

NEW AND LITTLE-KNOWN MAYFLY SPECIES (EPHEMEROPTERA)
FROM THE AMUR BASIN

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Until recently one species of the genus *Isonychia* was known for the Amur Basin, namely *I. japonica* Ulm. (Chernova, 1952), described by Ulmer (1919) from Japan and the Korean Peninsula.

When processing material of mayflies collected in the period 1949-1967 we found two new species of this genus: *I. ussurica*, sp. n., and *I. polita*, sp. n. The first of these differs considerably from the European species *I. ignota* and the Japanese *I. japonica* in genital structure and in the colored wings. *I. polita* is further markedly different from the other species mentioned in genital structure and in the larger size of the body. Reference is also made in the paper to little-known nymphs of the genus *Isonychia* found in the Amur Basin.

The types of the new species are in the collections of the Zoological Institute, USSR Academy of Sciences in Leningrad.

The author is pleased to express his gratitude to M. Keffermyuller and R. S. Kazlauskas, who were kind enough to supply material of the European species *I. ignota* for comparison.

Genus *ISONYCHIA* Eaton, 1871

(= *Chirotonetes* Eaton, 1885).

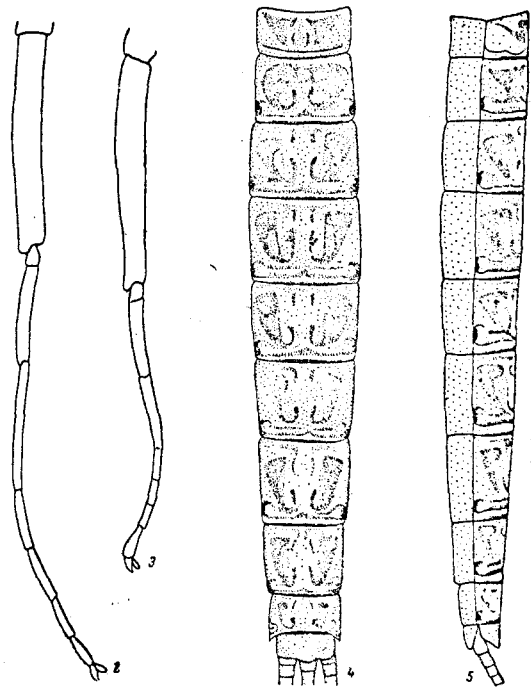
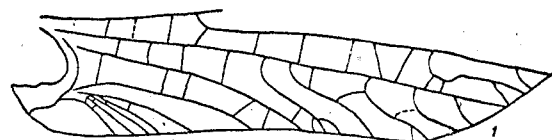
1. *Isonychia polita* Bajkova, sp. n. (Figs. 1-6).

Male imago (alcohol). Head light brown. Thorax brownish above and below, with light spots on its sides; three slender dark lines on prothorax and metathorax. Wings hyaline; longitudinal veins light brown, crossveins yellowish; crossveins linking A_1 of forewing with posterior margin smaller than in *I. ignota* Walk., *I. japonica* Ulm. and *I. ussurica*, sp. n., first and second veins branching (Fig. 1). Legs light brown, with narrow dark bands at points of articulation. Femur of foreleg practically twice as long as tibia, which is $1/3$ the length of the tarsus; 1st tarsal segment longer than tibia and 2.3 times as long as 2nd tarsal segment; tarsal segments of foreleg arranged in order of decreasing length: 1, 2, 3, 4 and 5; the 2nd segment equal to the 3rd; hind femur 2.5 times as long as tibia; tarsal segments of hind leg arranged in order of decreasing length: 1, 5, 2, 3 and 4; 1st tarsal segment 2.4 times as long as 2nd, (Figs. 2, 3).

Ventral surface of abdomen pale brown with lemon-yellow tinge, dorsal surface with characteristic brownish markings: large, dark, practically triangular spots located along sides of each abdominal tergite, curved slender stripes and small spots along the median line (Figs. 4, 5). Genital lobes in the form of broad plates, outer margins of each lobe extended forward and slightly bending inward (Fig. 6). Caudal setae light brown with dark banding.

Length of body 19 mm, length of wing and caudal setae 12 mm. Nymph unknown.

One male imago was collected from vegetation around the Iman River near the settlement of Roshchino, July 1958 (holotype).



Figs. 1-5. *Isonychia polita*, sp. n.

1) part of forewing of male imago (Iman River, settlement of Roshchino), 2) foreleg of male imago, 3) hind leg of male imago, 4) abdomen of male imago from above, 5) abdomen of male imago from the side.

Comment. This species differs very markedly from the previously described species of the genus *Isonychia* in the ratio of the length of the tibia and the 1st tarsal segment, in the coloration and size of the body and also in genital structure. However, in the form of the penis *I. polita* is similar to the North American species *I. aridus* Say (Eaton, 1883-1888). In the length ratio of the tibia of the foreleg it is closer to the genus *Oniscigaster*.

2. *Isonychia ussurica*, sp. n. (Figs. 7-11).

Male imago (alcohol). Eyes black with grayish tinge; head brown; thorax dark brown, shiny above, brownish below; fore wings colored: brownish from middle of wing practically to its apex (Fig. 7); costal and subcostal fields nearer wing

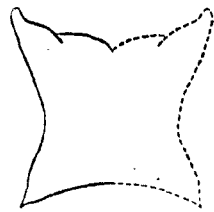
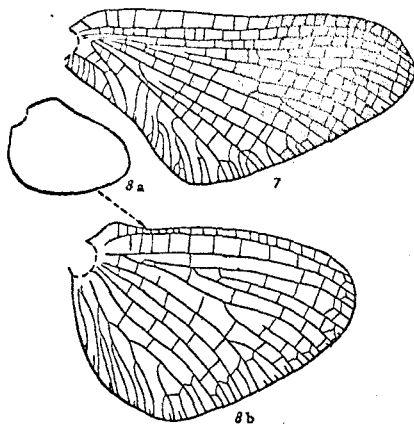


Fig. 6. *Isonychia polita*, sp. n. Penis of male imago.



Figs. 7-8. *Isonychia ussurica*, sp. n.
7) forewing of male imago (Khor River, Bol'shaya channel), 8a) hind wing of male imago, 8b) the same considerably enlarged.

base brownish in color in some specimens; * crossveins and longitudinal veins brownish; costal field with 23-25 crossveins; 3rd and 4th crossveins linking A_1 of forewing with posterior margin multi-branched; hind wings hyaline, without spots (Fig. 8, a, b). Anterior legs dark brown, tibia piceous brown; bases of tarsal segments light, terminal tarsal segment entirely brown; femur considerably shorter than tibia; tarsal segments in most specimens arranged in order of decreasing length: 1, 2, 3, 4 and 5; 1st and 2nd segments practically equal in length, 5th segment of some specimens longer than 4th; 2nd and 3rd pairs of legs yellow; femur of hind leg longer than or of same length as tibia; tarsal segments arranged in sequence of decreasing size: 5, 1, 2, 3, 4; 2nd segment sometimes longer than 1st or same length (Table 1).

Dorsal surface of abdomen brownish with dark bands around intersegmental articulations; abdominal sternites pale brown with a yellow tinge; terminal abdominal sternites darker; 10th sternite with a deep notch, its inner margin extended, genitalia light brown; 1st segment of forceps the shortest (Fig. 9); genital lobes in the form of broad plates; their ends extended; lobes of penis each bearing two small apical spinules; slender setae located on inner surface of each lobe (Fig. 10); caudal setae pale yellow, basally brownish.

Female imago. Head brownish yellow; eyes black with a grayish tinge; thorax dark brown above and below; wings hyaline, without spots; longitudinal veins and crossveins well marked; 26-29 crossveins in costal field of females, more than in males; 4th and 5th crossveins linking A_1 of forewing with posterior margin branching several times. Femur and tibia of forelegs brownish; tarsus variegated; bases of 1st-4th tarsal segments light, apical segment entirely brownish; femur shorter than tibia; tarsal segments of foreleg arranged

*In the North American species *I. annulata* Trav. the forewings are brownish basally and centrally (Needham et al., 1935).

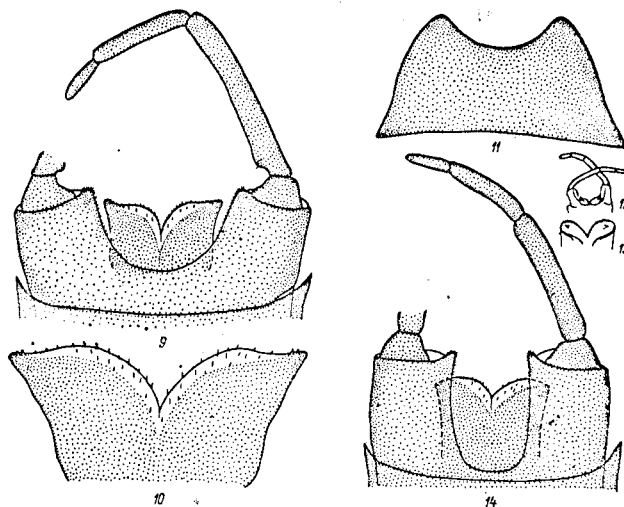
Table 1

Size of femur, tibia and tarsal segments in divisions of an eyepiece micrometer¹

Species	Length (mm)	Sex	Foreleg							Hind leg					Where and when collected		
			Femur	Tibia	tarsal segments					Femur	Tibia	tarsal segments					
					1st	2nd	3rd	4th	5th			1st	2nd	3rd		4th	5th
<i>Isonychia polita</i> , sp. n.	19.0	♂ Imago	27.0	16.0	17.0	7.0	6.6	5.1	5.1	27.0	12.0	8.0	4.0	3.0	5.0	Iman River, near village of Roshchino, July 1958	
<i>Isonychia ussurica</i> , sp. n. ²	11.8	♀ Imago	15.5	23.7	4.1	3.7	3.6	2.0	3.8	20.0	17.0	2.5	2.5	2.0	3.5	Khor River, Bol'shaya channel, Aug. 15, 1951	
The same	11.5	♀ "	15.0	22.5	4.0	3.8	3.0	2.5	3.2	20.5	17.4	2.7	2.6	2.1	3.3	The same	
" "	13.2	♂ "	17.5	27.0	11.5	10.5	8.0	6.0	3.0	20.0	20.0	3.0	2.8	2.0	3.3	Khor River, Bol'shaya channel, Sept. 21, 1950	
" "	13.5	♂ "	18.0	28.0	11.0	9.5	7.5	6.0	3.0	20.8	20.2	3.0	2.9	2.1	3.2	The same	
" "	14.6	♂ "	19.0	31.5	12	11.5	8.0	6.2	3.0	21.0	20.5	3.2	2.9	2.1	3.3	"	
" "	13.6	♀ "	15.0	22.0	4.0	3.5	3.0	2.5	3.0	18.3	17.0	2.4	2.7	2.1	3.1	Khor River, Bol'shaya channel, Aug. 14, 1951	
<i>Isonychia japonica</i> Ulm.	13.0	♂ "	14.1	21.6	5.5	5.3	4.0	3.4	3.0	15.0	13.0	1.8	1.8	2.5	2.8	Amur River, near Khabarovsk, Sept. 12, 1961	
The same	12.0	♂ "	13.5	20.0	5.2	5.1	3.9	3.8	2.5	14.0	12.8	1.7	1.5	1.1	2.8	The same	
" "	13.2	♀ "	13.0	14.0	2.2	2.7	2.0	1.0	3.0	16.1	14.2	1.5	2.0	1.2	3.1	"	
<i>Isonychia ignota</i> Walk.	13.5	♀ "	—	—	—	—	—	—	—	18.6	16.0	2.0	2.0	1.1	2.5	Neris River, village of Turnishkes, Lithuania, July 17, 1959	

¹Measurements made at a magnification of 2 x 3 (Tyods).

²Considerable variation in the ratio of tarsal segments of the foreleg occurs in *I. ussurica* males. This is particularly noticeable as the size of the insects increases. Because of that we measured the legs of several specimens.



Figs. 9-14. *Isonychia*, genitalia and genital appendages of male and female.

9-10) *Isonychia ussurica*, sp. n., male imago: 9) genital appendages, 10) penis; 11) same species, genital plate of 9th sternite of female; 12-13) *I. velma* Needham, male imago: 12) genital appendages, 13) penis (from Needham, 1932); 14) *I. japonica* Ulm., genital appendages of male imago (Amur River at Khabarovsk).

In order of decreasing length: 1, 2, 3, 5 and 4; 3rd and 5th segments equal; 2nd and 3rd pairs of legs yellowish; femur of hind leg longer than tibia; tarsal segments arranged in decreasing order of size: 5, 2, 1, 3 and 4; 1st and 3rd segments equal.

Abdomen brownish above, pale brownish yellow below; genital plate of 9th sternite projecting slightly beyond margin of abdomen; its lateral surfaces slightly curved, apical angles rounded; plate with a semicircular notch at apex (Fig. 11); caudal setae colored as in male.

Size in mm	Male	Female
Body length	11.5-14.0	12.0-14.2
Wing length	12.0-14.0	13.5-14.5
Length of caudal setae	31.0-32.0	19.0-20.0

Nymph unknown.

Comment. Only two species of the genus are known from Japan and China (Formosa): *I. japonica* Ulm. and *I. formosa* Ulm. The species here described is similar in the color of the body and the legs to the North American *I. velma* Needh., but differs from it in genital structure and the coloring of the wings (Figs. 12-13; see Needham, 1932).

Distribution and material. Ussuri basin: Khor River, Bol'shaya channel, Aug. 25, 1950, 1 ♂; same locality, Sept. 21, 1950, 2 ♂♂ and 1 ♀; same locality, Sept. 14, 1951, 5 ♂♂ and 1 ♀ (paratype); same locality, Aug. 20, 1952, 1 ♂; same locality, Aug. 15, 1953, 8 ♂♂ and 4 ♀♀; same locality, Aug. 20, 1956, 3 ♂♂ (including holotype), the author's collections. Maritime Territory, source of Sitsa River, Suchan, Aug. 30, 1928, collections of A.I. Kurentsov (material ZIN Acad. Sci. USSR).

3. *Isonychia japonica* Ulm., 1919 (Figs. 14-18).

The species was originally described from Japan by Ulmer from male and female adults. The nymphs have been described by Ueno (1928) from Japan.

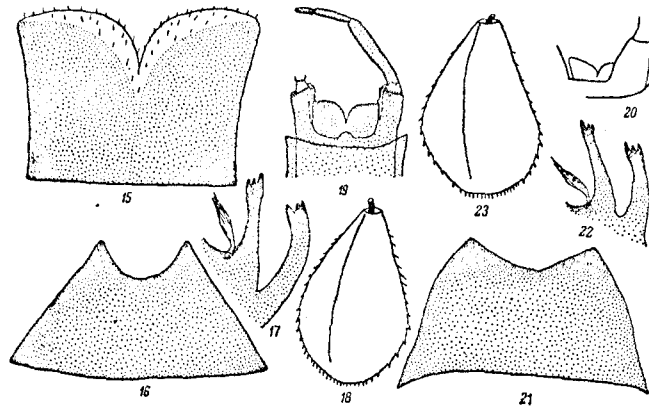
Later reference was made to nymphs of this species by Imanishi (1940) from the Korean Peninsula. The winged insects are recorded for the first time for the Amur Basin. Since the male and female subimagines of this species are unknown, we describe them below.

Male and female subimagines. Coloration of body, legs and caudal setae the same as in the imago but less clearly expressed; a light longitudinal stripe along the median line of the body, as in the nymphs, which is absent from the adults. Fore and hind wings brown-cinnamomeous; longitudinal veins weakly shaded, light; crossveins dark brown, black in costal and subcostal fields; hind wing with characteristic coloration: a rather broad dirty brownish band, which is not preserved in the imago, extends all along its posterior margin.

Size, mm	Male	Female
Body length	11.0-13.8	12.5-14.0
Wing length	12.0-13.0	13.0-14.0
Length of caudal setae	28.0-30.0	18.0-20.0

Comment. Imanishi (1940) notes that some nymphs of this species reach a length of up to 18 mm in bodies of water in Japan. The largest nymphs from the Amur Basin are 15 mm, and alate forms 14.0 mm.

Distribution and material. The species is found in Japan, the Korean Peninsula and the Amur Basin: upper reaches of the Amur, Shilka River, 4 km below Chasovaya. Upper reaches of the Amur: 10 km below the village of Pokrovka and near Sgibnevo; mouth of B. Never River and near Dzhallinda (Chernova, 1952); Sungari River, right bank near Harbin (foreign collections). Middle reaches of the Amur, Amur River, opposite the village of Leninskoye (Baykova, 1965). In addition, we know of nymphs from the Bira River, 3 km below Lake Teploye. Lower reaches of the Amur: 90 km below Khabarovsk, the Yelabuga near Sarapul'sk channel; the Bolon', Serebryany channel; 2 km above the



Figs. 15-23. *Isonychia*, structural details of imago and nymph.

15-18) *I. japonica* Ulm.: 15) penis of male, 16) genital plate of 9th sternite of female, 17) apical teeth on mandible of nymph, 18) shape of second pair of nymphal gill filament plates, 19-23) *I. ignota* Walk.: 19-20) genital appendages of male [19) Warta River, Poland, drawing by Keffermyuller, 20) after Eaton, 1883-1888], 21) genital plate of female (Neris River, village of Turnishkes, Lithuania), 22) apical tooth on nymphal mandible, 23) shape of second pair of nymphal gill filament plates.

village of M. Gor'kiy, the middle of the river (Chernova, 1952); the Amur, near the village of Malmyzh, in front of a cliff; same locality, near Khabarovsk; Ussuri River, mouth, middle of the river; Khor River, channels: Bol'shaya, "Potopilis", springs: Orekhov and Privalovskiy; Kiya River, left bank, Marusino village area; Iman River, near the village of Roshchino; same locality, Fedurovskaya channel; Salasu River (Lake Khivanda). S. Maritime Territory: Chernaya rechka; Pozhiga River, right bank, Transbaykalia; Kul'dur, mountain stream; Darasun River (Baykova, 1965).

We collected a large number of nymphs, 22 male and 16 female adults and 9 male and 8 female subimagines.

The nymphs are numerous in the Sungari River near the shore on water plants where the current is swiftest. Comparatively large numbers were noted on drifting benthos in the Amur and Ussuri Rivers at a depth of 1.5-3 m. In the Khor River nymphs were taken at a depth of 0.5-3 m with fish fly traps. In addition, nymphs were collected in small mountain rivers and water courses where springs rise in a sand-shingle bottom at a depth of 0.1-0.5 m. Some nymphs were found in silty sand between stones. The nymphs are eaten by the "Amur barbel" (*Hemibarbus maculatus*), the "flathead asp" (*Pseudaspius leptocephalus*), and autumn chum and sturgeon fingerlings.

Adults were collected in July-September. They are most abundant on the wing in the first few days of August and at the beginning of the second third of September.

Comment. The species *I. japonica* is closest to *I. ignota* in the coloration of the nymphs and in the shape of the filamentous gills and the structure of the genitalia. Nevertheless, females differ sharply in the shape of the genital plate of the 9th sternite (Figs. 19-23).

4. *Isonychia* "na" Iman. (Figs. 24-26).

Three nymphs were collected with an egg net in the Amur River opposite the village of Leninskoye and near Khabarovsk. These nymphs differ sharply from *I. japonica* in body coloration (Fig. 25). It is quite possible that they belong to the new species, *I. ussurica*, described by the author from the winged stage, although no nymphs were found in the area where the alate forms were collected.

Isonychia "na" nymphs are known from Manchuria (Imanishi, 1940).

5. *Isonychia*, sp. 1 (Figs. 27-29).

Nymphs (alcohol). Head brown with a light stripe between eyes (Fig. 27). Apical teeth of mandible with three teeth, the outer teeth being of equal length, the central tooth smaller (Fig. 28); middle lobe of hypopharynx without an incision. Thorax brownish, with a light stripe extending along the median line, which is slightly narrower than in *I. japonica*. Rudimentary wings of last instar nymph dirty brown before emergence, with distinct light crossveins and dark bands on each side of them. Legs variegated; two dark transverse bands on each femur, one on each tibia and tarsus.

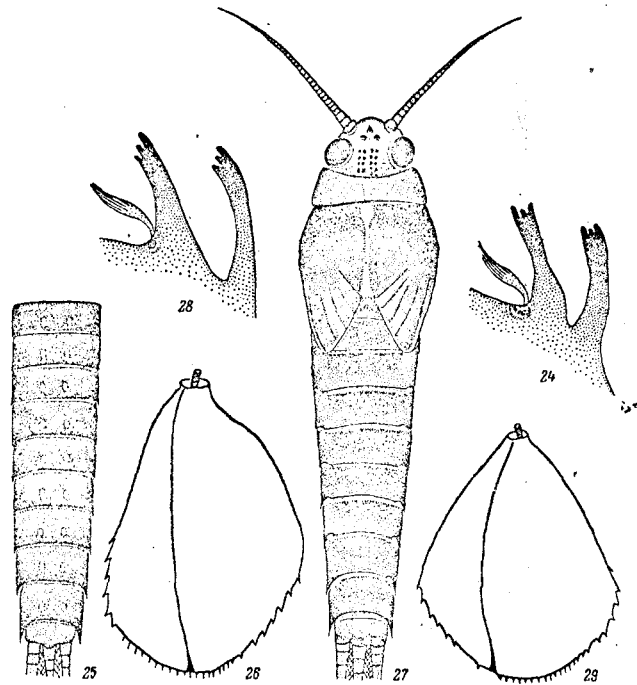
Abdomen dark brown, without spots and stripes; upper portion of tergite darkest (Fig. 27); basal abdominal sternites light brown, apical sternites considerably darker; each abdominal sternite with two dark punctate spots toward each lateral margin. Characteristic gill filament of third pair of gills broader than in *I. japonica*; its lateral surfaces, nearer the posterior margin, convex (Fig. 29). Caudal setae unicolorous.

Body of mature nymph 10-11 mm long, caudal setae 5 mm long.

Comment. This species resembles *I. japonica* in having a light stripe on the head and the thorax. It differs from it in the structure of the teeth on the mandible, the shape of the third pair of filamentous gills and the color of the abdominal tergites, on which there is no light longitudinal stripe. The nymph of *Isonychia*, sp. 1, apparently belongs to a new species or else to *I. ussurica*, described above from the winged stage from the Ussuri basin. However, no such nymphs were found where the alate forms were collected.

Distribution and material. Middle reaches of the Amur: Amur River, Golovinskaya channel; same locality, near the village of Leninskoye, Amur River near Khabarovsk. In all three nymphs were collected.

The nymphs were caught with an egg net at a depth of 2-7 m, at a water temperature in July-August of 20 to 25°C.



Figs. 24-29). *Isonychia*, details of nymphal structure.

24-26) *Isonychia* "na" Iman: 24) apical teeth of nymphal mandible (the Amur near Khabarovsk), 25) dorsal view of nymphal abdomen, 26) shape of 3rd pair of nymphal gill filament plates, 27-29) *Isonychia*, sp. 1: 27) dorsal view of nymph (the Amur, village of Leninskoye), 28) apical teeth of nymphal mandible from below, 29) shape of 3rd pair of nymphal gill filament plates.

KEY FOR IDENTIFICATION OF SPECIES OF THE GENUS *ISONYCHIA*

Males

- 1 (6). Wings hyaline.
- 2 (5). Abdomen cinnamon-brown to dark brown. Its tergites with only a pair of elongated dark spots closer to the median line.
- 3 (4). Fourth crossvein linking A_1 of forewing with posterior margin branched once. Paired spots on 1st-9th abdominal tergites comparatively narrow and dark. Lobes of penis slightly drawn out into angles (Figs. 19, 20). Body length 12-13 mm *I. ignota* Walk.
- 4 (3). Fourth crossvein linking A_1 of forewing with posterior margin branched several times. Paired spots on 1st-6th abdominal tergites comparatively broad, with a narrow light line in the middle; these spots on 7th-9th abdominal tergites milky white. Lobes of penis with practically straight lateral margins, broad, apically not drawn out into angles but noticeably rounded. Inner surface of each lobe with slender hairs (Fig. 15). Body length 11.0-13.8 mm *I. japonica* Ulm.
- 5 (2). Abdomen very variegated. Its tergites having large and small dark and curved lines (Figs. 4, 5). Genital lobes in the form of broad plates; outer

margins of each lobe extended forward and slightly curving inward (Fig. 6). Body length 19 mm *I. polita*, sp. n.

- 6 (1). Wings colored.
- 7 (8, 9). Extreme anal angles of fore and hind wings with small rose-pink striae. Anterior margin of forewing with rose-pink coloring concealing the veins C, Sc, R and the apical portion of the wing. Lobes of penis with straight lateral margins, ends of lobes rounded. Inner surface of each lobe with fine hairs (Figs. 12-13). Body length 14 mm. *I. velma* Needham
- 8 (7, 9). Anal angles of fore and hind wings hyaline. Forewing brownish in color from middle practically to apex (Fig. 7). Lobes of penis apically drawn out into acute angles each bearing two small denticles; inner surface of each lobe with fine hairs (Fig. 10). Body length 11.5-14.0 mm. *I. ussurica*, sp. n.
- 9 (7, 8). Forewing brownish at base and in center. Body length 10 mm *I. annulata* Needham

Females

- 1 (4). Genital plate of 9th sternite with curved lateral margins, weakly tapering apically.
- 2 (3). Apical angles of genital plate rounded; apex of

plate with a semicircular recess (Fig. 11). First and 2nd crossveins linking A₁ of forewing with posterior margin, not branched; 4th and 5th veins branched several times. Body length 12.0-14.2 mm *I. ussurica*, sp. n.

- 3 (2). Apical angles of genital plate slightly acuminate; apex of plate with a sharp recess (Fig. 21). First and 2nd crossveins linking A₁ of forewing with posterior margin, branched; 4th and 5th crossveins branched once, both joined together. Body length 13.0-16 mm *I. ignota*, Walk.
- 4 (1). Genital plate with straight lateral margins, strongly tapering apically. Apical angles of plate drawn out and acuminate; apex of plate with a semicircular recess (Fig. 16). First and 2nd crossveins linking A₁ of forewing with posterior margin, not branched, 4th crossvein branched several times and not joined with 5th. Body length 12.5-14.0 mm *I. japonica* Ulm.

Nymphs

- 1 (4). Abdomen without a longitudinal light stripe along median line of body.
- 2 (3). Abdominal tergites without light spots, dark brown, anterior margins of tergites darkest (Fig. 27). Characteristic third pair of filamentous gills practically symmetrical, with strongly convex lateral surfaces nearer the posterior margins (Fig. 29). Body length of mature nymphs 10-11 mm *Isonychia*, sp. 1.
- 3 (2). Abdominal tergites with two light small rounded spots nearer the median line of the body (Fig. 25). Body length of mature nymphs 12 mm. Third pair of filamentous gills asymmetrical (Fig. 26) *Isonychia* "na" Iman.
- 4 (1). Abdomen with a distinct longitudinal light stripe along median line of body.
- 5 (6). Anterior margin of middle lobe of hypopharynx straight. Each apical tooth of mandible with one long denticle (Fig. 22). Second filamentous gill with strongly convex lateral margin (Fig. 23)..... *I. ignota*, Walk.
- 6 (5). Anterior margin of middle lobe of hypopharynx rounded. Only one apical tooth of mandible with a long denticle (Fig. 17). Second filamentous gill lacking strongly convex lateral margin, practically symmetrical (Fig. 18)..... *I. japonica*, Ulm.

SUMMARY

Descriptions are given of two new mayfly species from the Ussuri Basin (*Isonychia ussurica*, sp. n., and *I. polita*, sp. n.) and also of the previously unknown larvae of species belonging to the genus *Isonychia*; the paper also contains keys for identification of adults and nymphs.

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