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ON THE MAYFLIES (EPHEMEROPTERA) OF THE AMUR BASIN

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Mayflies of the genus Siphonurus (S. chankae, S. zhelochovtsevi) were described from the Amur basin by Chernova (Tshernova) (1952) from the imago. We have succeeded in identifying the nymphs of these species by rearing the winged forms from them.

The present study is devoted to the description of a new species of the genus Siphonurus from the nymph and of the female reared from it in the Teplovka River (Bira river basin). Nymphs of S. chankae and S. zhelochovtsevi, and of other little known species from the Amur region and the Maritime Territory are described for the first time.

The type of the new species is in the Zoological Institute, USSR Academy of Sciences in Leningrad.

Fam. SIPHLONURIDAE

Genus SIPHLONURUS

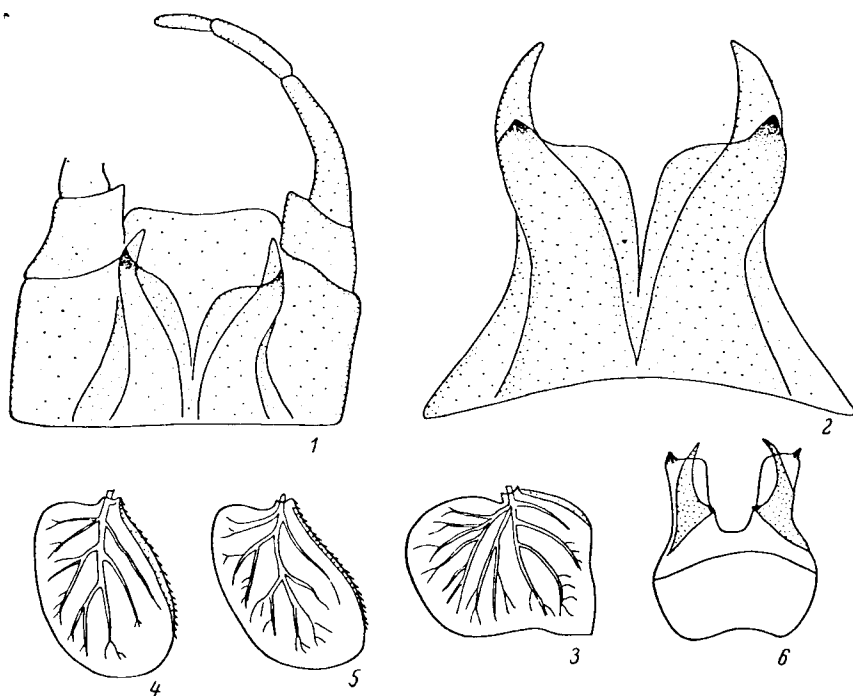
Siphonurus zetterstedti (Figs. 1-6).

Range and material. The species was previously known in the USSR from the Kola Peninsula, the Pechora river basin and Lake Onega; it was described from Scandinavia. It occurs in E. Siberia: upper reaches of the Yenisei, upper reaches of the Angara (Baykova, 1965b), in the Amur Basin; the rivers Onon, Shilka, Chernaya, Bira, Birakan, Bidzhan, Ussuri, Khor, Birushka, Kiya, Tudo-Vak, Salasu, Amgun', Yay, My, Amur (middle and lower reaches) and lakes Bolon', Malaya and Bol'shaya Sharga and Kizi, and in the Southern Maritime Territory (Arzamazovka River).

Comment. Illies (1967) records this species as S. lacustris in a summary of the Ephemeroptera of Europe.

The species is abundant and widely distributed in the Amur basin. The nymphs inhabit waters of various types: lakes, water courses, small cut-off pools in which water temperature reaches 29°C, large rivers, and also small rivers, streams and springs fed by groundwater in which water temperature in the summer is between 9 and 16°C. In the winter nymphs were collected in the Khor and Salasu rivers from autumn chum spawning redds. They prefer beds of submerged water plants and heavily silted stones. They are found on snags and on sand and shingle bottoms. In the Teplovka River, issuing from spring lake, the nymphs are abundant in cushions of algae and grey ooze (as many as 1000 per 1 m²). In Lake Kizi, around the mouth of the Yay River, vast numbers of nymphs were congregated around the water's edge on vegetation and old roots, and also in small inlets containing submerged growing vegetation at a depth of 0.5-1 m. In the Amur and Ussuri rivers nymphs were collected with egg nets at a depth of 2-18 m. In the benthos transported by the Iman and Khor rivers nymphs were taken in fingerling traps at a depth of 0.5-3 m when water temperature in the spring was 8-13°C. The nymphs are consumed by greyling, lenok (Brachymystax lenok), whitefish, taimen (Hucho taimen), Dolly Varden, autumn chum fingerlings, "Amur barbel" (Hemibarbus longirostris) and "Amur catfish" (Parasilurus azotus).

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Figs. 1-6. *Siphonurus zetterstedti*.

- 1) Genital appendages of male (Bira River); 2) penis; 3) gill leaflet from 3rd abdominal segment of nymph (from Bengtsson, 1930); 4-5) gill leaflet from 7th abdominal segment of nymph [4) Bira River; 5) from Bengtsson, 1930]; 6) genital appendages of male (after Bengtsson).

Flight was recorded from early June to late September.

The body length of last instar nymphs is 15-16 mm, the length of the caudal filaments 1 mm.

Siphonurus chankae (Figs. 7-12).

The species was described by Chernova (1952) on the basis of the winged stage from the Khanka. We reared adult insects from nymphs (Fig. 7). The nymphs were previously unknown and are described for the first time below.

Nymph (alcohol). General color of body yellow-brown. Head ranging from light to dark brown; two long spots on head between eyes; labium and clypeus dark or one small light spot located on clypeus along median line; inner tooth of maxilla with three apical teeth, of which the middle one is the largest (Fig. 8); labial palps well developed; 1st segment of labial palp constricted near the articulation with the 2nd segment (Fig. 9). Thorax with numerous light spots of various shapes above; most middle instar nymphs have a thin light stripe extending along the median line of the body (head, thorax, 1st and 2nd abdominal tergites), broadening on the prothorax into a light spot. Legs light yellow; a single dark transverse band on the femora and tibiae of all legs (on their articulation); tarsi apically dark; length of tarsal segments varying, as in species of the genus *Isonychia*, in relation to body size (Baykova, 1970). Abdomen variegated; 1st and 2nd abdominal tergites dark brown, with a thin light stripe along median line; this stripe sometimes absent; 4th and 5th abdominal tergites light, 6th dark brown; there is a large light spot on the 7th abdominal tergite, nearer its base; 8th and 10th abdominal tergites light; on the 9th

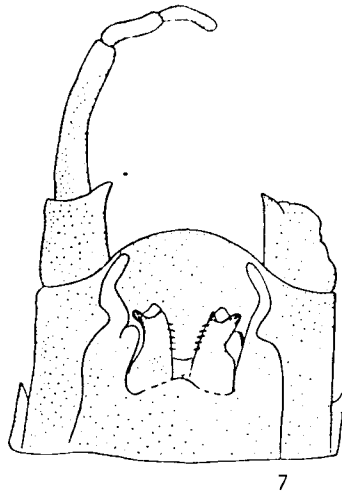
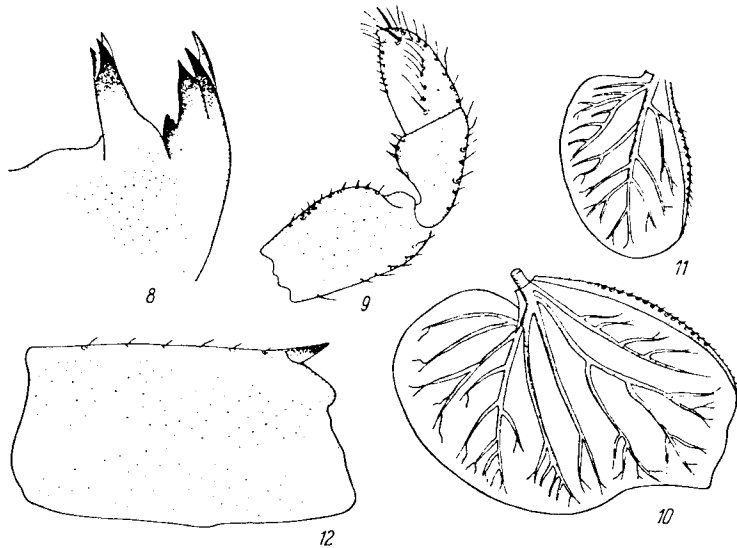


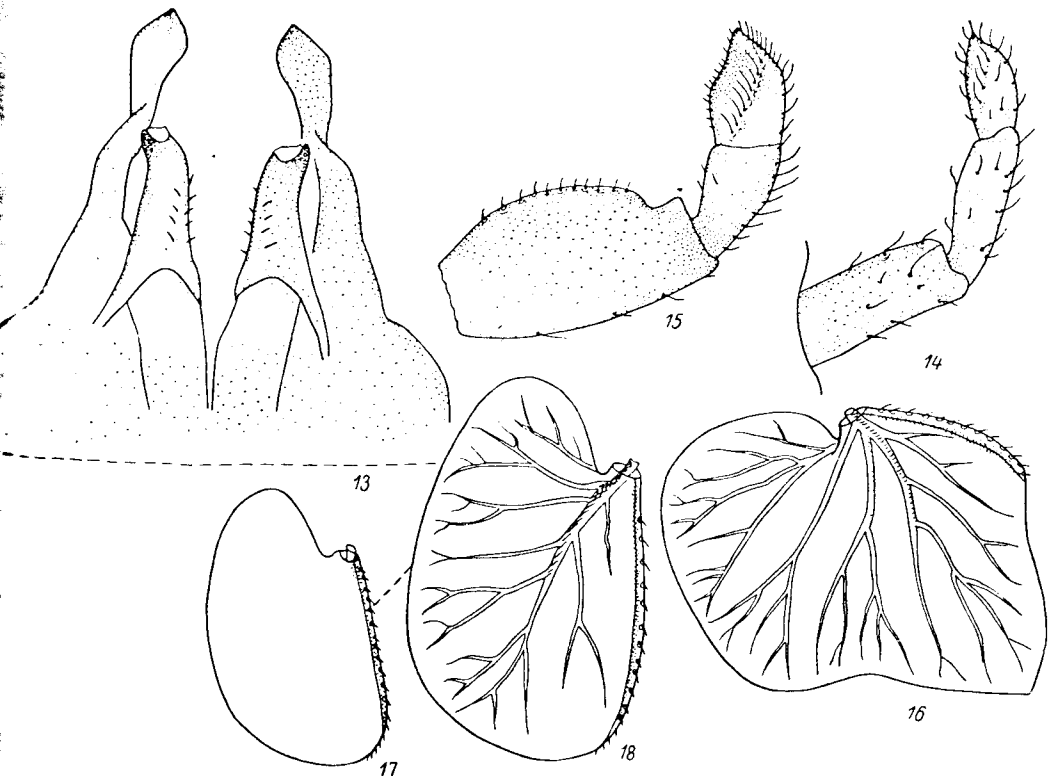
Fig. 7. *Siphonurus chankae*, genital appendages of male.



Figs. 8-12. *Siphonurus chankae*.

8) Maxillary teeth of nymph from below; 9) labial palp; 10) gill leaflet of 7th abdominal segment of nymph; 12) subanal plate of nymph.

tergite there are paired rounded light spots nearer the median line; the light spots along the lateral margins of the tergite are greatly elongated; dark tergites have paired light spots nearer their lateral margins; each abdominal tergite bears two dark oblong spots; the branches of the trachea are clearly apparent on the sides of the abdomen; the bases of the points of insertion of the gill leaflets have a black dot: the abdomen is brownish-yellow below, with paired dots on each sternite; only the 8th abdominal sternite has dark U-shaped markings; the gill leaflet of the 3rd pair has a small notch on the posterior margin.



Figs. 13-18. *Siphonurus zhelochotsevi*.

13) Genital appendages of male (Tudo-Vak River, Ussuri basin); 14-18) nymph: 14) maxillary palp; 15) labial palp; 16-18) gill leaflet of 3rd and 7th abdominal segments [16) 3rd segment; 17-18) 7th segment].

Fig. 10); the gill leaflet of the 7th pair lacks an extended anterior margin on the inner side (Fig. 11). Subanal plates bearing one sharp spine (Fig. 12); caudal filaments light brown, with yellow tinge, and with a broad dark band nearer the apical margin.

Body length of mature nymphs 16-25 mm, length of caudal filaments 8-9 mm. This is the largest species of the genus in the Amur basin.

Range and material. Upper reaches of the Angara (Sukatskenye, 1962). Amur basin, rivers: Bira, Teplovka and Khor. Lakes: Khanka, Bol'shaya and Malaya Sharga, Udyl'. Southern Maritime Territory, rivers Arsen'yevka and Artemovka. We collected 36 nymphs and 20 imagines.

Nymphs are numerous in the Malaya and Bol'shaya Sharga lakes. They are found on vegetation and snags and in cut-off pools on the silty bottom with a large content of detritus at a temperature of 12-18°C, in June - August between the waters edge and a depth of 1.5 m. In cut-off pools water temperature reached 30°C. When the pools dry out a proportion of the nymphs have succeeded in completing development; the remainder will perish. Nymphs that had been for from 3-6 hours in a drained zone (beneath damp old plant roots transported by the current) completed their metamorphosis when placed in an aquarium.

Winged insects were recorded at the end of May, in June and in July. Mass flight was observed in Lake Bol'shaya Sharga in the middle of June.

Mayflies of this species are an important food item for autumn chum fingerlings at the time of their downstream migration, when they account for 72-100% of their food in terms of frequency of occurrence and for 55.5% by weight (in the food of young grayling, for example, winged individuals of this species are 80% of the number of items consumed). Juvenile lenok, Dolly Varden and whitefish feed on them.

Siphonurus zhelochovtsevi (Figs. 13-18).

The species was described by Chernova (1952) on the basis of adult males from Transbaikalia. We reared winged insects from nymphs (Fig. 13). The nymphs, which were unknown, are described for the first time below.

Nymphs (alcohol). Head brown; two long dark spots located on head between eyes; these spots broaden at the ends; 1st and 2nd segments of maxillary palps practically equal (Fig. 14); 1st segment of labial palp long; it is convex on the inner side and has a rectangular notch at the articulation with the 2nd segment (Fig. 15). Thorax brown, with numerous light spots various shapes and sizes above; the two largest spots in the shape of an irregular letter O are located on the mesothorax, nearer the median line. Legs brownish yellow, without spots; the legs of nymphs before emergence are light brown, and there is a small dark spot where the femur articulates with the trochanter. Abdomen variegated; 1st abdominal tergites dark brown with two large light spots on each side nearer the lateral margins; these spots sometimes merge on the 6th tergite; two large light tetragonal spots on median line of 7th abdominal tergite and one small round spot at the point of insertion of the gill leaflets; last three abdominal tergites light - brownish yellow; on each abdominal tergite there are two small oblong dark brown spots nearer the median line and well expressed on the apical tergites; there is one small dark spot on each at the point of insertion of the gill leaflets; abdominal sternites brownish; on either side of the abdomen, nearer its lateral margins, there is a dark brownish stripe; in some nymphs this stripe is absent or weakly expressed; along the median line of each tergite there is a single small light oblong spot; gill leaflet of 3rd pair with a notch on posterior margin (Fig. 16); gill leaflet of 7th pair with a greatly extended superior margin on inner side (Figs. 17-18); caudal filaments pale brownish yellow, with a dark transverse band nearer the apex.

Body length of nymphs before emergence of subimago 9.5-14.5 mm, length of caudal filaments 6-7 mm.

Range and material. Transbaikalia, Ingoda River. Amur basin: rivers Bira, Teplovka, Birakan, Amgun', Nizhnyaya Uda, Khor and Tudo-Vak; lakes: Bol'shoye and Maloye Sharga. Southern Maritime Territory: Kamenka River, an unnamed stream at Yakovlevka settlement.

We collected a total of 5 ♂♂ (imagines) and 4 ♀♀ (subimagines) and 18 nymphs.

The nymphs were collected along the bank of fast-flowing rivers with submerged snags and in cut-off temporary pools on detritus and the ooze bottom; in Lake Malaya Sharga nymphs were collected from vegetation throughout the lake at a temperature of 12-29°C in the summer.

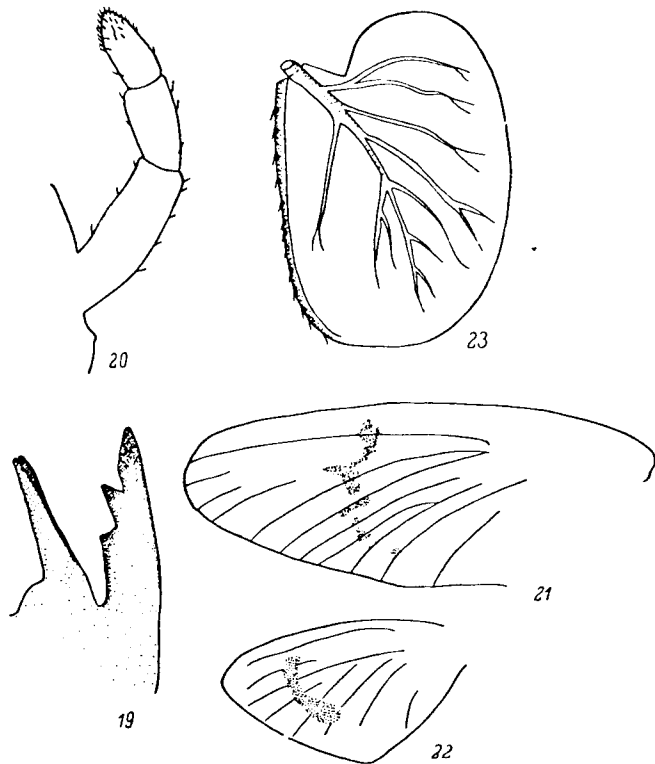
Imagines were collected in June-August in the Nizhnyaya Uda, Tudo-Vak, Bira and Khor rivers. The number of insects flying is largest in the first half of June.

Siphonurus binotatus (Figs. 19-23).

Synonyms: Siphonurus maculosus; Siphonurus grandiosa.

Comment. Nymphs of this species were recorded by Ueno (1928) under the name Siphonurus alternatus. Later the same author (Ueno, 1931) described the nymph of S. binotatus from Japan. Imanishi (1940) recorded nymphs of this species for waters in N. China and gives a comparative description.

The nymphs collected by us in the southern Maritime Territory have typical coloration: their elytra have dark spots (Figs. 21-22). The gill leaflet of the 7th abdominal segment of the nymph is of a different structure (Fig. 23) from that depicted in the paper by Ueno (1928).



Figs. 19-23. *Siphonurus binotatus*, nymph.

19) Apical tooth of left maxilla from below; 20) palp of left maxilla from below (Margaritovka River, Southern Maritime Territory); 21) rudiments of fore wing; 22) rudiments of hind wing; 23) gill leaflet of 7th abdominal segment.

Range and material. Japan, northeastern China. Nymphs of this species in the last star before flight are known from the southern Maritime Territory: the Kiyevka, Margaritovka and Mineral'naya rivers (Baykova, 1965).

We collected 6 nymphs on a shingle bottom, in a fast current, at a depth of 0.25-0.4 m.

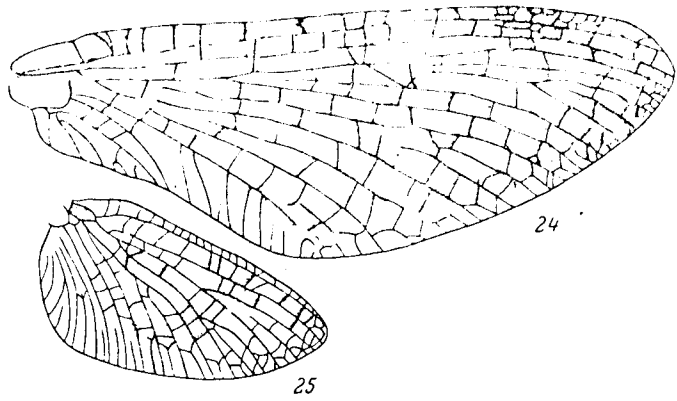
In comparing the environmental conditions of *S. binotatus* and *S. sanukensis*, Imanishi (1940) noted that nymphs of the first species were found only in the lower reaches of rivers to which there was a flow of muddy water, whereas *S. sanukensis* inhabited such a tempestuous high mountain river with a low water temperature as the Kasima River in the Japanese Alps, in which it was found right up to the source.

Siphonurus brodskyi, sp. n. (Figs. 24-30).

One female was reared from a nymph found in the Teplovka River issuing from a spring on 16 Aug. 1954. It is well distinguished from all other members of this genus by the presence of black brown spots on the wings, as in *Oniscigaster palaeartica*.

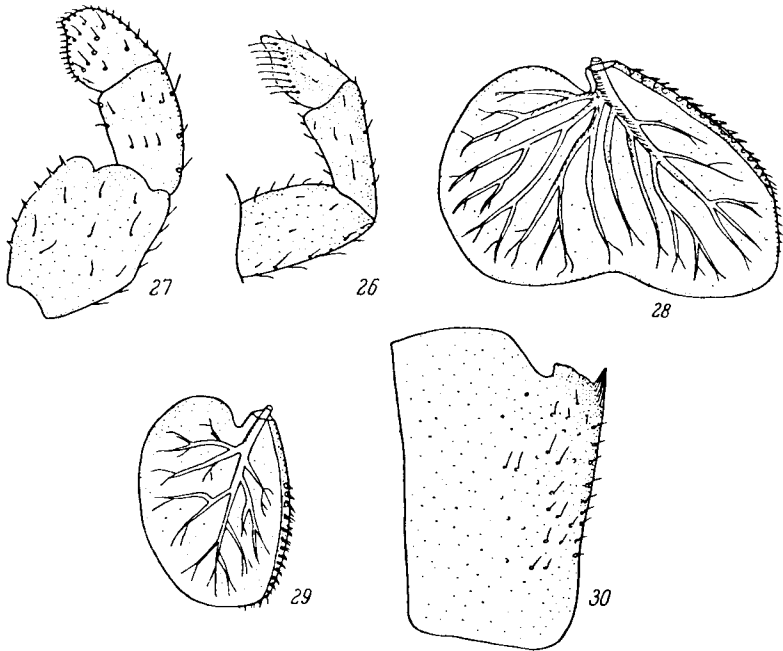
The species has been named after K. A. Brodskiy, who devoted his first research to the mayflies of the Asian regions of the USSR.

Female (alcohol). Eyes dark, with violet-grey tinge; thorax variegated, with small brownish spots of various shapes and with striae. Fore legs light brown, 2nd and 3rd



Figs. 24-25. *Siphonurus brodskyi*, sp. n., female, imago.

24) fore wing; 25) hind wing.



Figs. 26-30. *Siphonurus brodskyi*, sp. n., nymph.

26) Maxillary palp; 27) labial palp; 28) gill leaflet of 3rd abdominal segment; 29) gill leaflet of 7th abdominal segment; 30) subanal plate.

pairs yellowish. Fore and hind wings variegated: there is one dark brown oblong spot at the base of the fore wing (Fig. 24); there are similar large dark spots of various shapes and sizes in the middle of the wing (from its anterior to its posterior margin); in addition, there are dark stripes and small spots over the whole of the fore wing, mainly on the cross veins; at the base of the hind wing there are two small dark spots (Fig. 25); there

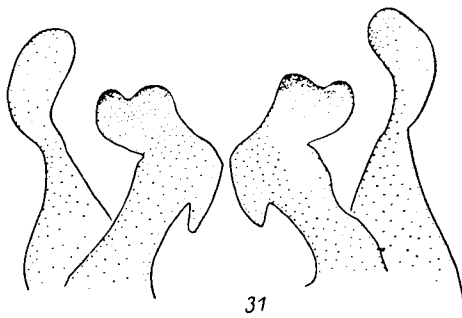


Fig. 31. *Siphonurus* sp., genital appendages of male, imago (Lake M. Sharga).

cross veins; at the base of the hind wing there are two small dark spots (Fig. 25); there is one very large dark brown spot practically in the middle of the hind wing.

Abdomen brown-yellow above; markings on abdominal tergites with the form of dark bands extending obliquely from the anterior angles of the tergites to the median line of the abdomen; these bands broaden slightly on the posterior margin of the tergite; each abdominal tergite has a pair of small dark oblong spots on its median line; abdominal sternites pale yellow, with characteristic U-shaped dark brownish markings.

Body length of female 18 mm, length of caudal filaments 17 mm.

Nymph (alcohol). Head light brown, with two long spots on head between eyes; inner margin of 1st segment of labial palp with small denticles; 1st segment of labial palp short and broad; on the inner side where it articulates with the 2nd segment it has a deep notch (Fig. 27); 1st segment of maxillary palp shorter than 2nd (Fig. 26). Thorax brown, with infrequent light spots above; femora of all legs with dark transverse bands; these bands absent from tibiae; tarsus dark when it joins the claw. Abdomen dirty olive above, with yellowish tinge; paired dark oblong spots located on abdominal tergites nearer the median line; light spots on abdominal tergites weakly expressed or wanting. Abdomen pale brownish yellow below, without spots; gill leaflet of 3rd pair drawn out toward outer margin (Fig. 28); on the posterior margin it has a small notch; gill leaflet of 7th pair with slightly drawn out anterior margin (Fig. 29); subanal plate with sparse hairs (Fig. 30); caudal filaments light brown, with a broad dark transverse band located nearer the apical part. Body length of mature nymph 18 mm, length of caudal filaments 7 mm.

Material. Holotype: ♀, Amur basin, Bira River, 6 July 1954 (O. Ya. Baykova).

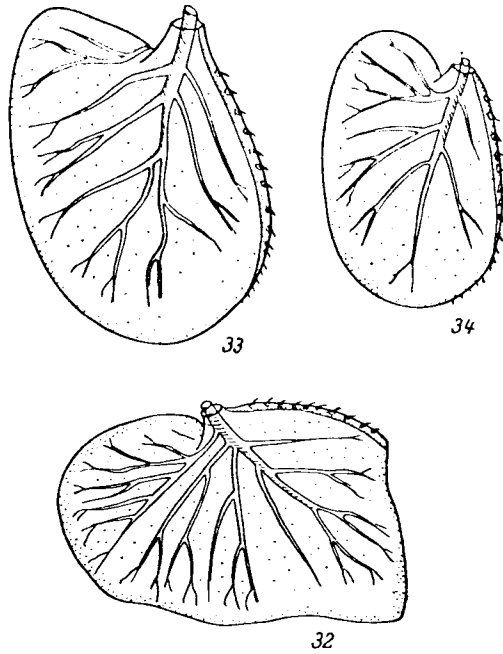
The nymph from which the female was reared was found on grey ooze 7-12 cm thick among hornwort beds at a depth of 15 cm and a water temperature of 9°C.

Siphonurus sp. (Figs. 31-34).

Range and material. Amur basin: Birakan, Khor, Iman, Tudo-Vak and Duki rivers, upper reaches of Amgun'. In all we collected 2 nymphs, 2 ♂♂ and 1 subimago ♂.

The nymphs were found in fast-flowing mountain rivers and in small bodies of stagnant water on sand-shingle and silt-sand bottoms mixed with detritus at a depth of 0.2-0.6 m.

The specimens collected by us (male subimagines) are distinguished from males of the species referred to above by the shape of the genitalia, the inner genital lobes of which are very broad and weakly recurved inward (Fig. 31).



Figs. 32-34. *Siphonurus* sp., gill leaflet of 3rd and 7th abdominal segments of nymph.

32) 3rd segment (Lake M. Sharga); 33-34) 7th segment (Khor River, from the stomach of a lenok).

In *S. binotatus* from Japan these lobes have very sharp points. The species may possibly be identical to *S. sanukensis*, for which we do not know the description of the adult phase, although the nymphs of the species under consideration differ from *S. sanukensis* nymphs in the color of the thorax and the 9th abdominal tergite. *S. sanukensis* inhabits the Kasima River, and is known from the Korean Peninsula (Imanishi, 1940).

Body length of male imagines 17 mm, length of caudal filaments 20 mm.

LARVAL IDENTIFICATION KEY TO THE GENUS *SIPHONURUS*

- 1 (10). Wing rudiments without dark spots in the middle. Posterior margin of gill leaflet of 3rd pair notched and drawn out into an acute angle.
- 2 (7). Gill leaflet of 7th pair without drawn out anterior margin on inner side.
- 3 (4). Inner margin of 7th gill leaflet located below its base (Fig. 11). Along the median line of the thorax (and sometimes on the 1st and 2nd abdominal tergites) there is a fine light stripe. On each abdominal tergite there are two dark oblong spots. The branches of the trachea are clearly visible on the sides of the abdomen, in contrast to other species. Body length of nymph before emergence 16-25 mm . . . *S. chankae*.
- 4 (3). Inner margin of 7th gill leaflet on a level with its base or slightly higher.
- 5 (6). Inner margin of 7th gill leaflet equal to its base. Body very variegated. Body length of nymph before emergence 15-16 mm *S. zetterstedti*.

- (5). Inner margin of 7th gill leaflet scarcely higher than its base. 1st segment of labial palp very broad and short (Figs. 27, 29). Abdomen dirty olive, with yellowish tinge; paired oblong dark spots on abdominal tergites located nearer the median line of the abdomen. Body length of nymph before emergence 18 mm . . . S. brodskyi.
- (2). Gill leaflet of 7th pair with drawn out anterior margin on inner side.
- (9). Anterior margin of 7th leaflet rounded and greatly drawn out (Figs. 17-18). First abdominal tergites dark brown, with two large light spots nearer the lateral margins of the abdomen. Body length of nymph before emergence 9.5 - 14.5 mm . . . S. zhelochovtsevi.
- (3). Anterior margin of 7th gill leaflet pointed and weakly drawn out (Fig. 33). Body variegated. Body length of nymph before emergence 17 mm Siphonurus.
- (1). Wing rudiments with dark spots of various shapes in the middle (Figs. 21-22). Posterior margin of gill leaflet of 3rd pair with a small notch, weakly drawn out and rounded. Anterior margin of 7th gill leaflet broad, rounded and slightly higher than its base (Fig. 23). Basal segment of labial palp abruptly broadened in the middle; last two segments of maxillary palp of practically equal length (Fig. 20). Body length of slightly immature nymph 14 mm S. binotatus.

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