

MAYFLIES OF THE GENUS IRON EATON (EPHEMEROPTERA,
HEPTAGENIIDAE) FROM THE CAUCASUS

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Mayflies of the genus Iron Eaton have remained poorly investigated in the Palearctic. Only 6 Palearctic species of this genus are known, whereas there are more than 20 in the Nearctic (Traver, 1935); the genus is not represented in the European fauna. Almost all the Palearctic species have been described solely from imagines.

In 1928 Uéno described an Iron nymph from Japan (Uéno, 1928), and three years later he described the adult male of the species I. nipponicus (Uéno, 1931). The nymph of I. maculatus was described from the basin of Lake Teletskoye (Chernova, 1949). Adult mayflies of this species have been reared from nymphs and recently described (Baykova, 1974). In 1930 K. A. Brodskiy described 2 species from Soviet Central Asia. From a study of the imago and subimago of males and females he distinguished 4 variations for I. montanus, but gave a description only of the female subimago for the second species, I. rheophilus (Brodskiy, 1930). Two species of the genus Iron are known from the Caucasus: I. znojkoï, for which male and female imagines have been described, and I. caucasicus, for which only the male imago is known (Chernova, 1938). The last-mentioned species was placed in the genus Cinygma in the original description. Having reexamined the generic characters of the imagines of all Palearctic and Oriental genera of the family Heptageniidae, O. A. Chernova now (1974) places this species in the genus Iron. The nymphs of the species from the Caucasus remain unknown, although the nymphal morphology of the genus iron in the fauna of this region has been investigated in detail (Sadovskiy, 1946).

The present article is devoted mainly to a description of the nymphs of species of the genus Iron from the Caucasus. I. znojkoï and I. caucasicus nymphs are described for the first time. In addition, two new species, the imagines of which are unknown, are established on the basis of nymphs: I. fuscus, and I. nigripilosus. A nymphal identification key has been compiled for these 4 species. The male subimago of Iron znojkoï is described for the first time, and we also give some additional characters of the male imago derived from the holotype.

Edmunds and Allen (1964) treated Iron as a subgenus of the genus Epeorus. The status of the group was not established with absolute clarity in the article. The authors wrote that the structural type of the penis in Epeorus torrentis was different from that of some North American species defined as belonging to the genus Epeorus, and that therefore they regarded Iron as a subgenus of the genus Epeorus. In our opinion, the main character of nymphs of the genus Iron, along with many others, is the strong development of the first pair of gill lamellae, which meet on the ventral side of the abdomen. This character is not developed in all the nymphs of North American

species classified as Iron. It is possible that such species should not be placed in iron. The complexity of determining generic relations in the Epeorus - Iron group arises from the lack of precise generic characteristics due to the low level of investigation of mayflies of these genera. Chernova (1974, 1976) adopted the classification of American authors when compiling imaginal and nymphal identification keys to the genera of the family Heptageniidae. However, in the course of investigating the material at our disposal it appeared that mayflies of the iron group should be regarded as representing an independent genus. It will not be possible to give a full description of the genus Iron until mayflies from Soviet Central Asia have been studied and described.

The holotypes of the new species are in the collection of the Zoological Institute, USSR Academy of Sciences (Leningrad).

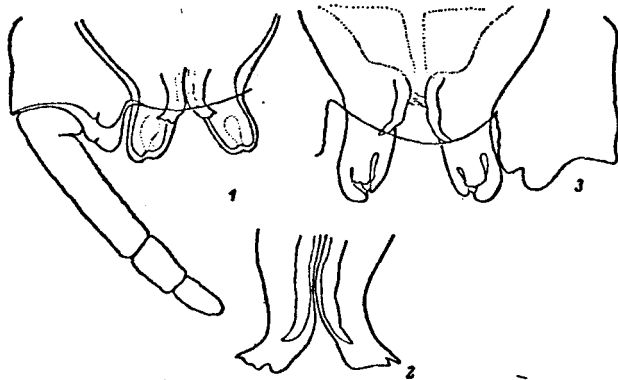
The author is deeply indebted to O. A. Chernova for continuous discussion and for access to collections and types for study.

Iron znojkoï.

I. znojkoï: Chernova, 1938 : 59, imago, male and female.

Male subimago (alcohol). General body coloration whitish-yellow. Eyes black, head dark yellow, lower margin of head brown. Thorax dark yellow on all sides. Wings matte, crossveins of fore and hind wings brownish, weakly bordered with brown. Abdomen whitish-yellow, with brownish markings on tergites consisting of a narrow band on the anterior margin of the tergite that forms a small triangular spot along the median line. The ganglia of the ventral nerve cord show through on the ventral side of the abdomen. Styliger convex, lobes of penis projecting beyond margin of styliger for approximately one third, their distal ends slightly diverging. A slight constriction of the lobes of the penis is to be observed toward the distal end; the gonopore appears as a narrow notch (Fig. 1). Titillators broad, with pointed outer angles and uneven apical margin, protruding beyond margin of styliger for about a quarter of its length. The imaginal titillators, which show through, appear as narrow processes pointed at the distal end and not projecting beyond the margin of the styliger (Fig. 2).

Nymph. The head is of practically the same shape in males and females. The posterior margin of the head of the female is rounded and narrowed. Toward the anterior margin the head broadens gently, its lateral margins are bluntly rounded. Anterior margin practically straight, slightly convex, without a notch along the median line. Posterior margin of head of male straight. Head covered with hairs along



Figs. 1-3. *Iron znojkoj*.

1) Genitalia and 2) titillators of male subimago (Armenia, Ayriget River, below Dastakert village, 16 July 1956, preparation No. 435, L. A. Zhil'tsova); 3) genitalia of male imago, holotype (Nakhichevan district, Gillyak, Gilyan-chay, 1 July 1933, A. V. Petrov).

the margin, these hairs darker on the sides and recurved onto the upper surface of the head (Fig. 4). Labrum broad, its length half its width. Lateral margins broadly rounded, middle of anterior margin strongly concave, posterior margin slightly concave. Outer surface of labrum covered with numerous fine hairs that are denser around the median line. There are thicker and longer hairs on the sides of the labrum (Fig. 5). The length of the mandibles is twice their width, the width of the molar margin of the left mandible is little more than half the width of the mandible. The length of the outer tooth of the mandible is greater than the width of the molar margin. On the outer surface of the mandibular tooth there are two small denticles above a group of fanlike setae. The inner tooth, which is half as long as the outer tooth, is tricuspid on the upper margin; the marginal cusp, which is longest, comes to a point (Fig. 6). The upper tooth of the maxilla lacks a process extended upward. The inner lobe of the hypopharynx is broad, its length only slightly exceeding its width. The upper margin of the inner lobe is divided by two notches into three unequal parts, the middle one of which is twice the width of the lateral parts. Outer lobes of hypopharynx narrower than inner lobe (Fig. 7). The glossae have a slightly elongate and broadly rounded outer margin; the inner margin is practically straight. The paraglossae are pyriform; the width of their upper narrow part is one third of the overall length (Fig. 8). The claws have 3-4 blunt denticles. The spinules on the outer surface of the femora are broadly rounded apically and narrowed basally. There are narrow spinules along the margins of the femora (Fig. 9). The first gill lamella is twice the length of the 3rd; its upper surface is broader than its lower surface, and the outer margin is thickened. The gill lamellae of pairs II-VII have a small rounded process on the outer thickened margin that is densely covered with long sharp spinules. All the gill lamellae are pubescent along the outer margin, bearing fine, rather long hairs (Figs. 30-32). Gills II-VI bear 30 or more gill filaments, the length of which is slightly less than the width of the corresponding gill lamella. Gill VII has approximately 20 gill filaments. There are light hairs on the tergites along the median line of the abdomen.

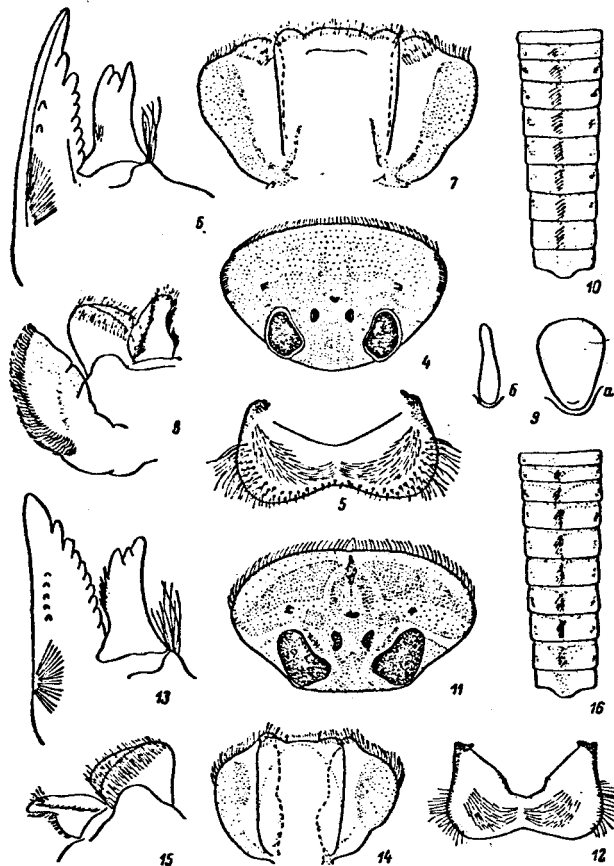
Overall coloration of body ranging from light brown to dark brown. The markings of the head are typified by dark triangular spots around the eyes. The legs are light brown, the hairs on the femora, tibiae and tarsi are light, the femora of all legs lack dark spots. Abdominal tergite I lacks markings, on tergites II and III the markings take the form of a dark triangular spot, the apex of which is toward the posterior margin of the tergite. The marking on each of tergites IV-IX consists of a narrow dark band on the anterior margin of the tergite, which broadens toward the middle and gives way to an unpaired narrow stripe on the median line of the abdomen. There are small dark spots on the sides of the tergites; these spots are paler on segments I, II and VIII (Fig. 10). The abdominal sternites devoid of markings; gills not colored.

Length of nymph before emergence 14-19 mm, length of cerci 16-18 mm.

Material. Soviet Georgia: Military Georgian Highway, near Kazbegi station, stream, 2 Aug. 1930, 24 early instar nymphs (K. A. Brodskiy); Upol village, Ardon River, 22 May 1970, 5 nymphs, Mizur village, Ardon River, 5 July 1970, 1 nymph; Terek River, Yuzhnyy settlement, 25 April 1970, 2 nymphs; Gmi village, Armkhi River, 28 May 1970, 1 nymph (L. I. Kornoukhova). Armenia: Ayriget River, below Dastakert village, 16 July 1956, 1 ♂ subimago, preparation No. 435; Ambert River at Abaran village, 3 June 1956, 2 nymphs; Arpa River, 10-12 km below Dzhermuk Spa, 24 May 1956, 3 nymphs (L. A. Zhil'tsova). Nakhichevan ASSR: Paraga, Paraga-chay River, 25 June 1933, 4 nymphs (K. A. Brodskiy).

Range. North Caucasus, Transcaucasia.

Comment. The genitalia of the adult male of *I. znojkoj* are depicted in Fig. 3; the illustration was drawn from a preparation of the holotype. The titillators, which were not illustrated and described in the original description (Chernova, 1938), are narrow processes extending from midway along the lobes of the penis; they do not project beyond the convex margin of the styliger, their distal ends are narrowed and slightly pointed.



Figs. 4-16. *Iron*. Structural details of nymphs.

4-10) *I. znojkoii*: 4) head of female; 5) labrum; 6) cutting edge of left mandible; 7) hypopharynx; 8) part of labium; 9) spinules on surface of femur (a), along margin of femur (b); 10) markings on abdominal tergites (Nakhichevan district, Paraga, Paraga-chay River, 25 June 1933, preparation No. 420, K. A. Brodskiy); 11-16) *I. caucasicus*: 11) head of male; 12) labrum; 13) cutting edge of left mandible; 14) hypopharynx; 15) part of labium; 16) markings on abdominal tergites (Azerbaijdzhan, stream flowing from Lake Gey-Gel', 27 June 1974, preparation No. 427, N. D. Sinichenkova).

The nymph described above has been classified as belonging to the species *I. znojkoii* on the basis of the similarity between the markings on the abdominal tergites of imagines and nymphs, and also on the basis that mature nymphs were found at the same time and in the same regions as had previously been indicated for the subimago of this species (Chernova, 1938).

I. znojkoii nymphs are distinguished from the other species from the Caucasus by the shape of the head, by the broad, short labrum, the broad median lobe of the hypopharynx, and the broad mandible with narrow molar margin.

Iron caucasicus.

Cinygma caucasica Chernova, 1938 : 58 - 59, male imago; *Iron caucasicus* Chernova, 1974 : 812, imago.

Nymph. The head is of the same shape in females and males. The posterior margin of the head is straight, little more than half the length of the anterior margin, the inferolateral margins are slightly concave, the anterior angles broadly rounded. The anterior margin of the head is slightly convex with a small notch in the middle; it is covered with short fine hairs extending onto the anterior angles. The width of the head is more than 1.5 times its length (Fig. 11). The width of the labrum is 1.5 times its length; its anterior angles are broadly rounded; the middle of the anterior margin is slightly concave; the posterior margin is strongly concave. The labrum bears fine short hairs on the upper surface (Fig. 12). The length of the mandibles is more than twice their width; the width of the molar margin of the left mandible is only half the width of the mandible. The length of the outer tooth equals the width of the molar margin; 5-7 small denticles may be seen on its outer surface above the setae. The inner tooth of the mandible, which is two-thirds as long as the outer tooth, is apically tricuspid, with the middle cusp the shortest (Fig. 13). The upper

tooth of the maxilla is drawn out into an upward recurved slender process. The median lobe of the hypopharynx is broader than the lateral lobes; its length is at least 1.5 times its width; the upper margin is divided by two small notches into three nearly equal parts (Fig. 14). The outer angle of the glossae is slightly drawn out and broadly rounded, the inner margin is practically straight. The paraglossae are usually inclined one toward the other, with their distal ends almost touching. The upper part of the paraglossae is appreciably narrower than the lower part, its width is little more than 1/5 of the overall length (Fig. 15). The claws bear 4 small sharp denticles, the upper one of which, nearer the distal end of the claw, is the largest. The spinules on the femora and gills are of the same structure as in the previous species. Gills II-VII have 20 or less slender gill filaments, the length of which is half the width of the corresponding gill lamella. There are fine light hairs along the median line of the abdominal tergites.

Overall color of body dark brown, usually with a distinct dark pattern on the head and abdominal tergites. The spots around the eyes take the form of a narrow dark band situated along the inner eye margin. On the anterior margin of the head, each side of the median line, there are paired triangular spots, between which a small unpaired triangular spot may be seen, extending into narrow stripes toward the anterior and posterior margins of the head (Fig. 11). Legs and hairs on femora, tibiae and tarsi light brown. Femora of all legs without dark spots. In nymphs of the early instars the 1st abdominal tergite is black; in nymphs of late instars it is dark brown. There is a broad dark band on the anterior margin of each tergite on abdominal segments II-IX; on tergites II and III this band is extended along the median line to form a triangle, the vertex of which reaches the posterior margin of the tergite. On tergites IV-IX the triangular broadenings are scarcely expressed, but there is a clearly apparent median unpaired stripe along the median line of the abdomen. The sides of the tergites bear small dark spots (Fig. 16). The ganglia of the ventral nerve cord usually show through on the abdominal sternites as rounded dark spots situated around the anterior margin of the sternite, from which oblique dark streaks extend. Gills and sternites rosepink; on the sternites the color is deeper along the median line and bounded by oblique streaks. A rosepink tinge is sometimes apparent on the femora and head.

Length of mature nymphs 12-13 mm, length of cerci 13.5-14.5 mm.

Material. Soviet Georgia: Teberda reservation, Dzhemagat River, 8 Aug. 1958, 14 adult males (dry coll.) (L. Arens). Armenia: Marmarik River at Tsakhkadzor village, 8 June 1956, 28 nymphs; Ambert River at Abaran village, 3 June, 1956, 2 nymphs; stream flowing from the Semenovskiy Pass toward Dilizhan, 19 June 1956, 6 nymphs; Ambert River above Inoklyu village, 2 June 1956, 18 early instar nymphs (L. A. Zhil'tsova). Azerbaidzhan: stream from Lake Gey-Gel', 27 June 1974, 12 nymphs (N. D. Sinichenkova); Kara-chay River above Shaumyanovsk, 1 June 1974, 17 nymphs (V. V. Zherikhin).

Range. North Caucasus, Transcaucasia.

Comment. In identification keys to the genera of the family Heptageniidae based on the imago a long 1st segment of the fore tarsus of the male, which

is longer than all the other segments, is indicated as a distinguishing character of *Iron*. The 1st segment is shorter than the 2nd in *I. caucasicus*, and on the basis of this character it could be placed in the genus *Cinygmula*, but the presence of only one pair of titillators on the lobes of the penis in the male is not typical for this genus. In addition, the absence of *Cinygmula* nymphs and the abundance of *Iron* nymphs in places where *I. caucasicus* imagines are found is also indirect confirmation that this species should be referred to the genus *Iron*. We consider that the species *I. caucasicus* is an exception in the genus *Iron*, like other known exceptions in some genera of the family Heptageniidae (Chernova, 1974).

I. caucasicus imagines were first described from the upper reaches of the Sakarsu River, Lake Gey-Gel'. Because it was in the vicinity of this lake that we found nymphs of the genus *Iron* belonging to the same species, we have classified the nymphs discovered as *I. caucasicus*. In addition, the overall coloration of the body and the markings on the abdominal tergites of imagines and nymphs coincide.

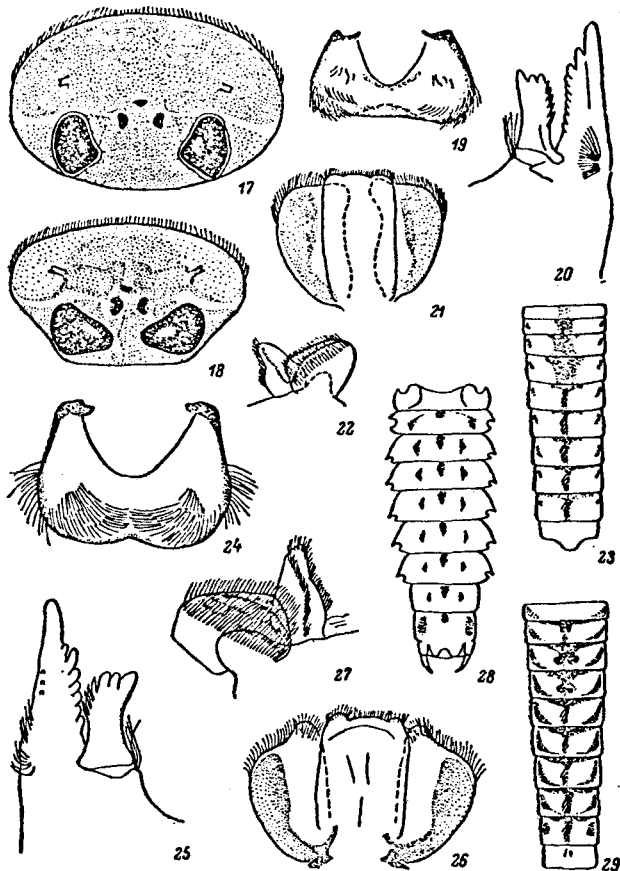
It should be noted that the coloration of the head and abdomen described above is not always clearly expressed. In nymphs before a molt all that remains of the unpaired dark triangle at the anterior margin of the head is a small streak. Not all nymphs, even those caught at the same time, have colored gills and abdominal sternites. Bright rosepink coloration, sometimes acquiring a violet tinge, is found only in recently molted nymphs. The color fades and may completely disappear when nymphs are stored in alcohol.

The nymph of *I. caucasicus* is distinguished from other Caucasian species by the shape of the head, the characteristic markings on it and the colored gill lamellae.

The stream flowing from Lake Gey-Gel', and the Kara-chay River, in which we collected *I. caucasicus* nymphs, is cold, fast-flowing, with a stony bottom. The stream is fairly shallow, while the river is up to 1 m deep in the area where the nymphs were collected.

Iron fuscus.

Nymph. The shape of the head is not the same in females and males. In males the posterior margin of the head is straight, little more than half as long as the anterior margin, the lateral margins are slightly concave, the anterior angles are broadly rounded, and the anterior margin slightly convex, without a notch in the middle. The head of the female is virtually ellipsoidal in shape. Anterior margin of head covered with short hairs in male and female. Width of head more than 1.5 times its length in male, less than 1.5 times its length in female (Figs. 17, 18). Labrum broad, its width practically twice its length, anterior angles broadly rounded, anterior margin slightly concave, posterior margin strongly concave. Labrum slightly narrowed toward base. Fine hairs on surface only around anterior margin and a few on the sides, longer and thicker hairs on anterior angles (Fig. 19). Length of mandibles 2.5 times their width, width of molar margin of left mandible half width of mandible. Length of outer tooth slightly less than width of molar margin, small denticles absent from its outer surface. Inner tooth of mandible two thirds the length of outer tooth; of the three denticles on its apex the outermost is the largest and the other two are of the same size (Fig. 20). Upper tooth of maxilla drawn out into an upward recurved slender process. Inner lobe of hypopharynx



Figs. 17-29. *Iron*. Structural details of nymphs.

17-23) *I. fuscus*: 17) head of female; 18) head of male; 19) labrum; 20) cutting edge of left mandible; 21) hypopharynx; 22) part of labium; 23) markings on abdominal tergites (Armenia, stream flowing from Semenovskiy Pass toward Dilizhan, 19 June 1956, preparation No. 422, paratype, L. A. Zhil'tsova); 24-29) *I. nigripilosus*: 24) labrum; 27) part of labium (Georgia, Ardon River, Mizur village, 5 July 1970, preparation No. 429, paratype, I. I. Kornoukhova), 25) cutting edge of left mandible; 26) hypopharynx (Georgia, Kistinka River, 19 Sept. 1970, preparation No. 434, paratype, I. I. Kornoukhova); 27) paraglossae; 28) markings on abdominal sternites; 29) markings on abdominal tergites (Georgia, Terek River Yuzhny settlement, 7 May 1970, holotype, I. I. Kornoukhova).

of the same width as the lateral lobes, its length practically 1.5 times its width, upper margin divided by two notches into three practically equal parts (Fig. 21). Glossae of the same structure as in other species. Paraglossae pyriform, the width of their narrow upper part little more than one third the overall length of the paraglossae (Fig. 22). Spinules on femora and gills as in *I. znojki*. Gill filaments on gills of middle abdominal segments broad, narrower on last gill. 15 or more gill filaments on gills II-VI, 10 on VII; the length of these filaments is slightly more than half the width of the corresponding gill lamella. Slender light hairs along median line of abdominal tergites.

Overall color of body dark brown. Head lacking distinct markings. Dark spots on inner margin of

eyes triangular (Figs. 17, 18). Legs, and hairs on femora, tibiae and tarsi light brown. There is a single dark spot in the middle of a light area on all femora. Distinct dark markings absent from 1st abdominal tergite. On the other segments black markings stand out clearly against a dark brown ground. There are median spots all along the segment on tergites II-IV; a median longitudinal stripe broadening into a transverse band at the anterior margin of the tergite is clearly apparent on segments V-IX. There are small oblique spots along the sides of tergites II-IX (Fig. 23). The abdominal sternites have dark spots with oblique streaks extending from them. Gills not colored.

Length of mature nymph 13-14.5 mm, length of cerci 12-14.5 mm.

Material. Soviet Georgia: Terek River, 36 km along the Military Georgian Highway, 19 Sept. 1970, 2 nymphs, paratypes (L. I. Kornoukhova). Armenia: stream flowing from Semenovskiy Pass toward Dilizhan, 19 June 1956, 1 nymph (holotype), 2 nymphs (paratypes) (L. A. Zhil'tsova). Nakhichevan ASSR: Paraga, Paraga-chay River, 25 June 1933, 3 nymphs (K. A. Brodskiy).

Range. North Caucasus, Transcaucasia.

Comment. Imagines unknown. The shape of the head and the existence of spots on the femora converge this species with the new species *I. nigripilosus* and distinguish it from *I. caucasicus* and *I. znojkoj*. The nymphs described above are distinguished from *I. nigripilosus* by the markings on the abdominal tergites and sternites, and also by light brown hairs on tibiae and tarsi.

Some specimens do not have dark spots on all legs; these spots are absent from obviously regenerated legs, but clearly apparent on the other legs.

Iron nigripilosus.

Nymph. Shape of head not the same in males and females. Posterior margin of head of male slightly concave, its length half the head width. Lateral margins noticeably concave, anterior angles broadly rounded, anterior margin practically straight, slightly convex, with a barely perceptible notch in the middle. Width of head more than 1.5 times its length. Head of female practically elliptical, posterior margin slightly convex, lateral margins slightly concave, anterior margin convex, without a notch in the middle. Width of head less than 1.5 times length. Labrum slightly narrowed toward base, its anterior margin slightly notched, its posterior margin deeply concave, its width practically 1.5 times its length. Fine hairs converging on median line on outer surface of labrum, lateral angles covered with longer thick hairs (Fig. 24). Length of mandibles 2.5 times their width, width of molar margin of left mandible half width of mandible. Length of outer tooth slightly greater than width of molar margin, three small denticles on its surface. Inner tooth of left mandible two thirds as long as outer tooth, the outermost denticle of its three apical denticles the longest and thickest, the other two of equal size (Fig. 25). Upper tooth of maxilla not drawn out into an upward recurved fine process. Inner lobe of hypopharynx narrow, its width two thirds of its length, upper margin of inner lobe divided by two notches into three unequal parts, the middle one slightly wider than the lateral parts. Outer lobes of hypopharynx of practically the same width as inner lobe (Fig. 26). Posterior margin of glossae drawn out and broadly rounded, their inner margins practically straight. Paraglossae broader in lower part, apically narrowed and obliquely truncate, the width of their narrow upper part little more than one quarter the overall length of the paraglossae (Fig. 27). Spinules on femora and gills as in *I. znojkoj*. Gills II-VI have up to 20 slender gill filaments, the length of which is one-third the width of the corresponding gill lamella. Gill VII has no more than 10 slender gill filaments. There are light hairs along the median line of the abdominal tergites.

General color of body dark brown. There is a short dark band around the inner margin of the eyes, nearer their upper part. Above the lateral ocelli there are typical dark brown rounded spots of the same size as the lateral ocelli. A group of dark hairs recurved onto the upper surface of the head is clearly

apparent on the sides of the head. The markings of the head described above are the same in males and females. Legs light brown, with a distinct dark spot in the middle of a light area. Hairs on femora light brown, on tibiae and tarsi very dense, dark brown. In larvae ready to emerge a dark transverse band shows through on the fore femur; this band is darkest near the margins of the femur. Markings on abdominal tergites and sternites black. Tergite I has only lateral oblique spots; on II the dark band at the anterior margin is drawn out toward the median line of the tergite in two small paired spots. The markings are practically identical on tergites III and IV, a dark band at the anterior margin broadens into a triangle, the vertex of which is pointed downward, and each side of which a single rounded spot is to be seen. On tergites V-VII the markings are similar to the previous markings, except that the rounded spots are absent and a median unpaired stripe is to be seen. On segment VIII and IX this stripe is thicker. On the sides of tergites II-VIII the lateral spots are rounded and longitudinally extended (Fig. 29). At the anterior margin of the sternites there is a rounded dark spot that is longitudinally extended and slightly pointed below. To the sides of it there are lateral triangular spots that gradually reduce from sternite II to sternite VIII. Lateral spots on sternite IX rounded, longitudinally extended (Fig. 28). Gills not colored.

Length of mature nymph 12-14 mm, length of cerci 13-14.5 mm.

Material. Soviet Georgia: Terek River, Yuzhny settlement, 7 May 1970, 1 nymph, holotype; Kistinka River, along the Military Georgian Highway, 19 Sept. 1970, 1 nymph; Terek River, Gvileti village, 9 May 1970, 4 nymphs; Terek River, Balta village 11 June 1970, 2 nymphs; Ardon River, Mizur village, 5 July 1970, 1 nymph (L. I. Kornoukhova).

Range. North Caucasus.

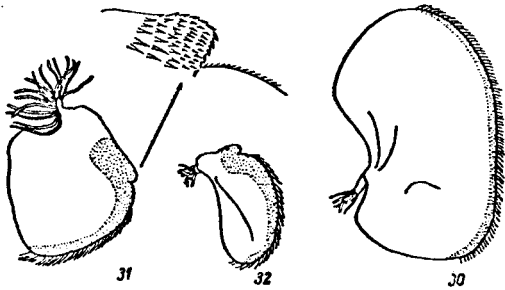
Comment. Imagines unknown. Distinguished from all species from the Caucasus by the characteristic markings on the abdominal tergites and sternites, and by the presence of dense dark brown hairs on the tibiae and tarsi.

NYMPHAL IDENTIFICATION KEY TO MAYFLIES OF THE GENUS IRON IN THE CAUCASIAN FAUNA

- 1 (4). Femora without spots. Width to length ratio of head the same in females and males. All three apical denticles on inner tooth of left mandible of different size.
- 2 (3). Width of head more than 1.5 times length, anterior margin with slight notch in the middle. Width of labrum 1.5 times its length. Gills II-VII bear no more than 15 gill filaments. Markings on sternites consisting of rounded spots with oblique streams extending from them. *I. caucasicus*.
- 3 (2). Width of head less than 1.5 times its length, anterior margin without a notch in the middle. Width of labrum twice its length. Gills II-VII bearing up to 30 gill filaments. Abdominal sternites without markings. *I. znojkoj*.
- 4 (1). All femora with single dark spots in middle of light areas. Width to length ratio of head not the same in females and males. Of three apical

denticles on the inner tooth of the left mandible two are of the same size.

- 5 (6). Markings on abdominal sternites consisting of rounded spots with oblique streaks extending from them. Dark spots on sides of tergites. Hairs on tibiae and tarsi light brown. Gill filaments thick. Paraglossae apically rounded. I. fuscus.
- 6 (5). Markings on abdominal tergites consisting of rounded spots in the middle and triangular spots to the sides of them. Oblique dark streaks on sides of tergites. Hairs on tibiae and tarsi dark brown. Gill filaments slender. Paraglossae apically truncate. I. nigripilosus.



Figs. 30-32. Iron znojkoj. Structure of nymphal gills.

30) Gill I; 31) gill V; 32) gill VII. Preparation No. 420.

We must conclude with a few general remarks. The nymphs of the genus Iron described above may be compared only to the nymphs of I. maculatus, since this is the only Palearctic species for which the nymph is known. The nymph of I. maculatus differs markedly from that of Caucasian nymphs in the structure of the gills. The latter have strongly developed gill lamellae on segment I; the upper part of the lamella is broader than the lower part. There are small rounded processes covered with small sharp spinules on the thickened margins of gills II-VII (Figs. 30-32). In I. maculatus the upper part of the 1st gill lamella is narrower than the lower part, there is only slight thickening along the margins of all gills, and processes are completely absent from the thickened margin (see Chernova, 1949, Fig. 9).

All nymphs of the genus Iron from the Caucasus are typified by light hairs along the median line of the abdominal tergites. The hair clusters are dense on nymphs of the early instars, while in late instar nymphs, especially before emergence, the hairs are sparse, although still clearly apparent. Without doubt we classify nymphs with such a character as belonging to the genus Iron.

It has been noted that the shape of the eyes alters in nymphs of the genus Iron in the course of ontogeny. In early instar nymphs the eyes are of the same shape in females and males; the length of the eyes exceeds their width and they are inclined relative to the longitudinal axis of the body (Fig. 11). In late instar

nymphs the eyes of females remain of the same shape (Fig. 4), whereas in males the inner corners of the eyes are extended, so that their width is increased, and may exceed their length (Fig. 18).

It has been noted in the descriptions of I. znojkoj and I. nigripilosus nymphs given above that the upper tooth of the maxilla does not bear a slender upward recurved process. However, we cannot be completely certain that this is a distinct morphological character, since the process could have been broken off or worn away. If this character is to be examined we must make a preparation and examine it under the microscope. The amount of material of these two species at our disposal was slight, and we were unable to make more than two preparations each of I. znojkoj and I. nigripilosus. The mandibular teeth and the claw denticles may, as a rule, become worn and be blunted and shorter in Iron nymphs before the molt. In some preparations the apical part of the outer mandibular tooth is broken off and it appears short, but a new mandible shows through, on which it is clearly apparent that there is a long apical tooth. In this connection nymphs that had recently molted were selected for the preparations. It is possible that we did not succeed in this when making the preparations of the two species referred to above.

The ratio of the length of the gill filaments and the width of the gill lamella is given as a taxonomic character in the descriptions. It should be borne in mind that the gill filaments are shorter in early instar nymphs and that this ratio will be different. This character must be examined in nymphs of the middle and late instars.

In the nymphs of I. longimanus the tibiae of all legs are longer than the femora (Edmunds and Allen, 1964, Fig. 1), in which respect they differ from the nymphs of I. maculatus and from those of all species from the Caucasus, in which the fore tibia is longer than the femur, the middle tibia is of the same length as the femur, and the hind tibia shorter.

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