Бира, среднее течение Амура).



Рис. 36. Ноги самца имаго: а — передняя нога, б — задняя нога.

Figure 35. Genitalia of male imago (river Bira, middle reaches of the Amur).

Figure 36. Legs of male imago: a - fore-leg, b - hind-leg.

The species is distributed in the mountain and foothill tributaries of the Amur basin, in the liman of the Amur, in the rivers of the Northern and Southern Primorye, and also in

the basin of the river Yenisey. Furthermore, it has been noted by Imanishi for Manchuria under the name E. "naz" Iman. (Imanishi, 1940).

The flight of E. zapekinae commences in the last third of June and continues to the end of September. The process of the eclosion of the subimago from the nymph takes 40 - 60 seconds. The duration of the subimago stage is from 15 to 30 hours. The subimago moults to the imago in 70 - 90 seconds.

10. Ephemerella mucronata Bengtss., 1909 (Figure 37)

The species was described by Bengtsson in 1909. A short description of the imagos and larvae from the Amur basin is given by O. A. Chernova (1952). However the drawing of the genitalia, which was provided by her, is very small and the lobes of the penis are not sufficiently clearly depicted. In connection with this we present a clearer illustration of the penis of the male imago (river Plitnyazhnaya, upper reaches of the Yenisey).

Length of body of the male imago - 10.5 mm, length of fore-wing - 11 mm, length of caudal filaments - 10 mm.

REMARKS. The species described by us is similar to E. krieghoffi in the form of the penis; it differs from the latter in the dimensions of the body and in the structure of the processes of the penis (Figures 37 - 38).

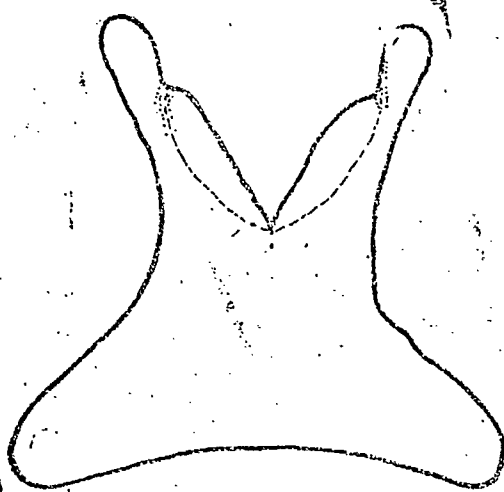


Рис. 37. *Ephemerella mucronata* Bengtss.  
Penis самца имаго

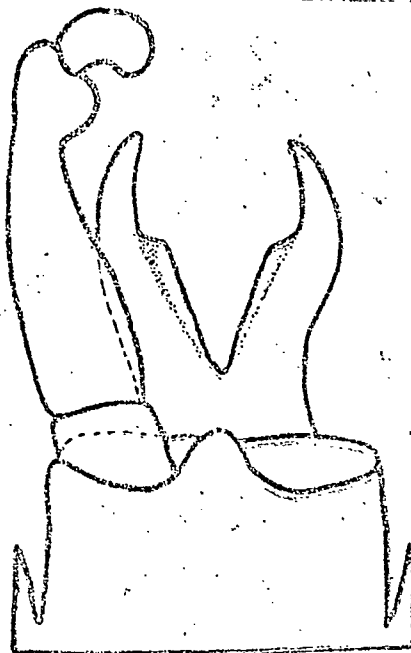


Рис. 38. *E. krieghoffi* Ulm.  
Гениталии самца имаго по  
Улмер, 1929)

Figure 37. *Ephemerella mucronata* Bengtss.  
Penis of male imago.

Figure 38. *E. krieghoffi* Ulm.  
Genitalia of male imago (according to Ulmer, 1929).

In our collection there are present interesting winged insects which are clearly different from those described above. We have not been able to establish to what species these forms belong. Unfortunately, these species were collected only as single specimens. It is possible that they are new species or that they belong to species described previously from the larval stages: *E. lepnevae* Tshern., *E. levanidovae* Tshern. or *E. dentata* Bajkova.

11. Ephemerella sp. 1 (Figures 39 - 41).

MALE IMAGO (in alcohol). Head and thorax of a chestnut-brown colour, upper half of eyes orange, lower half - black with a grey tinge; antennae light-coloured; wings transparent with pale-brown longitudinal veins, cross veins yellowish; fore-legs light-brown, middle and hind-legs of an olive-yellow colour; the tibia of the fore-leg is 1.2 times as long as the femur, the tarsus is almost equal in length to the tibia; the first segment of the tarsus is just barely longer than the second, the first segment is 1.1 times as long as the third and fourth taken together; the fourth tarsal segment is the smallest, it is half as long as the third; the femur of the hind-leg is 1.2 times as long as the tibia, the tibia is 3.5 times as long as the tarsus (see Figure 39).

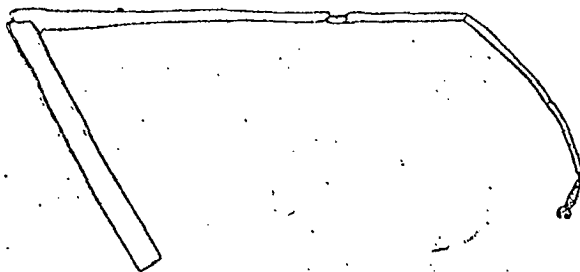


Рис. 39. Передняя нога самца имаго (р. Бира, среднее течение Амура)

Figure 39. Fore-leg of male imago (river Bira, middle reaches of the Amur).

The abdomen has a rusty-brownish coloration; on each abdominal tergite, close to its upper edge, there are situated two dark oblongate maculae; genitalia light-yellow; forceps with a short third segment, penis with a clearly expressed

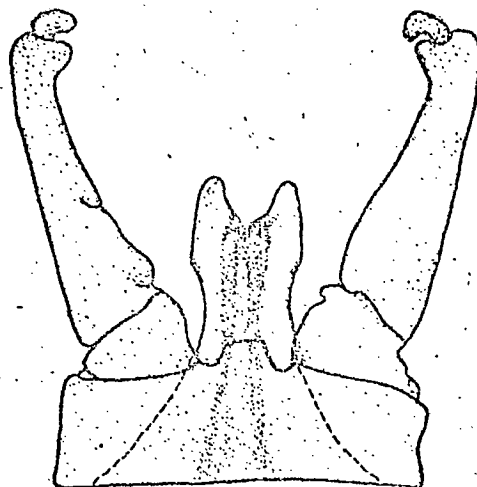


Рис. 40. Половые  
придатки самца имаго.

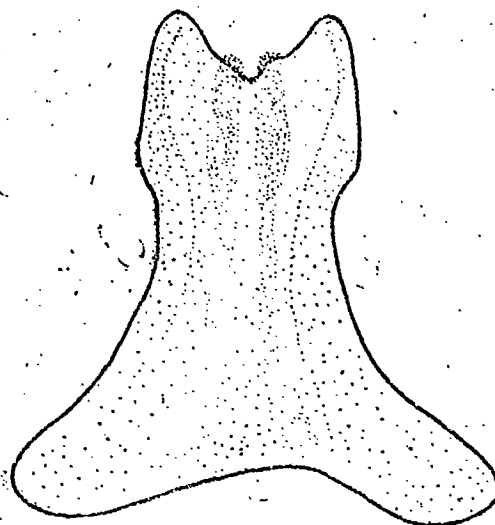


Рис. 41. Penis  
самца имаго

Figure 40. Genitalia of male imago.

Figure 41. Penis of male imago.

constriction medially; at the apex it is slightly split into two small, wide processes, each process has a rounded tip, the outer edge of the penis in its upper part forms a bend in the form of an angle (see Figures 40, 41); caudal filaments light-brown with darker segments at the base. Length of body - 8.6 mm, length of wing - 9 mm, length of caudal filaments - 10 mm.

MATERIAL. Middle reaches of the Amur: river Bira, beside the Teplovskii fish-hatchery, 12, VII - 1959, 1 male imago. The river Bira in the region of the hatchery has been fairly well studied with respect to the may-fly fauna. In hydrobiological collections here there have fairly frequently been found larvae of E. lepnevae Tshern. and E. dentata Bajk., from which we were unable to rear the adult insects. It may be assumed that Ephemerella sp. 1 belongs to one of these species.

12. Ephemerella sp. 2 (E. cryptomeria Iman.?) (Figures 42a, b - 43).

MALE IMAGO (in alcohol). Head and thorax brown, lustrous, with a chestnut tinge; antennae light-yellow, their basal segment is brown and markedly thickened; wings transparent, costal and subcostal veins brown, remaining veins of a reddish-brown to yellow colour, cross veins yellowish; anterior pair of legs brown, middle and hind-legs of a light-reddish-brown colour; tibia of fore-leg 1.2 times as long as the femur, tarsus 1.1 times as long as the tibia, first segment of tarsus barely longer than the second, the third and fourth segments taken together not much longer than the first; the fourth segment is the smallest, the third segment is almost twice as long as the fourth. The tibia of the hind-leg is equal in length to the femur and is 2.9 times as long as the tarsus (Figure 42a, b).

Abdomen of a brownish to reddish-brown colour, its last tergites are more reddish than brown; base of forceps

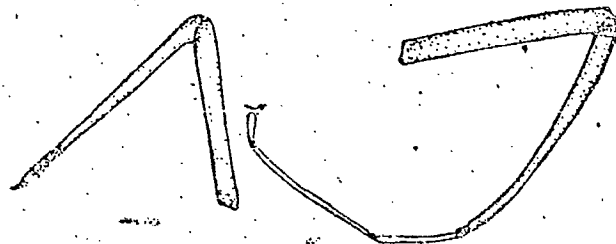


Рис. 42. Ноги самца-имаго (р. Хор, нижнее течение Уссури). а — передняя нога, б — задняя нога

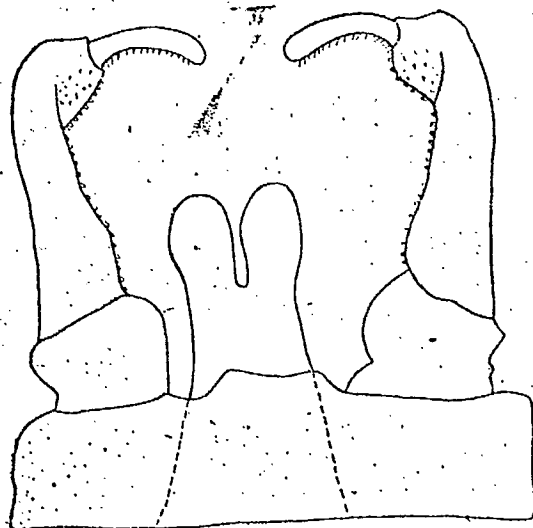


Рис. 43. Половые придатки самца-имаго

Figure 42. Legs of male imago (river Khor, lower reaches of the Ussuri): a - fore-leg, b - hind-leg.

Figure 43. Genitalia of male imago.

brownish, its second segment thickened in the apical portion, the last segment narrow and long, the second segment is 2.3 times as long as the third; penis straight, it is slightly broadened towards the apex, it is split almost down to its middle into two lobes; each lobe has a rounded, slightly broadened tip (see Figure 43); caudal filaments yellowish. Length of body - 11.7 mm, length of wing - 12 mm, length of caudal filaments - 11 mm.

MATERIAL. Lower reaches of the Ussuri: river Khor, Bol'shaya branch, 1 male imago.

REMARKS. In the form of the genitalia this species is similar to E. cryptomeria Iman., described for Japan by Imanishi (1937), but it differs from this in the structure of the tenth sternite and in the dimensions of the body.

13. Ephemerella sp. 3 (Figures 44a, b, v - 46).

MALE IMAGO (in alcohol). Head and thorax dark-brown; eyes orange with a grey tinge below; antennae light-brown. Wings transparent; costal, subcostal veins and radius brown, cross veins yellowish; femur and tibia of fore-leg dark-brown, tarsi yellow, femora of the middle and hind pairs of legs light-brown, tarsi pale-yellow; tibia of fore-leg 1.2 times as long as the femur, tarsus longer than the tibia; the third and fourth tarsal segments taken together are just barely shorter than the first; the fourth segment of the tarsus is the smallest, the third is almost three times as long as the fourth; the tibia of the hind-leg is shorter than the femur and 2.9 times as long as the tarsus (Figure 44a, b, v). The abdomen is brown with a light chetnut tinge and with yellow patches at the intersegmental joints; the last segments of the abdomen are dark-brown, almost black; genitalia brown; the first segment of the forceps is the smallest, the last segment is narrow and long, it is one third the length of the second segment; the second segment of the forceps is markedly bent and expanded in its apical portion; the penis is almost straight, it is slightly split at the apex (see

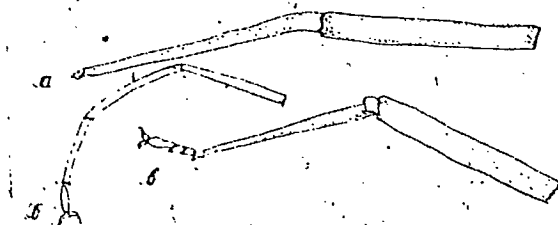


Рис. 44. Ноги самца имаго (р. Хор, нижнее течение Уссури): а — голень и бедро передней ноги, б — лапка передней ноги, в — задняя нога

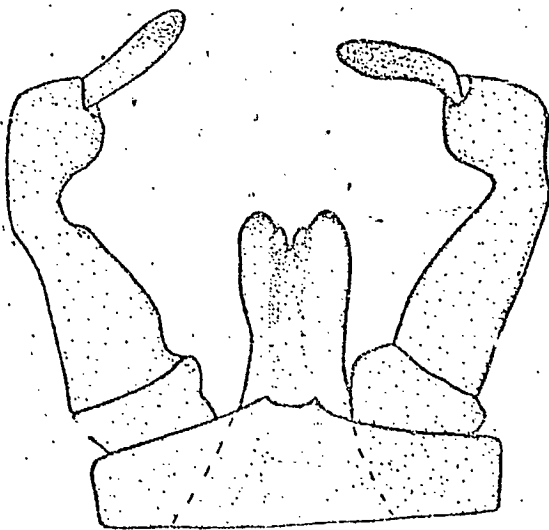


Рис. 45. Половые придатки самца имаго

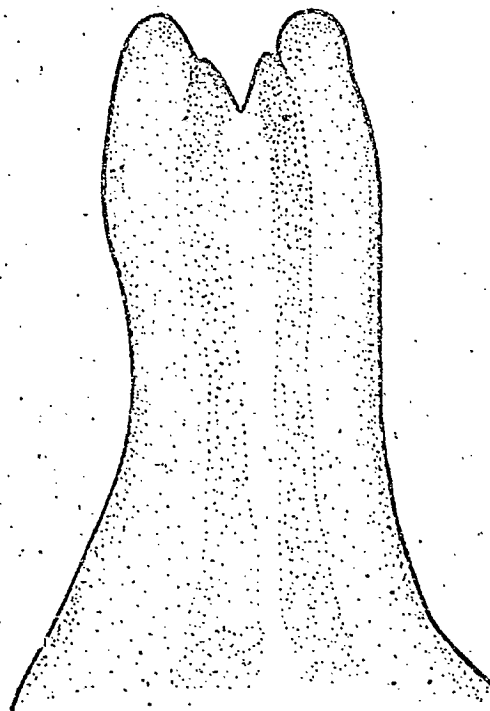


Рис. 46. Penis самца имаго

Figure 44. Legs of male imago (river Khor, lower reaches of the Ussuri): a - tibia and femur of fore-leg, b - tarsus of fore-leg, v - hind-leg.

Figure 45. Genitalia of male adult.

Figure 46. Penis of male adult.

Figures 45, 46); caudal filaments dark-brown. Length of body - 12.5 mm, length of wing - 12.8 mm and of caudal filaments - 14 mm.

MATERIAL. Lower reaches of the river Ussuri: river Khor, Bol'shaya branch, 20, VII - 1952, 1 male imago.



THE FLIGHT AND DURATION OF THE WINGED PHASES OF THE FAMILY  
*Ephemerellidae*

The duration of the winged phases and the character of the flight have been fairly well studied in the families Ephoronidae and Palingeniidae (Pavlovskii and Lepneva, 1948; Chernova, 1952) but these questions have remained completely uninvestigated with respect to the other families, in particular with respect to the family *Ephemerellidae*.

May-flies are the only group of winged insects which possess the capacity to moult, i.e. they have two winged stages: the subimago and the imago. Below are presented separately some observations on each of the stages of these insects.

A. Subimago

The emergence of may-flies occurs through a medial rupture of the larval integument on the dorsal side of the thorax. Initially the thorax of the may-fly is freed, then the head and fore-legs, followed by the wings, second and third pairs of legs. Last to be freed are the abdomen and caudal filaments. Under experimental conditions there were cases when the emerging may-flies were unable to free the wings and caudal filaments, occasionally also the hind pair of legs. Such occurrences were not encountered in nature.

Our observations have shown that under natural and experimental conditions the emergence of the may-flies from the nymphal skins occurs mainly in the early morning, during warm windless weather, with the onset of daybreak, and in

solitary cases up to 10 - 11 a.m. The majority of may-flies emerge in the evening, after the hottest part of the day (between 17.00 to 20.00 hours) and rarely can emergence be observed during the daytime hours. Mass emergence of E. basalis in 1952 was observed after a thunderstorm and heavy downpour. Flight occurs during cloudy weather with light rain showers of short duration, but flight is not observed in constant rainy weather.

The emergence, in large numbers, of the subimagos of E. basalis from the larvae has been observed at the water line on completely dried-out stones. In cages, for the rearing of the winged forms, which were standing in slowly flowing or still water, the larvae that were about to moult crawled out of the water to a height of 3 - 6 cm above its surface up the metal wall of the cage or up onto plant stems which had been placed into the cages. The emerged specimen did not remain for long on the nymphal skin. The subimago slowly crawls along the stone, on which the moult occurred, and then flies up onto the shore-line grass or shrubs, where it hides in the shade on the under-side of a leaf. May-flies in the subimago stage were not found far from water, even at comparatively short distances of the order of 300 - 400 m.

The process of emergence from the nymph in the representatives of this family takes from 40 seconds to 2 minutes, and moreover in the smaller species, such as E. ignita and E. zapekinae (E. "naz" Iman.), emergence occurs more rapidly than in the larger species, E. aurivillii and E. basalis.

The species of the family Ephemerellidae remain in the subimago stage for from 15 hours to two days. The longest duration of the subimaginal stage was observed in E. aurivillii and E. basalis.

The moulting of the subimago into the imago varies in each of the species of the family Ephemerellidae and ranges from 70 seconds to 2-3 minutes. It should be noted that the emergence of the subimago from the nymphal skin proceeds more rapidly than the moult of the subimago.

#### B. Imago

The flight period of the species of this family extends from 2.5 to 3.5 months. In individual species, as for example E. aurivillii, the first specimens appear at the end of May (1956) or at the beginning of June, as was observed in 1950, while the last dates of finding the imago were at the end of the last third of August. The flight period of E. ignita is just as extended: winged insects of this species were collected in the first third of June and up to the end of September. The shortest flight period was found in E. basalis (2 - 2.5 months), and moreover the main mass of these individuals emerged for their first flight in June. Only a small number of specimens were found in July.

As a result of many years of observation we were unable on even a single occasion to see a flight of E. aurivillii in fairly big clusters, as in the other representatives of this family.

In comparison with E. aurivillii, the flight of E. ignita is more simultaneous. Thus, on the mornings (5 - 6 a.m.) of the 7th of July and 10th of August there were found large numbers of the winged insects of E. ignita.

No less interesting was a flight of Ephemerella kozhovi which occurred on the Pavlenovskii branch (basin of river Khor) in July 1950 on a warm cloudless morning. The insects were caught on the shore-line vegetation (on the shaded side of the plants) along the whole island. On a hot sunny day the imagos of this species were found 300 - 400 meters from the shore in dense growths of smallreed\*.

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The periods and intensity of the flight differ in different species of may-flies. The periods of the emergence flights for every body of water are fairly constant and are determined mainly by the temperature conditions. The intensity of the flight is determined by the population numbers in this or that body of water. Thus, in the river Teplovka, which flows out of a limnocrone with a water temperature of 14-14°C, in the summer the most simultaneous emergence flight occurred in the middle of July, while in the river Bira, which has a higher summer temperature (23-24°C), this occurred at the beginning of July. In the system of streams and springs of the river Khor, with a heavy discharge of underground waters, as a consequence of the even thermal conditions mass flights of E. basalis were constantly observed, over the course of several years, in the first days of June.

Until recently it was considered (Pavlovskii and Lepneva, 1948; Chernova, 1952) that mass emergence flights of

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\* Translator's note. Calamagrostis sp.

may-flies are characteristic of those species which have a short life span of the winged insect, often living only a few hours, as for example of all of the species of the families Ephoronidae and Palingeniidae, and also of the species Oligoneuriella rhenana of the family Oligoneuridae.

S. G. Lepneva (Pavlovskii and Lepneva, 1948), who observed a huge emergence flight of Polymitarcys virgo on the river Kama, described how in a single instant the adult insect emerged and immediately flew off, with the white skin of the subimago hanging down from the end of its abdomen (Pavlovskii and Lepneva, 1948).

During the massive emergence flights of this species on the Amur the insects also quickly shed their subimaginal skin when they moulted to the imago.

Of the family Ephemerellidae, only in one species, E. basalis, was I able to observe a huge flight, in 1950 - 1951 on the Bol'shaya branch (mouth of the river Khor).

The elucidation of the character of the flight of this remarkable may-fly is very interesting. Therefore we will briefly describe the observations on the flight of E. basalis, which were carried out over the course of 5 years.

The first specimens were caught on June 1st (1951) and June 4th (1950)\*. A mass flight in 1950 was observed on the 5th of June. On this day there was a warm overcast morning. At about 9 - 10 a.m. the shore-line vegetation, and also shrubs and trees, were covered by these striking reddish-brown insects in tremendous numbers. At 11 a.m. the sun was

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\* In 1952 and 1954 emergence flights were noted at the end of May.

shining and many insects were hovering in the air. During the midday heat they hid from the rays of the sun in the shade under the leaves of trees, shrubs and other vegetation.

From the 5th to the 12th of June there periodically occurred small brief rain showers but the numbers of E. basalis did not decrease. Only after a considerable downpour which occurred on June 13th was there a marked decrease in the numbers of this species, but right up until the 20th of June large numbers of the insects could be collected in the forest under the leaves of oaks. At the beginning of July the may-flies of this species were found very rarely, while in August only solitary specimens were to be found. The last dates of finding the imagos belong to the middle of August.

On the days of the mass flight, males were predominant by a factor of 2 to 2.5. It is no less interesting to note that the insects fly quite far away from the river. We collected the winged insects of E. basalis 1.5 to 2 km away from the river.

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Swarming of may-flies occurs mainly in the evening. In comparison with the evening flight, the morning flight is very sparse. The evening flight is more intensive. It commences after the drop in temperature following the hottest part of the day (at 5-6 p.m.) and continues until sunset. The maximum number of flying individuals, i.e. the climax of the flight, occurs at 19.00 to 20.00 hours. The mating of the may-flies occurs in the air. The may-flies dance at a height of 2 - 5 m, at a distance of 1 to 3 m from the edge of the water, over the vegetation. The mating E. basalis slowly drift down from a height and at a distance of 50 - 70 cm from the ground the pair separates.

The females of this species oviposit while seated on shore-line vegetation or on the leaves of trees and then fly over the water with the prepared egg batch. Some species of may-flies of the genus Baetis, for this purpose, dive under the water and deposit their eggs on the under surface of a stone (Pavlovskii and Lepneva, 1948).

Oviposition by the female of E. basalis takes 20 - 25 minutes, during which time the female bends round in a circle the end of her abdomen, where the egg batch is retained. The form of the egg batch is round, of a greenish muddy-grey colour with a diameter of 0.4 cm. The fecundity of this species, determined on the basis of 3 larvae in the last stage of maturation, comprised 6080 eggs. The number of eggs in one batch was 1420. The egg batches are released into the water, they sink down onto the bottom, where the development of the eggs proceeds. It may be assumed that the female lays 2 - 3 batches and perhaps even more, since there are 4.3 times as many eggs in the larva as in an egg batch.

The duration of the development of the eggs in E. basalis depends on the temperature of the water. Under natural conditions embryonic development proceeds over the course of 20 - 28 days (at a water temperature of 13 - 16°C); in experimental conditions, where the water temperature was 20 - 25°C, the duration of the incubation of the eggs comprised 9 days. On emerging from the eggs the young larvae remain in the mucus of the egg batch and only leave the batch on the second day, scattering themselves over the bottom of the body of water.

The duration of the life of the imago in the insects of this family varies and depends on the meteorological conditions. Thus, the large species E. basalis and E. aurivillii live longer during overcast days (from 10 to 22 days), while in hot sunny weather they die very quickly (from 5 to 8 days). The small species E. ignita and E. rufa live for only 3 to 5 days.

Table 2.

Dimensions and average weight of may-flies  
in the imaginal stage.

Таблица 2

Размеры и средний вес поденок имагинальной стадии

Название вида Species name	А. Количество исследова- ний	Стадия Stages	В. Длина тела, мм	С. Длина кры- ла, мм	Д. Сред- ний вес, мг
<i>Ephemerella thymalli</i>	1 самец	имаго i	9,0	8,5	9
<i>Ephemerella rufa</i>	1 самец	»	6,5—7,5	7—7,8	6
<i>Ephemerella ingita</i>	3 самца	»	6,0—8,2	6,5—8,5	5
»	5 самок	субимаго s	5,8—1,0	6,1—7,0	5,5
»	2 самки	имаго i	6,3—8,8	6,8—9,0	6
»	4 самки	субимаго s	6,2—6,8	7,2	8
»	1 самец	имаго i	6,9	7,0	6
<i>Ephemerella aurivillii</i>	2 самца	имаго i	10,3—13,8	10,5—14,0	20
»	2 самца	субимаго s	10—11,5	12	18
»	1 самка	имаго i	11—14,5	12,5—15	34
»	1 самка	субимаго s	12,5—13,0	12—13,5	27
»	1 самка	имаго i	12,5	13,0	19
<i>Ephemerella basalis</i>	10 самцов	имаго i	11,5—16,2	13—17	54
»	8 самцов	субимаго s	13—15	13—16,5	65
»	4 самки	имаго i	12—17,0	14—21	68
»	3 самки	субимаго s	11—16	13—18	87
<i>Ephemerella triacantha</i>	2 самки	субимаго s	9—10	9,9—5	15
»	1 самец	субимаго s	8,5	10,0	18
<i>Ephemerella orientalis</i>	2 самца	субимаго s	11	12,0	30
»	2 самки	субимаго s	9—12	11—14	39
<i>Ephemerella kozhovi</i>	5 самцов	имаго i	8,6—9,5	10,0	24
»	3 самца	субимаго s	8—8,8	9,2	25
»	4 самки	имаго i	8,5—9,5	10,0	17
»	3 самки	субимаго s	8—9,3	9,5	23
<i>Ephemerella zapkinae</i>	2 самца	имаго i	5,7—6,5	6,7	6
<i>E. mucronata</i>	1 самец	имаго i	10,5	11,0	19,5
<i>Ephemerella sp. 1</i>	1 самец	имаго i	8,6	9	9,5
<i>E. sp. 2 (E. cryptomeria)</i>	1 самец	имаго i	11,7	12	10,7
<i>E. sp. 3</i>	1 самец	имаго i	12,5	12,8	22

A. - Number examined

B. - Length of body, mm

C. - Length of wing, mm

D. - Average weight, mg

m - male

f - female

i - imago

s - subimago

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Таблица 2

а кры- зм	Сред- ний вес, мг
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5	9
-7,8	6
-8,5	5
-7,0	5,5
-9,0	6
2	8
0	6
-14,0	20
2	18
-15	34
-13,5	27
0	19
-17	54
-16,5	65
-21	68
-18	87
5	15
0	18
0	30
-14	39
0	24
2	25
0	17
3,5	23
5,7	6
1,0	19,5
9	9,5
2	10,7
2,8	22

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ТОМ

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Рис. 1