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Revision of Palearctic Genera and Subgenera of Mayflies in the Subfamily Cloeoninae (Ephemeroptera, Baetidae) with Descriptions of New Species from the USSR*

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Abstract. A new diagnosis of the subfamily is provided, including 2 genera: *Baetopus* (with subgenera *B.* sens. str. and *Raptobaetopus*) and *Cloeon* (with 7 Palearctic subgenera: *Centroptilum* = *Neocloeon* syn. nov., *Cloeon* sens. str., *Similicloeon* subg. nov., *Intercloeon* subg. nov., *Pseudocentroplitum, Procloeon,* and *Pseudocentroptiloides*). The following species are described: *Cloeon (Intercloeon) spiniventre, C. (I.) petropolitanum, C. (Procloeon) heterophyllum,* and *C. (P.) macronyx. Cloeon (Pseudocentroptiloides) nana* (Bogoescu) is a comb. nov. from *Centroptilum.* The phylogeny of the genera and subgenera is discussed, some new synonymy is brought forth, and many figures are presented.

Kazlauskas (1972) proposed dividing the family Baetidae into two subfamilies: Baetinae and Cloeoninae. These subfamilies exhaust the diversity of the Palearctic representatives of the Baetidae, although there is a considerable number of non-Palearctic genera in this family that cannot be assigned to either the Baetinae or the Cloeoninae (for example, *Callibaetis, Cloeodes,* and others). The lack of material on non-Palearctic genera presently makes it impossible to propose a more practical division of the family into subfamilies.

Below, a new division of the subfamily Cloeoninae into genera and subgenera based on study of the species of the USSR fauna is proposed.

Type specimens of the new species are deposited in the Zoological Institute of the USSR Academy of Sciences in Leningrad.

Subfam. **Cloeoninae**

Common characters of the subfamily include the following: 1) in mature larva ready to molt to the subimago, the rudiments of the subimaginal forceps fit under the cuticle so that the second segment of the forceps is directed laterally, while the third is bent caudally and medially (Fig. 1, *4, 5*) (apomorphic character not found in other taxa—Novikova and Klyuge, 1987); 2) the larval claws are weakly arcuate, symmetrical, with or without two identical rows of fine denticles (Figs. 3, *16;* 9, *17*) (unlike the majority of the representatives of the Baetinae); 3) intercalary veins of the forewings are solitary (unlike the subfamily Baetinae and some other taxa).

The subfamily comprises two genera: *Baetopus* and *Cloeon.*

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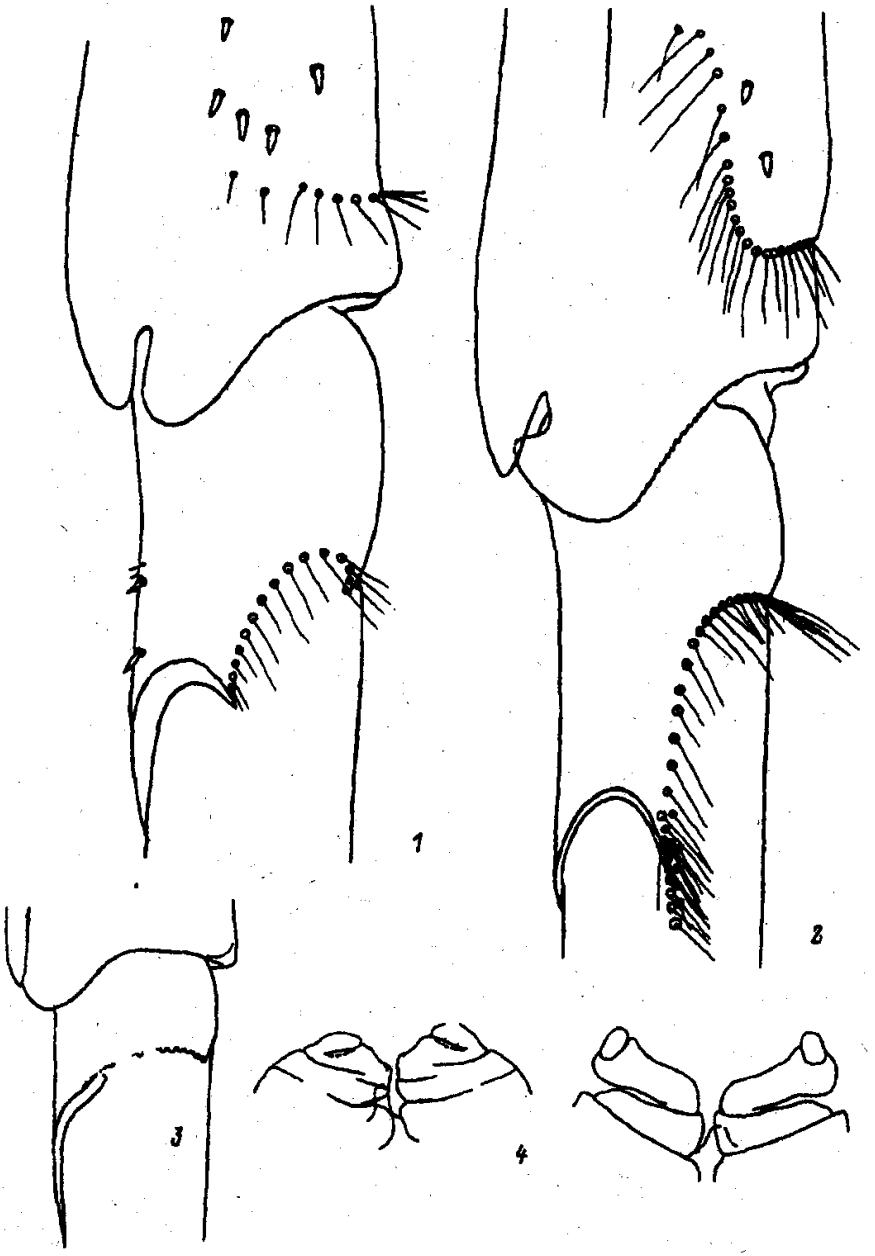

Fig. 1. *Cloeon* Leach and *Baetopus* Keff., larvae: *1*) *Cloeon (Pseudocentroptilum) unguiculatum* Tscher., patellar articulation and section of patellotibial suture; *2*) *C. (Procloeon) pennulatum* Fshern., same; *3*) *Baetopus (B.) wartensis* Keff., same; *4*) *B. (Raptobaetopus) tenellus* Albarda, subimaginal rudiments of forceps of mature larva, in preparation; *5*) *Cloeon (C.) dipterum* L., same.

Genus *Baetopus* Keffermüller, 1960

Type species *B. wartensis* Keffermüller, 1960.

The following characters should be added to the diagnosis of this genus found in the literature (Müller-Liebenau, 1978; and others): tergalii[1] of larva sessile, that is, not capable of rapid rhythmic oscillations; patellotibial suture on tibia as in Fig. 1, *3;* in the imago the mesonotal median suture is in the form of a crest as in the subgenus *Centroptilum* of the genus *Cloeon* (Fig. 2, *8*).

The genus includes two subgenera: *Baetopus* and *Raptobaetopus* Müller-Liebenau, 1978 (type species *Centroptilum tenellum* Albarda, 1878) considered by some workers separate genera.

Examined species: *Baetopus (Baetopus) wartensis* Keffermüller, 1960; *B. (Raptobaetopus) tenellus* (Albarda, 1878).

Genus *Cloeon* Leach, 1815

Type species *Ephemera diptera* Linnaeus, 1761.

Larva. Maxillary palpus not thickened (Figs. 2, *1-3, 12;* 3, *13*), labial palpus terminally truncate (Fig. 2, *4-6, 13*) (unlike *Baetopus*). Tibia with patellotibial suture interrupted on outer side, ends connected by arcuate row of long hairs, end of suture on anterior side of tibia bent distally toward side opposite rest of suture on posterior side of tibia, and arcuate row of bristles connected with ends of suture at acute angle (Fig. 1, *1, 2*) (unlike all other Baetidae). Terminal abdominal segments bearing spinules on lateral margins (Fig. 5, *1*) (unlike all other Baetidae). Tergalii mobile, that is, capable of making rapid rhythmic oscillations and providing a current of water around larval body (unlike *Baetopus* and subfamily Baetinae and some other taxa). Caudal filaments in middle part with dark rings on every 4th segment (Fig. 5, *10-12*) (unlike all other Baetidae).

Imago. Second segment of forceps thickened at end, 3rd (terminal) segment not large, clavate.

Discussion. We are placing in this genus species previously assigned to the genera *Cloeon, Centroptilum,* and *Procloeon.* The genera *Cloeon* and *Centroptilum* in their present form are artificial and are distinguished only on the basis of a single formal character: presence of the hindwing in *Centroptilum* and its absence in *Cloeon.* This character cannot be generic since it varies in closely related species. Therefore, it makes sense to combine *Centroptilum* and *Cloeon* into a single genus divided into a number of subgenera.

The genus *Procloeon* until recently was characterized by the absence of the hindwings and separated from the genus *Cloeon* by the hindtarsal index (ratio of length of 1st segment to length of 3rd as 3:1 in *Procloeon* and 2:1 in *Cloeon*) and on arrangement of crossveins in forewings (Bengtsson, 1914; *Pseudocloeon* nom. praeocc. and others). In fact, proportions of hindtarsus may vary strongly in individuals of a single species: for example, in the type species of *Procloeon, C. bifidum,* this ratio may vary from 3:1 to 2.1:1. Arrangement of crossveins instable, and we observed individual variability for this character in *C. bifidum, C. macronyx* sp. n., *C. spiniventre* sp. n., and *C. petropolitanum* sp. n. In terms of a whole series of characters the type species of the genus *Procloeon* is close to the Pennulatum Group, which until now has been assigned to the genus *Centroptilum;* therefore, we believe it makes

[1]On use of the terms "tergalii" and "tracheal gills" see Klyuge (1989). [Tergali is the transliterated Russian spelling; the word should be "tergalium" in singular and "tergalia" in plural as an anatomical term.—*Transl. editor.*]

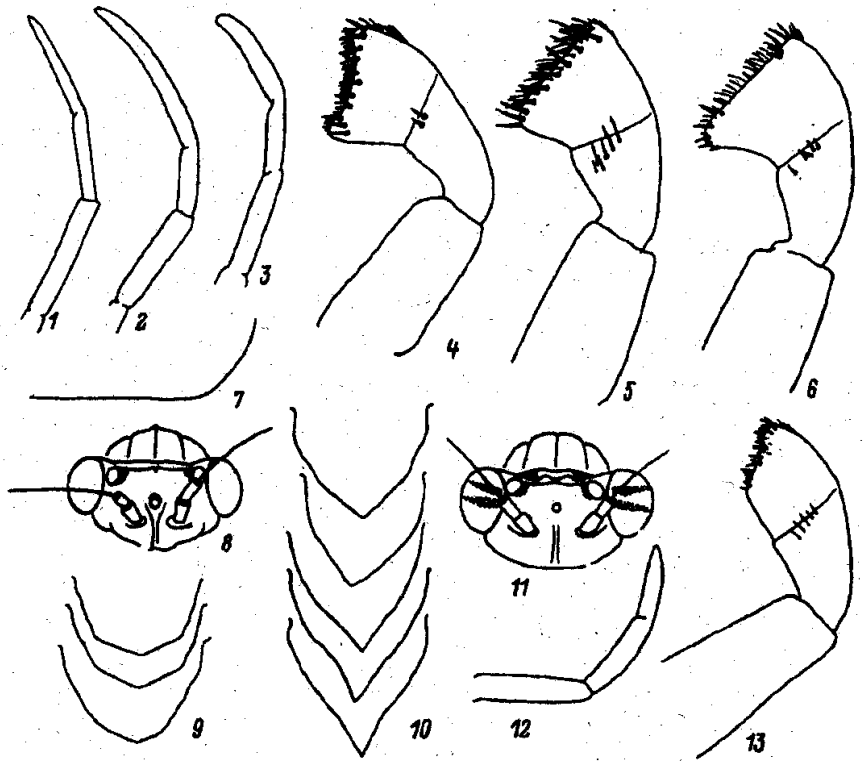

Fig. 2. Subgenera *Centroptilum* Eaton, *Cloeon* Leach, and *Similicloeon* subgen. n. of genus *Cloeon* Leach, larva and imago. *1-9*) Subgenus *Centroptilum: 1, 4, 8, 9*) *C. (C.) luteolum* Müll.; *2, 5, 7*) *Cloeon (C.)* sp. n. 1; *3, 6*) *C. (C.) kazlauskasi* Kluge. *10-12*) Subgenus *Cloeon: 10, 11*) *C. (C.) dipterum* L.; *12*) *C. (C.) tadjikistanicum* Brodsky. *13*) Subgenus *Similicloeon; C. (S.) praetextum* Bengtsson. *1-3, 12*) Larval maxillary palpus; *4-6, 13*) larval labial palpus; *7*) right half of metanotal posterior margin of larva; *8, 11*) head and mesonotum of ♀ adult, anterior view; *9, 10*) frontal suture of larva, variability of different specimens in same species.

sense to unite in a single subgenus *Procloeon* and the Pennulatum Group and expand the diagnosis of this subgenus with new characters. McCafferty and Waltz (1990) also include the Pennulatum Group in *Procloeon*, but treat *Procloeon* as a genus and more broadly than do we, including in it all of *Cloeon* s.l. except for *Cloeon* s. str., *Centroptilum*, and *Pseudocentroptiloides*.

We recognize 7 subgenera within the genus *Cloeon*. We believe that it would be incorrect to give these taxa the rank of genus because there are rather few characters distinguishing them and the subgeneric membership of many species may be reliably determined only by comparing characters of the larvae and adults of both sexes.

Subgenus *Centroptilum* Eaton, 1869

Neocloeon Traver, 1932.

Centroptilum: Kazlauskas, 1972.

Luteolum Group of genus *Centroptilum:* Keffermüller and Sowa, 1984.

Type species *Ephemera luteola* Müller, 1776.

Larva. Mandibular teeth very deeply cleft, on right mandible almost to base. Maxillary palpus 3-segmented, 3rd segment not shorter than 2nd (Fig. 2, *1-3*). Apical segment of labial palpus with inner angle retracted (Fig. 2, *4-6*). Frontal suture obtuse-angled (Fig. 2, *9*). Pronotum very short: width 4 times length at margin. Caudal filaments with extended bare terminal segments, spines on outer margin of cerci not enlarged. Tergalii in known species unilamellate.

Imago. Median suture of mesonotum in form of longitudinal crest (Fig. 2, *8*) (in other species of *Cloeon* s.l. that we studied, median suture concave—Fig. 2, *11*). Penis conical. Terminal segment of forceps larger than other in *Cloeon* s.l., but smaller than in *Baetopus*. Eyes of ♀ not enlarged and not close together (Fig. 2, *8*). Hindwings present or absent.

Discussion. The Luteolum Group was characterized on the basis of the structure of the adult penis, structure of the mandibles, maxillary palpus and ends of the larval caudal filaments as well as by having a pointed hindwing and presence of a digitate process between the forceps of the imago, symmetrical tergalii and absence of semicircular pits on the abdominal tergites of the larva (Kazlauskas, 1972; Keffermüller and Sowa, 1984). However, the last four characters are characteristic of only one species which was also available to these authors—*C. luteolum*. In addition, Keffermüller and Sowa point to the absence in *C. luteolum* of spines on the sides of the terminal abdominal segments. In fact, these spines are present in *C. luteolum*, as they are in all other species of *Cloeon*, but they are very small, difficult to distinguish from the spines covering the entire surface of the abdomen. In *C. kazlauskasi* and *Cloeon* sp. n. 1, the spines on the sides of the terminal segments of the abdomen are of normal size for *Cloeon*.

We are basing the diagnosis of the subgenus *Centroptilum* on the characters of the three species, which forces us to discard superfluous characters and broaden the diagnosis. Such an understanding of the subgenus *Centroptilum* also includes the North American species *Neocloeon almance* Traver, 1932, the type species of the genus *Neocloeon*. The latter was considered a synonym of *Cloeon* because of the absence in it of hindwings (Edmunds, Jensen, and Berner, 1976), but was recently assigned to the genus *Centroptilum* (McCafferty and Waltz, 1990).

Examined species: *Cloeon (Centroptilum) luteolum* (Müller, 1776), comb. n.; *C. (C.) kazlauskasi* (Kluge, 1983), comb. n.; *Cloeon (C.)* sp. n. 1 (only larva).

Cloeon (Centroptilum) sp. n. 1 (Fig. 2, *2, 5, 7*).

Material. Maritime Terr., Kedrovaya Pad' Nature Reserve, Narva River, VII.1980, 1 larva (Klyuge).

We do not provide this species with a name because there is only one larva in the final instar with torn tergalii. It differs from the two Palearctic species in the subgenus *Centroptilum* in the absence of hindwing pads.

Subgenus ***Cloeon*** Leach, 1815

Larva. Mandibular teeth cleft no more than to middle. Third segment of maxillary palpus little shorter than second, sometimes not clearly separated (Fig. 2, *12*). Apical segment of labial palpus only weakly expanded apically or not at all, its inner and apical margins form obtuse angle (as in Fig. 2, *13*). Frontal suture acute-angled (Fig. 2, *10*). Pronotum not shortened: three times as wide as long at margin. Caudal filaments with strongly extended bare terminal segments, spines on outer margin of cerci not enlarged. Tergalii, unlike in other subgenera, strongly expanded, with strongly protruding anterior margin, almost rounded; tergalii 1-6 with large dorsal lamaella, dorsal lamella of tergalii 2-6 with protruding anterior proximal lobe.

Imago. Penis conical. Eyes of ♀ not enlarged or close together (Fig. 2, *11*). Hindwings in known species absent. Eggs without densely sculptured membranes and not losing shape when dried (in all other Cloeoninae chorion dense and with distinct species- specific sculpturing); evidently, ovoviviparity is characteristic of all species in the subgenus *Cloeon.*

Examined species: *Cloeon (Cloeon) dipterum* (Linnaeus, 1761); *C. (C.) inscriptum* Bengtsson, 1914; *C. (C.) cognatum* Stephens, 1835; *C. (C.) tadjikistanicum* Brodsky, 1930.

Subgenus ***Similicloeon*** Kluge & Novikova, subgen. n.

Simile Group of genus *Cloeon:* Sowa, 1980.

Type species *Cloeon simile* Eaton, 1870.

Larva. Mandibular teeth cleft no more than to middle. Maxillary palpus in known species 2-segmented. Apical segment of labial palpus only weakly expanded apically or not at all, inner and apical margins forming obtuse angle (Fig. 2, *13*). Frontal suture acute-angled, pronotum not shortened. Caudal filaments with strongly extended bare terminal segments, spines on outer margin of cerci not enlarged. Tergalii in known species bilamellate.

Imago. Penis truncate or rounded. Eyes of ♀ not enlarged and not close together. Hindwings in known species absent.

Discussion. Until now species of the Simile Group were included in the genus *Cloeon.* They are close to species of the subgenus *Cloeon* only by plesiomorphic characters (narrow labial palpus, extended ends of caudal filaments of larva) and nonspecific characters found in the subgenera *Cloeon* and *Procloeon* (absence of hindwings in imago and bilamellate tergalii in lava). In terms of structure of penis *Similicloeon* differs sharply from the subgenus *Cloeon,* larvae of *Similicloeon* without specialized tergalii characteristic of the subgenus *Cloeon,* and eggs of *Similicloeon* with sculptured chorion. Therefore, we consider it reasonable to distinguish *Similicloeon* as a separate subgenus.

Examined species: *Cloeon (Similicloeon) simile* Eaton, 1870; *C. (S.) praetextum* Bengtsson, 1914; *C. (S.) schoenemundi* Bengtsson, 1936.

Subgenus ***Intercloeon*** Kluge & Novikova, subgen. n.

Type species *Cloeon (Intercloeon) spiniventre* sp. n.

Larva. Mandibular teeth cleft no further than to middle. Maxillary palpus in known species 2-segmented (Fig. 3, *13*). Apical segment of labial palpus obviously expanded, with rounded inner corner,

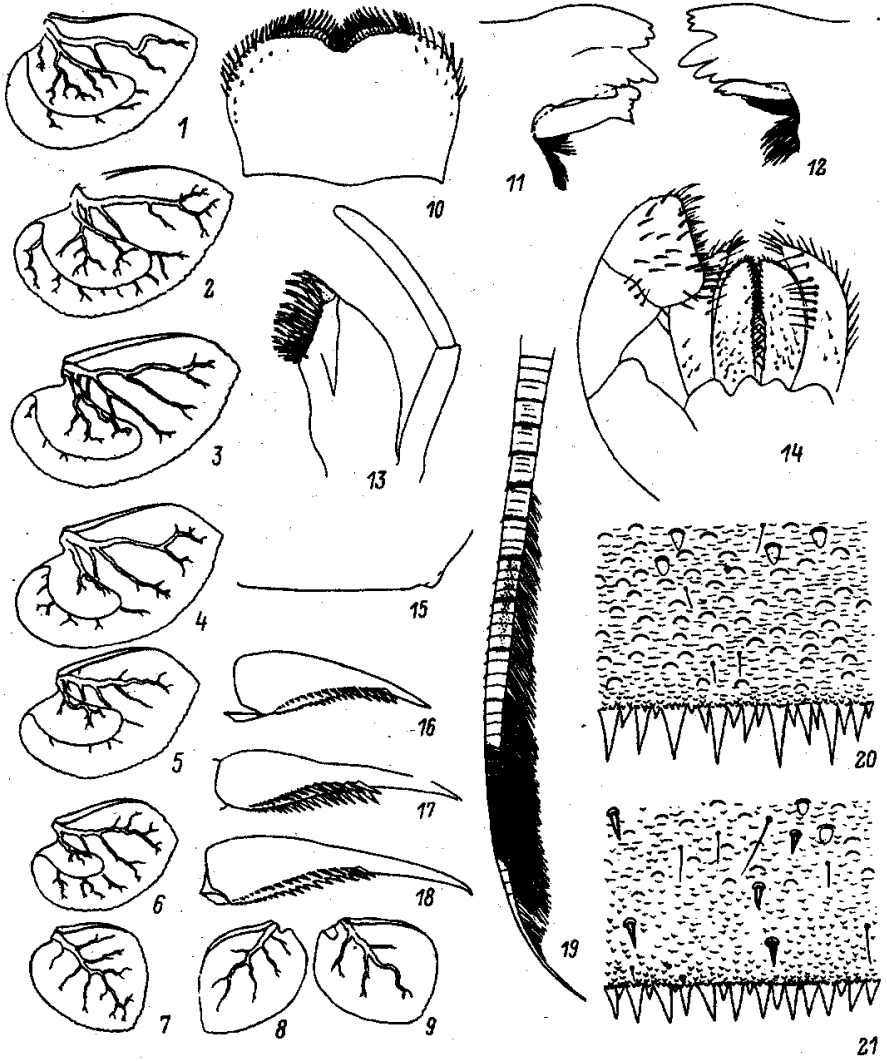

Fig. 3. *Cloeon (Intercloeon) spiniventre* sp. n., larva: *1-7*) tergalii 1-7; *8, 9*) tergalii 7 from one specimen: *10*) labrum; *11, 12*) teeth on left and right mandibles; *13*) maxilla; *14*) labium; *15*) right half of posterior margin of metanotum; *16-18*) claws; *19*) cercus; *20*) surface and posterior margin of 6th abdominal tergite; *21*) same for 6th sternite (*20, 21* - holotype).

inner and apical margins forming right angle (Fig. 3, *14*). Frontal suture acute-angled. Pronotum not shortened. Caudal filaments with strongly extended bare terminal segments, spines on outer margin of cerci not enlarged (Fig. 5, *10-13*). Tergalii in known species bilamellate (Figs. 3, *1-9;* 5, *2-9*).

Imago. Penis rounded (Figs. 4, *7, 8;* 6, *6*). Eyes of ♀ either not close together (Fig. 4, *4, 5*) or

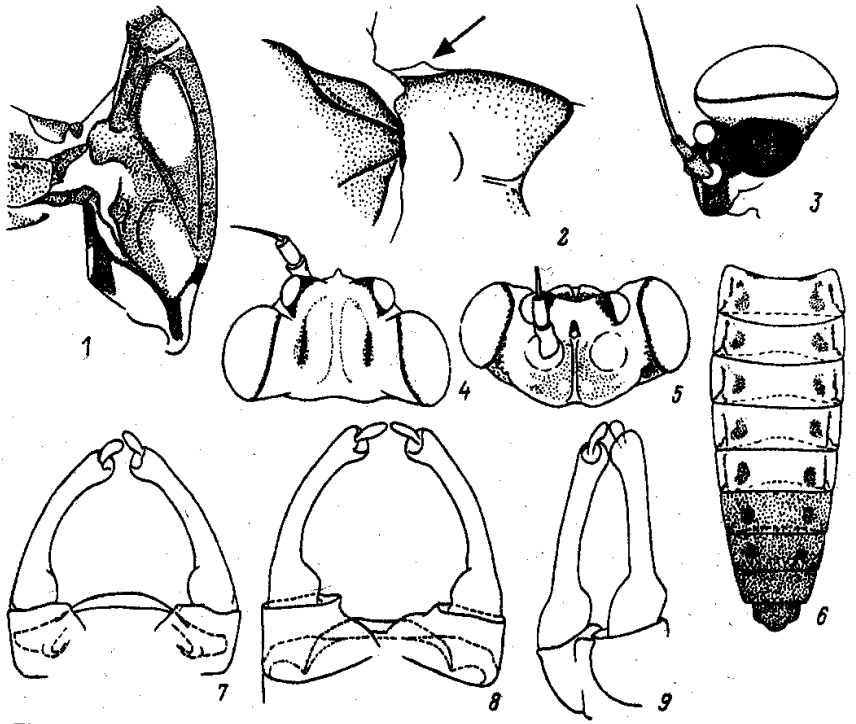

Fig. 4. *Cloeon (Intercloeon) spiniventre* sp. n., imago and subimago: *1*) left half of exuviae of subimaginal mesonotum; *2-9*) imago: *2*) right half of metanotum and hindwing rudiment, *3*) ♀ head, lateral view, *4*) ♀ head, dorsal view, *5*) same, frontal view, *6*) ♂ abdominal tergites, spread in preparation, *7, 8*) ♂ genitalia, ventral view, *9*) same, half turned (ventrolateral view) (*1, 7* - holotype).

somewhat close together, but in this case, in posterior part distance between them greater than in anterior part and exceeding eye length (Fig. 6, *3, 4*). Hindwings in known species absent.

Discussion. This subgenus occupies an intermediate position between the subgenera *Similicloeon* and *Procloeon:* in terms of structure of caudal filaments, the larvae resembling *Similicloeon,* but the shape of the labial palpus in them is same as in *Procloeon.*

Examined species: *Cloeon (Intercloeon) spiniventre* sp. n.; *C. (I.) petropolitanum* sp. n.

Cloeon (Intercloeon) spiniventre Kluge & Novikova, sp. n. (Figs. 3, *1-21*; 4, *1-9*).

Material. Altai, meadow in floodplain of Chuya River at Kosh-Agach, 28.VII-4.VIII.1987; 9 ♂ imagines (including holotype), 5 ♀ imagines, 4 ♂ and 4 ♀ subimagines (all reared from larvae); 21 larvae, 2 ♀ imagines (Klyuge); same locality, 20.V.1909: 1 larva (Emel'yanov). Tyumen Prov., M. Sos'va [River], Lake Svyatoy Sor, VI.1985: 1 larva (Zaguzova). Chita Prov., inundated peat bog in Undurzhi River valley at Taksha, 14.VII.1977: 20 larvae (Zherikhin). Khabarovsk Terr., Lake Bolon', Siy arm, 10.VI.1947: 1 larva. Mongolia: Tola River at Nalaykhi, 24.VI.1980: 1 ♂ subimago (reared from

larva) 11 larvae (Zherikhin); western shore of Lake Khubsugul opposite Turtu, 11.VII.1980: 3 ♂ imagines (Varykhanova).

Larva. Mandibular teeth not deeply cleft. Maxillary palpus 2-segmented. Wing pads with contrasting dark veins. Rudiment of hindwing pad barely evident. Legs monochromatic, femora without stripes. Claws small, 0.3-0.45 times length of tibia. Two rows of denticles extending considerably beyond middle of claw. Posterolateral spines developed, beginning with first or second abdominal segments; lateral row of spines beginning with 3rd-5th segment. Shape of lateral margins of abdominal segments as in *C. (I.) petropolitanum* sp. n. (Fig. 5, *1*). Abdominal sternites, in addition to rounded transparent scales and slender hairs, with stout pointed spinelike bristles. Coloration of abdominal tergites usually identical on all segments, consisting of pair of light submedial streaks and dots against dark background; more rarely segments differ in terms of intensity of coloration. Tergalii usually pointed at tip, with strongly developed postero-proximal lobe. Upper lamella always developed on tergaliae 1-6, small, narrow, arcuate, comes off lower lamella with wide base. Tergalii 7 with moderately protruding anterior margin, almost always without upper lamella, in rare cases a very small upper lamella may be developed. Proportions of tergalii varying: ratio of maximum length of largest tergalia (3rd pair) to length of smallest (7th pair) in measured individuals from 1.4 to 1.9 (in latter case: Fig. 3, *1-7*). Caudal filaments with dark stripe subapically; anterior and posterior to stripe usually lightest, making stripes contrasting.

Subimago. General color dark grayish. Anterior wing margin greenish, ♂ eyes greenish (in alcohol color disappears). Sides of abdominal tergites with dark spots visible as in imago.

Exuviae of subimago. Thorax brownish, mesonotum with large light spots and light parapsidal sutures. Membranous sections of pleurites and sternites light. Legs with darkened tarsi. Abdomen dark, lighter on sides, markings slightly developed at points of muscle attachment.

Imago, ♂. Head dark brown. Turbinate eyes not high, strongly expanded dorsally, in shape like those in *C. (I.) petropolitanum* sp. n. (Fig. 6, *8, 9*). Large part of stalk and faceted surface lemon yellow, very base of stalk brownish, faceted surface may be bordered by narrow contrasting dark brown edging, in some specimens this edging absent. Thoracic tergites, sternites, and pleurites dark brown with exception of light membranous sections; sometimes coloration of thorax lighter, ochreous brown. Legs pale, tips of femora and bases of tibiae indistinctly dark brownish. Ratio of length of femur, tibia, and tarsal segments in holotype as follows: on forelegs: 33:38:2:16:8:6, on mid- and hindlegs 28:23:7:4:2:5. Wings transparent, veins pale, *C, Sc,* and *R* somewhat darker than others. Wing base in region of bases of *Sc* and *R* proximal to humeral vein usually dark brown, in some specimens not darkened, whitish. In pterostigma with 6-8 oblique simple or weakly branched crossveins. Rudiment of hindwing barely evident. Abdomen whitish grayish, first segment darker, tergites 7-10 reddish brownish. Each of lateral parts of tergites with reddish brownish spot, these spots identically developed on segments 2-6. Articulations of tergites in median part darkened. Submedian streaks and points on abdominal tergites whitish, often not visible. Along margins of tergites dark brown tracheae often visible. Sternite 2 with pair of dark submedian stripes, other sternites lack markings. Genitalia and caudal filaments pale, whitish. First segment of forceps short and wide, forceps sharply bent ventrally at articulation of first and second segments; penis is broadly rounded at apex.

Imago, ♀. Head and thorax with ochreous and brownish spots, sometimes entire thorax except for membranous sections dark brown. Eyes widely separated, not protruding above vertex. Legs light or grayish brown. Abdominal tergites reddish, sides with more or less dark spots (as in ♂). Sternites light, sternites 2-8 sometimes with brown paired oval spots, these spots sometimes whitish, lighter than background and inconspicuous.

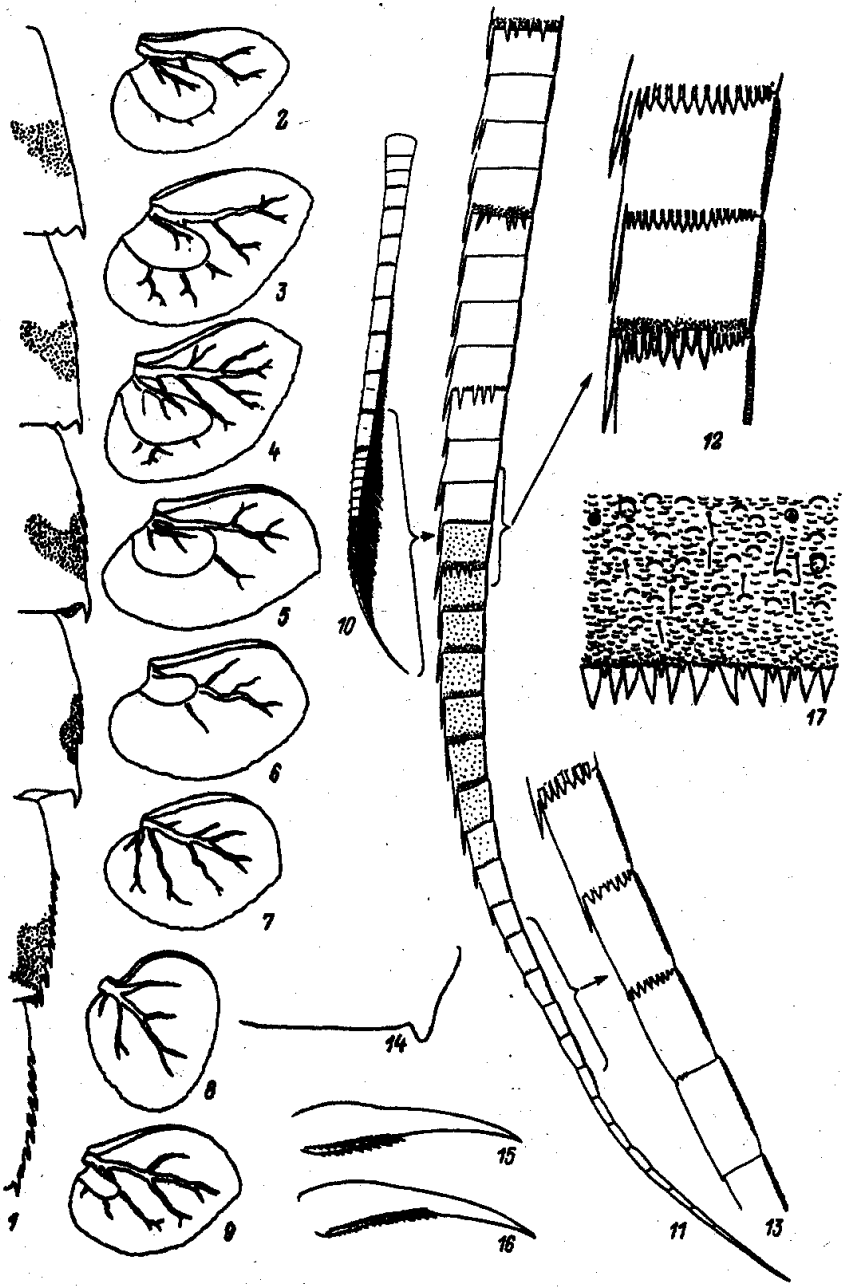

Fig. 5. *Cloeon (Intercloeon) petropolitanum* sp. n., larva: *1*) lateral margins of abdominal tergites 4-9; *2-8*) tergalii 1-7; *9*) tergalii 6, different specimen; *10-13*) cercus; *14*) right half of posterior margin of metanotum and rudiment of hindwing pad; *15, 16*) claws; *17*) surface and posterior margin of abdominal sternite 6 (*1-8* - holotype).

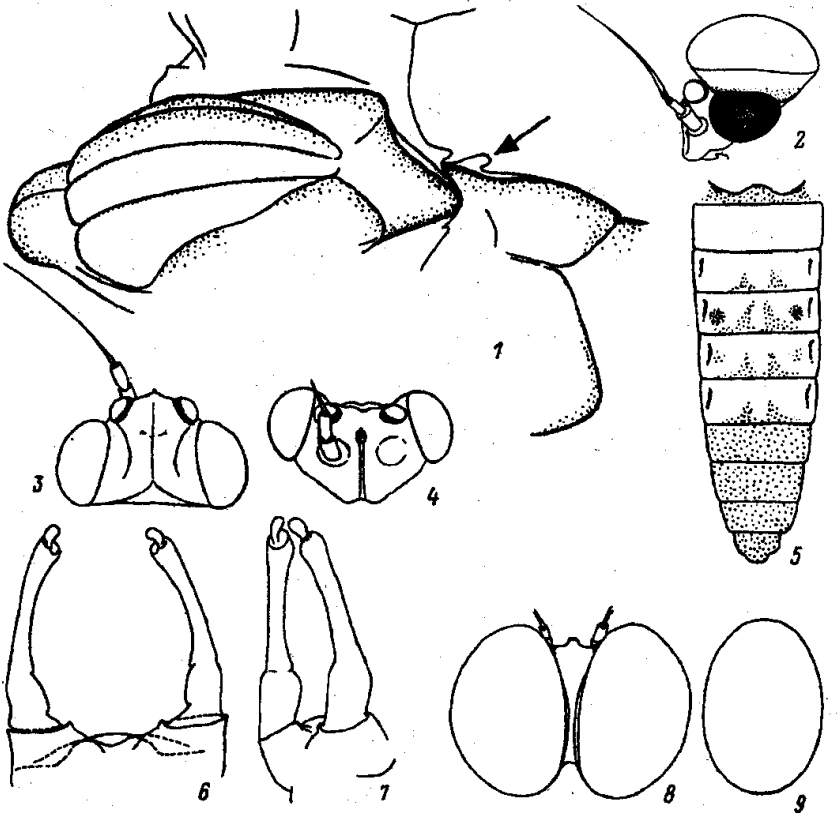

Fig. 6. *Cloeon (Intercloeon) petropolitanum* sp. n., imago: *1*) meso- and metanotum and rudiment of hindwing; *2*) ♂ head, lateral view; *3*) ♀ head, dorsal view; *4*) same, anterior view; *5*) ♂ abdominal tergites spread in preparation; *6*) ♂ genitalia, ventral view; *7*) same, half turned (ventrolateral view); *8*) ♂ head, dorsal view; *9*) faceted surface of turbinate eye.

Forewing length in ♂ 8-9 mm, in ♀ 9-10 mm.

Eggs. Chorion with irregular longitudinal rows of tubercles, each tubercle with deep pit, without spiral sculpturing.

Comparison. The new species differs from *C. (Intercloeon) petropolitanum* in structure of claw and tergalii 6-7 of larva, in brown coloration of adult thorax, and presence on adult abdominal tergites of identical paired spots. The larva differs from all our species of Baetidae as well in the presence of stout spinelike bristles on the abdominal sternites. In terms of external appearance and structure of the tergalii the larva of the new species resembles species of the subgenus *Similicloeon*, but differs in the shape of the labial palpus and lateral margins of abdominal segments 6-7. The adult ♂ is similar to that

of *Cloeon (Similicloeon) simile,* but differs in having the outer margin of the penis protruding (clearly visible when the penis is examined laterally and half turned; when examined ventrally the penis may appear truncate or emarginate because its tip is turned dorsally).

Cloeon (Intercloeon) petropolitanum Kluge & Novikova, sp. n. (Figs. 5, *1-17;* 6, *1-9*).

Cloeon praetextum: Chernova, 1941a: 218 (partim).

Material. Leningrad Prov., Ropsha, Ivanovskiy Pond, 28.VI-1.VII.1987: 15 ♂ imagines (including holotype), 12 ♀ imagines (all reared from larvae), 327 larvae, 9 ♂s and 8 ♀s (Klyuge); same locality, 19.IX.1936: 8 larvae (Lepneva and Chernova).

Larva. More or less distinctly green, especially in ♀s; in alcohol, green coloration disappearing and all larvae becoming yellowish. Mandibular teeth not deeply cleft (as in *C. spiniventre,* Fig. 3, *11, 12*). Maxillary palpus 2-segmented. Wing pads with contrasting dark veins. Rudiment of hindwing pad rather large. Legs light, femora with more or less conspicuous dark band apically. Claws of moderate length, 0.4-0.6 times length of tibia. Two rows of denticles barely reaching or not reaching middle of claw. Posterolateral spines developed, beginning with second abdominal segment, lateral row of spines beginning with segments 4-6. Lateral margins of abdominal segments 6-7 clearly differ from segments 8-9: S-shaped, in anteriorly convex, posteriorly concave; between posterolateral denticle and lateral row of denticles often with section free of denticles. Abdominal markings variable: either identical on all segments or diverse. Abdominal sternites without spinelike bristles; surface of sternites, especially those of abdomen, besides transparent scales and setae, with annular structures. Tergalii usually pointed apically, with strongly developed posteroproximal lobe. Upper lamella developed on tergalii 1-5, small, extending from lower lamella with wide base; very rarely upper lamella absent on tergalii 5, (then upper lamellae of preceding tergalii smaller than in Fig. 5, *2-5*). Tergalii 6 almost always without upper lamella, rarely with small upper lamella. Tergalii 7 always without upper lamella, with strongly convex anterior margin in proximal part making greatest width near base. Proportions of tergalii variable: ratio of maximum length of largest tergalia (3rd pair) to the length of the smallest tergalii (7th pair) in measured individuals varying from 1.3 to 1.7. Caudal filaments with more or less pronounced subapical dark stripe.

Subimago. ♂ yellowish green, ♀ intensively green, in both sexes not only trunk and legs green, but also anterior margin of wing (in alcohol green coloration disappearing in a few minutes, all individuals turning yellow).

Subimaginal exuviae. Colorless, only distal parts of legs and cerci brownish.

Imago, ♂. Head and thorax of freshly fixed specimens lemon yellow, in live specimens reddish. Turbinate eyes low, strongly expanded dorsally, lemon yellow, without dark rings; faceted surface oval, symmetrical. Legs pale, without darkening. Ratio of length of femur to tibia and tarsal segments in holotype on the front legs as 39:45:2:23:17:10:6, on midlegs as 31:26:10:4:2:5, on hindlegs as 31:25:8:3:2:5. Wings entirely transparent, with colorless veins. Pterostigma with 6-10 oblique simple or weakly branched crossveins, conspicuous hindwing rudiment present. Abdominal tergites 1-6 pale, with indistinct reddish markings, with whitish paired submedian stripes; tergites 7-10 bright yellow reddish; each side of tergites 4-6 with single pair of blurred reddish spots (on tergite 7 hardly visible against bright background), sometimes such a pair of spots present on tergite 2. Tergites 1-6 rarely mostly reddish brownish, or entirely colorless. Sides of tergites with dark brown tracheae showing through in form of contrasting stripes. Sternites pale. Genitalia and caudal filaments pale, whitish. First segment of forceps elongate, forceps curved ventrally at articulation of 1st and 2nd segments; penis broadly rounded apically.

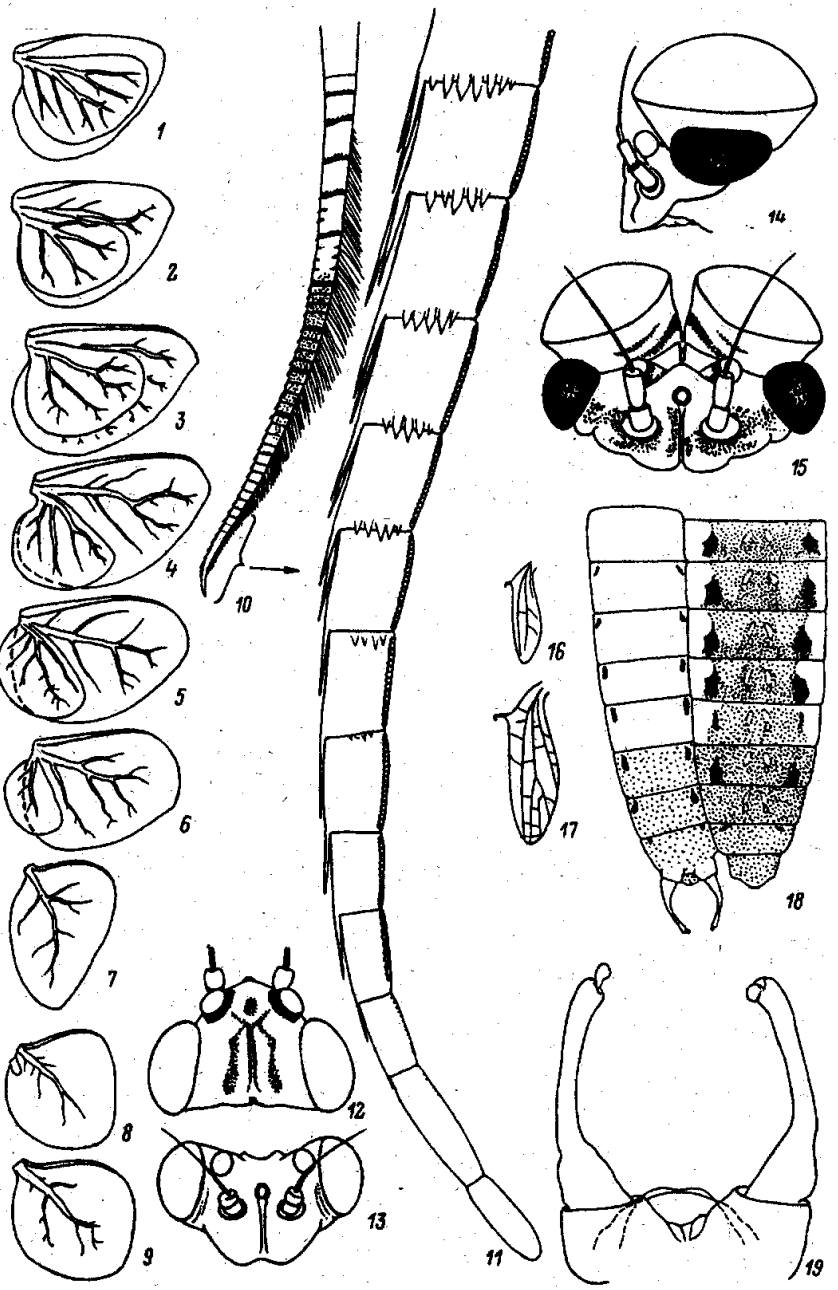

Fig. 7. *Cloeon (Pseudocentroptilum) unguiculatum* Tshern., larva and imago: *1-11*) larvae: *1-7*) tergalii 1-7; *8, 9*) tergalii 7 (other specimens); *10, 11*) cercus; *12-19*) imago: *12*) ♀ head, dorsal view; *13*) same, anterior view; *14*) ♂ head, lateral view; *15*) same, anterior view; *16, 17*) hindwings of different specimens (scale same as in *18*); *18*) tergites and sternites of ♂ abdomen, spread in preparation; *19*) ♂ genitalia, ventral view.

Imago, ♀. Body bright green (in alcohol green coloration disappearing after a few minutes and body turning yellowish). Head narrow, eyes large, approximated, separated posteriorly.

Length of ♂ forewing 8 mm, ♀ 8.5 mm.

Eggs. Chorion with longitudinal rows of tubercles fused in equatorial part of egg into longitudinal ridges; in dried eggs each tubercle with depression containing spiral structure.

Comparison. The new species differs from *C. (I.) spiniventre* in structure of claw and tergalii 6-7 of larva, absence in it of spinelike bristles on abdominal sternites, coloration of adult and subimaginal body (in absence of brown pigment on thoracic cuticle and in abdominal markings) as well as in narrower head of ♀ and in sculpturing on egg chorion. The imago of the new species externally (including proportions of tarsi and arrangement of crossveins of wing) and in structure of egg chorion resembling that of *C. (Procloeon) bifidum*, but differs from it in complete absence of pigment on thoracic sclerites and in having eyes of ♀ diverging posteriorly. Larvae of the new species externally resembling co-occurring larvae of *C. (Similicloeon) praetextum*, as a result of which they were confused with the latter (Chernova, 1941a). The new species differs from *C. (S.) praetextum* in shape of labial palpus, shape of tergalii 7, absence or small size of upper lamella of tergalii 6, and shape of lateral margins of abdominal segments 6-7.

Subgenus ***Pseudocentroptilum*** Bogoescu, 1947

Type species *Pseudocentroptilum motasi* Bogoescu, 1947 (= *Cloeon unguiculatum* Tshernova, 1941).

Larva. Mandibular teeth cleft no farther than to middle. Maxillary palpus 2- or 3-segmented, in latter case segment 3 approximately 0.5 as long as segment 2. Apical segment of labial palpus obviously expanded, with rounded inner angle, inner and apical margins forming right angle. Frontal suture acutely angular. Pronotum not shortened. Caudal filaments without extended bare terminal segments, spines on outer margin of cerci not enlarged (Fig. 7, *10, 11*). Tergalii in known species bilamellate (Fig. 7, *1-9*).

Imago. Penis rounded (Fig. 7, *19*). Eyes of ♀ not approximated, in posterior part distance between them greater than in anterior part and exceeding eye length (Fig. 7, *12, 13*). Hindwings present in known species.

Discussion. This subgenus is close to the subgenus *Procloeon* and may be grouped with it. It differs from typical *Procloeon* in the absence of certain apomorphic characters: thickened spines on cerci of larva and in having eyes of adult ♀ close together and parallel to each other.

Examined species: *Cloeon (Pseudocentroptilum) unguiculatum* Tshernova, 1941.

Cloeon (Pseudocentroptilum) unguiculatum Tshernova, 1941 (Figs. 1, *1;* 7, *1-19*).

Cloeon unguiculatum Chernova, 1941b (larva, Kazakhstan).

Pseudocentroptilum motasi Bogoescu, 1947, **syn. n.** (adult ♀, Romania); Keffermüller and Sowa, 1984 (adult ♀, eggs, Greece).

Centroptilum sp. I, sp. III; Landa and Soldan, 1983 (larva and adult ♀, Mongolia).

Centroptilum limnale Braasch and Soldan, 1983, **syn. n.** (larva, Kazakhstan).

"*Centroptilum* sp. (? = *P. motasi* Bogoescu, 1947)": Keffermüller and Sowa, 1984 (larva).

Material. Kazakhstan: Ili River, 1937—parts of larvae in preparations (syntypes) (Kinalev); Ters River at Burnooktyabr'skiy (SW of Dzhambul), 27.V.-11.VI.1986, 8 ♂ and 1 ♀ imagines, 8 ♂ and 2 ♀ subimagines (all reared from larvae), 40 larvae (Klyuge); Chu River at mouth of Kuragaty River, 18-19.VI.1986, 1 ♂ and 1 ♀ imago (reared from larvae), 1 larva (Klyuge); Sary-Bulak Stream (25 km N of Khantau), 22.VI.1986, 1 larva (Klyuge); same locality, 18.VI.1978, 1 ♂ imago (Kerzhner); 12 km W of Khantau, 15.VI.1978, 1 ♂ imago (Klyuge); Lepsa River at Lepsa, 3.VI.1978, 1 ♀ imago (Klyuge); Emel' River, 19.VII.1978, 1 larva (Klyuge). Kirgizskiy (Aleksandrovskiy) Range, Ken-Kol Gorge, 16.VII.1930, 2 ♀ imagines (dry collection) (Bianki). Uzbekistan: Gulistan Station (Golodnaya Steppe), 30.V.1903, 1 ♂ imago (dry collection) (Yakobson). Mongolia: Kobdoskiy Aymak, confluence of Dzabkhan and Tel' rivers, 24.VI.1978, 1 larva (Tsalolikhin): Uver-Khangayskiy Aymak, Tatsyn-Gol River, 15 km W of Bayan-Teg, 24-26.VII.1980, 1 ♂ imago (Zherikhin).

Larva. Mandibular teeth deeply cleft. Maxillary palpus 2- or 3-segmented. Wing pads darkened along inner margin. Legs pale, tarsi intensively darkened, if only in distal part, femora may be slightly darkened subapically. Claws approximately one-half length of tibia, bearing two rows of microscopic denticles in proximal parts. Posterolateral spines present beginning with abdominal tergite 2, lateral spinules developed only on segments 8 and 9. Tergalii 1-6 with large dorsal lamella. Tergalii 7 very diverse in shape, sometimes with small dorsal lamella (as described for *Centroptilum limnale*) or absent (as in original description of *Cloeon unguiculatum*). Caudal filaments with indistinct darkening in middle part.

Subimago. Lateral sutures of mesonotum dark brown, abdominal tergites in dorsal view brownish with light paired streaks and dots. Wings monochromatic brownish.

Imago, ♂. Head ochreous brown. Turbinate eyes with low stalk, strongly expanded dorsally, yellow with whitish edging along margin of faceted surface. Thorax ochreous brown, sternites dark brown. Legs pale, yellowish, without markings, ends of tarsi somewhat darker. Wings hyaline, veins pale yellowish, pterostigma whitish. Hindwing large, may differ strongly in size and shape in different individuals; usually with 3 longitudinal veins, second of which furcate, crossveins present. Abdominal segments 2-9 uniformly colored, tergites dorsally reddish brown, sometimes with pair of dark submedial streaks and dots; sides of tergites pale ochreous with blurred grayish brown spots or entirely grayish brown; sternites pale ochreous, with pair of contrasting longitudinal or rounded spots in anterolateral corners. Forceps pale. Caudal filaments pale, at base with distinct reddish-brownish annuli at articulations.

Imago, ♀. Head between eyes with reddish longitudinal bands against pale ochreous background. Body coloration same as in ♂.

Length of ♂ and ♀ forewing 8 mm.

Eggs. Chorion with uniform alveolate sculpturing. Eggs entirely or partially covered tightly with a film.

Subgenus ***Procloeon*** Bengtsson, 1915

Pseudocloeon: Bengtsson, 1914 (non *Pseudocloeon* Klapalek, 1905).

Cloeoptilum Kazlauskas, 1972 (nomen nudum).

Pennulatum Group of genus *Centroptilum:* Keffermüller and Sowa, 1984.

Type species *Cloeon bifidum* Bengtsson, 1912.

Larva. Mandibular teeth cleft no farther than to middle (Figs. 8, *15, 16;* 9, *23, 24*). Maxillary palpus 2- or 3-segmented, in latter case third segment approximately one-half as long second (Fig. 9, *20-22*). Apical segment of labial palpus clearly expanded, with rounded inner angle, inner and apical margins forming right angle. Frontal suture acutely angulate. Pronotum not shortened. Caudal filaments without extended bare terminal segments, in distal part of cerci each segment bearing on outer margin one very long and thick spine (Fig. 9, *19*). Arcuate row of setae on tibia longer than in other subgenera (Fig. 1, *2*). Denticles on claws very small or absent (Figs. 8, *17;* 9, *17*). Tergalii bilamellate or unilamellate (Figs. 8, *1-14;* 9, *1-15*).

Imago. Penis rounded (Figs. 8, *24, 25;* 10, *1, 2*). Eyes of ♀ large, approximated, inner margins parallel, distance between them equal to eye length; eyes also clearly protruding above head (Fig. 10, *8, 9*). Hindwings present or absent.

Discussion. This subgenus differs from other subgenera of the genus *Cloeon* in unique structure of eyes of adult ♀, structure of cerci, and shape of labial palpus of larva. These characters also pertain to species previously assigned to the genus *Procloeon* and species previously placed in the Pennulatum Group of the genus *Centroptilum* (= *Cloeoptilum* Kazlauskas, 1972). As generic characters of *Procloeon,* in addition to absence of hindwing, single-plate tergalii, and 2-segmented maxillary palpi in larva are cited (Bengtsson, 1914), while for the Pennulatum Group, among others, there are bilamellate tergalii and 3-segmented maxillary palpi in larva when hindwings are present in imago (Keffermüller and Sowa, 1984). In fact, these characters are combined differently in different species. For example, in the Far Eastern species *C. maritimum* and *C. albisternum* hindwings are present but the tergalii are single-plate; in *C. maritimum* the maxillary palpus is 3-segmented but in *C. albisternum* it is 2-segmented. In addition, in some species these characters are subject to individual variability (see below; Figs. 8, *1-14;* 9, *20-22*). Thus, *Procloeon* in the old concept and the Pennulatum Group may be separated only by the absence and presence of the hindwings in the imago, which is only a purely formal character. We therefore unite these groups into a single subgenus *Procloeon* (Novikova, 1987).

Examined species: *Cloeon (Procloeon) albisternum* (Novikova in Tshernova et al., 1986); *C. (P.) bifidum* Bengtsson, 1912; *C. (P.) heterophyllum* sp. n.; *C. (P.) macronyx* sp. n.; *C. (P.) maritimum* (Kluge, 1983), comb. n. (= *Centroptilum maritimum* Kluge; *Cloeoptilum maritimum:* Chernova et al., 1986); *C. (P.) pennulatum* (Eaton, 1970) (= *Centroptilum pennulatum* Eaton; *Cloeoptilum pennulatum:* Kazlauskas, 1972); *C. (P.) pulchrum* (Eaton, 1885) (= *Centroptilum pulchrum* Eaton).

Cloeon (Procloeon) heterophyllum Kluge and Novikova, sp. n. (Fig. 8, *1-25*).

Material. Krasnodar Terr., Lazarevskoye, Fokin Fissure near All-Union Research Institute of Plant Protection, 8-13.VI.1988, 21 ♂ imagines (including holotype), 9 ♀ imagines, 4 ♂ and 13 ♀ subimagines (all reared from larvae), 84 larvae, 1 ♀ subimago (Klyuge).

Larva. Mandibular teeth not deeply divided. Maxillary palpus 2- segmented. Longitudinal streaks on wing pads weak or absent. Hindwing pad rudiment present. Legs pale, without dark spots. Claws approximately one-half length of tibia, with two rows of microscopic denticles in proximal part. Posterolateral tergal spines present beginning with 2nd abdominal segment, lateral spinules developed beginning with 3rd to 5th segments. Tergalii in some individuals unilamellate, without dorsal lamella,

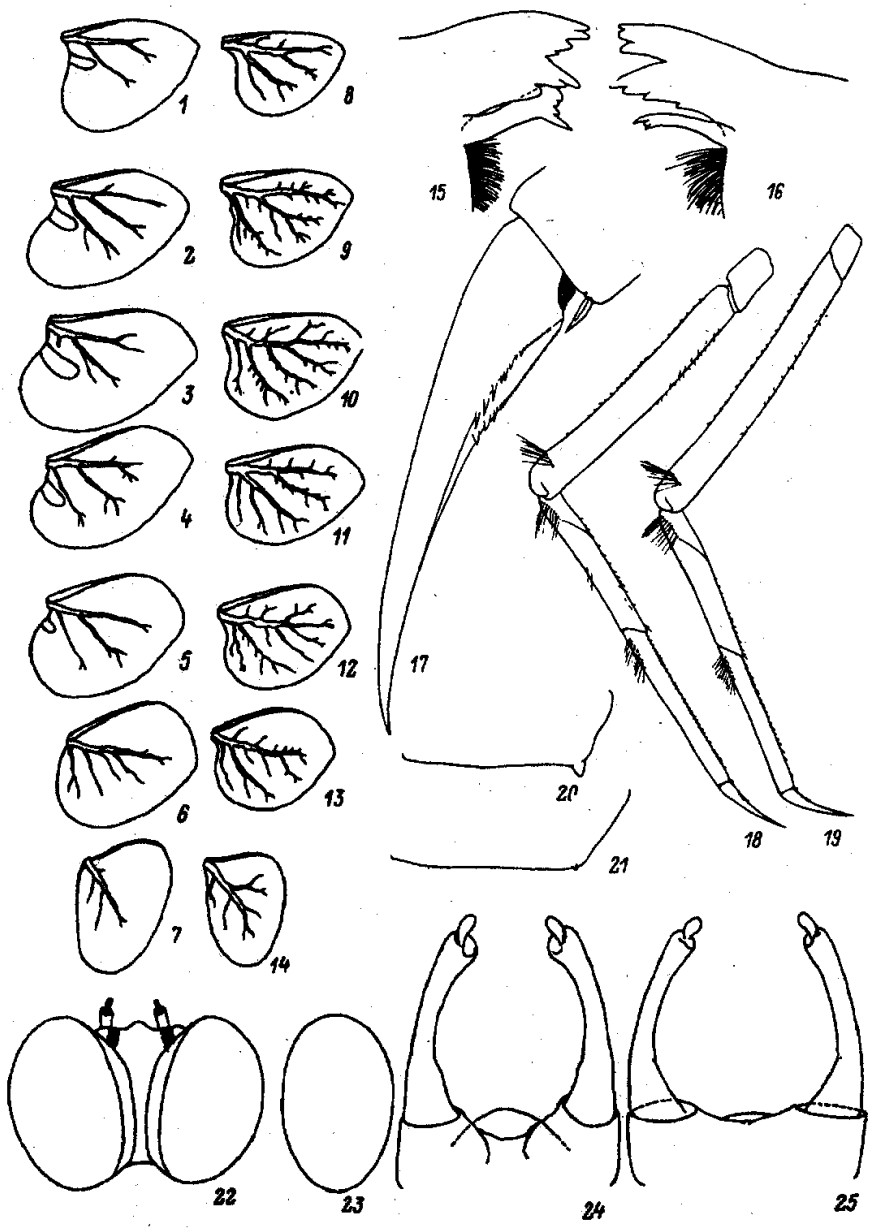

Fig. 8. *Cloeon (Procloeon) heterophyllum* sp. n. and *C. (P.) bifidum* Bengtsson, larva and imago. *1-20*) *C. (P.) heterophyllum* sp. n.: larva; *1-7* and *8-14*) tergalii 1-7 in different specimens; *15, 16*) left and right mandibular teeth; *17*) claws; *18, 19*) fore- and midlegs; *20*) right half of posterior margin of metanotum and rudiment of hindwing pad. *21*) *C. (P.) bifidum*, same as in 20; *22-25*) *C. (P.) heterophyllum* sp. n., imago, ♀s: *22*) head, dorsal view; *23*) faceted surface of turbinate eye; *24, 25*) genitalia, ventral view. (*8-14, 18, 19, 24* - holotype).

in other individuals with dorsal lamella, sometimes very small and developed only on anterior pairs of tergalii, or else larger and developed on tergalii 1-5. Caudal filaments pale, without dark bands (only with dark annuli along margin of every 4th segment), swimming hairs on caudal filaments dark.

Subimago. Cuticle colorless, sutures not darkened.

Imago, ♂. Turbinate eyes strongly diverging anteriorly, entirely yellow, stalk sometimes with brown annulus in middle, faceted surface subsymmetrical, without dark edging, sometimes with pale yellowish edging along margin. Thoracic tergites and pleurites intensively yellow, sternites whitish. Legs whitish. Ratio of length of femur to tibia and tarsal segments in holotype as follows: on forelegs as 56:67:2:30:22:13:8, on midlegs as 50:40:19:7:2:7, on hindlegs as 50:40:21:7:2:7. Veins on wings whitish. Hindwings absent; sometimes very small pointed hindwing rudiment visible (smaller than in Fig. 6, *1*). Abdominal segments 2-6 whitish, translucent; parallel to posterior margin of each tergite with indistinct reddish band, away from it on sides of tergite with pair of same indistinct reddish longitudinal spots; in some specimens these reddish markings indistinct. Tergites 7-10 reddish yellow, tergites 7-8 with reddish edging along posterior margin. Sternites 7-10 whitish. Forceps whitish; first segment evenly narrowing apically, without shelf at point of fusion with second segment; apical segment small.

Length of forewing 6-7 mm.

Eggs. Chorion with uniform sculpturing in form of frequent randomly arranged tubercles.

Comparison. The new species differs from the other dipterous species of the subgenus *Procloeon*, *C. (P.) bifidum*, in the absence of a dark band on the caudal filaments of the larva and in the presence of some individuals of a more or less developed dorsal lamella on the tergalii; the ♂ imago of the new species differs from that of *C. (P.) bifidum* in the absence of a shelf at the tip of the first segment of the forceps; the ♀ of the new species differs from that of *C. (P.) bifidum* in not having tubercles on the surface of the eggs forming longitudinal rows. In terms of the structure of the eggs the new species is similar to *C. (Similicloeon) simile*.

Cloeon (Procloeon) macronyx Kluge & Novikova, sp. n. (Figs. 9, *1- 24;* 10, *1-10*).

Centroptilum nana: Kazlauskas, 1964 (partim: nymph, nec imago), *C. nanum:* Keffermüller and Sowa, 1984 (partim: nymph, non imago) (non Bogoescu, 1951); *Cloeoptilum nanum:* Kazlauskas, 1977 (nymph); *Centroptilum potamonensis:* Jacob, 1973 (partim: nympha, non imago).

Material. Chu River at confluence with Kuragaty River, 17- 19.VI.1986, 15 ♂ imagines (including holotype), 12 ♀ imagines, 4 ♂ and 4 ♀ subimagines (all reared from larvae), 13 larvae (Klyuge); Chu River, 30 km below Chu, 15.VI.1978, 5 larvae (Klyuge); Lepsa River at Lepsa, 5.VI.1978, 1 larva (Klyuge). Bashkiria: Belaya River at Okhlebinino (above Ufa), VIII.1989, 5 larvae (Klyuge). Lithuania: Neris River above Vilnius, 22- 29.VI.1988, 15 ♂ and 32 ♀ imagines, 2 ♂ and 2 ♀ subimagines (all reared from larvae) (Klyuge); Nemunas River at Rilishkyay, 24.VI.1959, 2 ♂ imagines, 4 larvae; Nemunas River at Kaunas, 28.VI.1959, 10 ♂ imagines (Stashaytis). Poland: Varta River, 10-14.1964, 1 ♀ imago, 2 larvae (Keffermüller).

Larva. Coloration pale, with dark markings. Mandibular teeth deeply divided. Maxillary palpus 2- or 3-segmented, number of segments varying even in single specimen. Wing pads very narrowly darkened along inner margin. Legs pale, without dark spots. Claws very long, approximately equal to tibia in length, without denticles. Posterolateral spines present beginning with 1st abdominal segment, lateral spinules developed only on segments 8-9, sometimes individual spines present on segment 7.

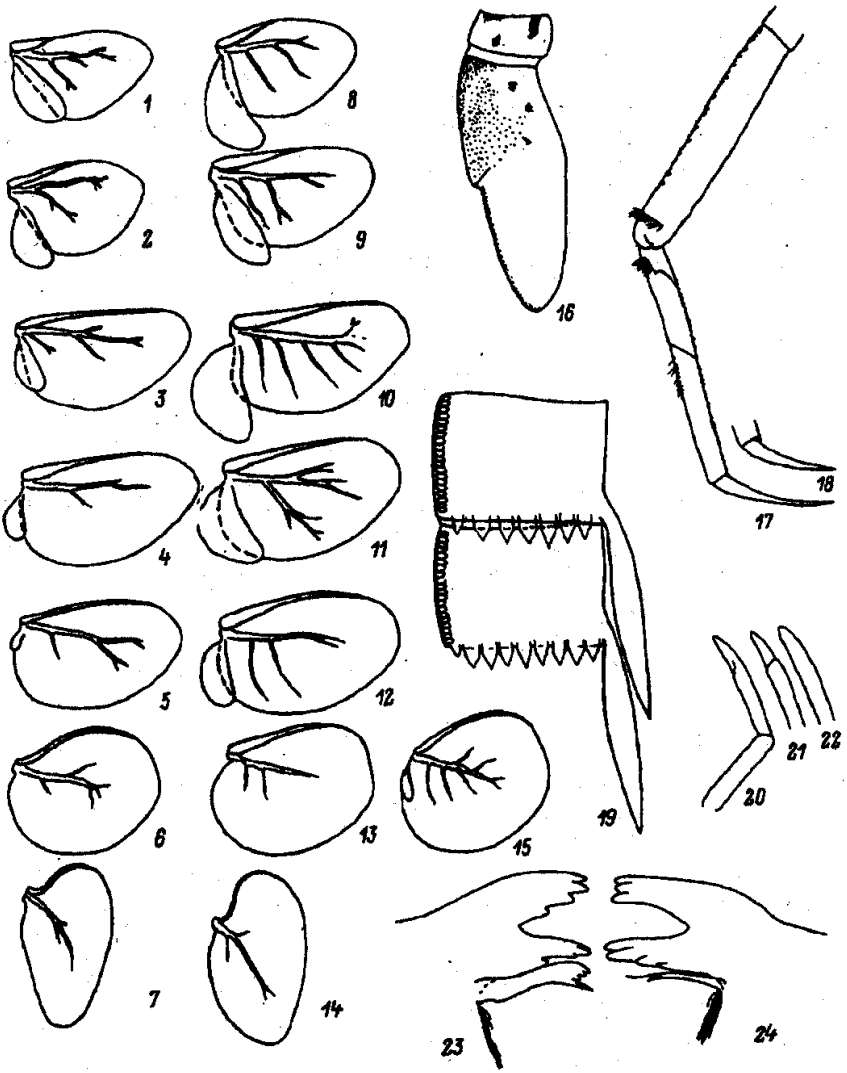

Fig. 9. *Cloeon (Procloeon) macronyx*, sp. n., larva: *1-7* and *8-14*) tergalii 1-7 in different specimens; *15*) tergalia 6 in different specimen; *16*) right half of exuviae of pro- and mesonotum; *17*) leg; *18*) claw of different specimen; *19*) segments of distal part of cercus; *20-22*) maxillary palpus of various specimens; *23, 24*) left and right mandibular teeth (*1-7, 23, 24* - holotype).

Upper lamella of tergalii not large, varying in size in different individuals. Caudal filaments with indistinct dark bands in middle.

Subimago. Mesonotum with brown lateral sutures. Tarsi darkened.

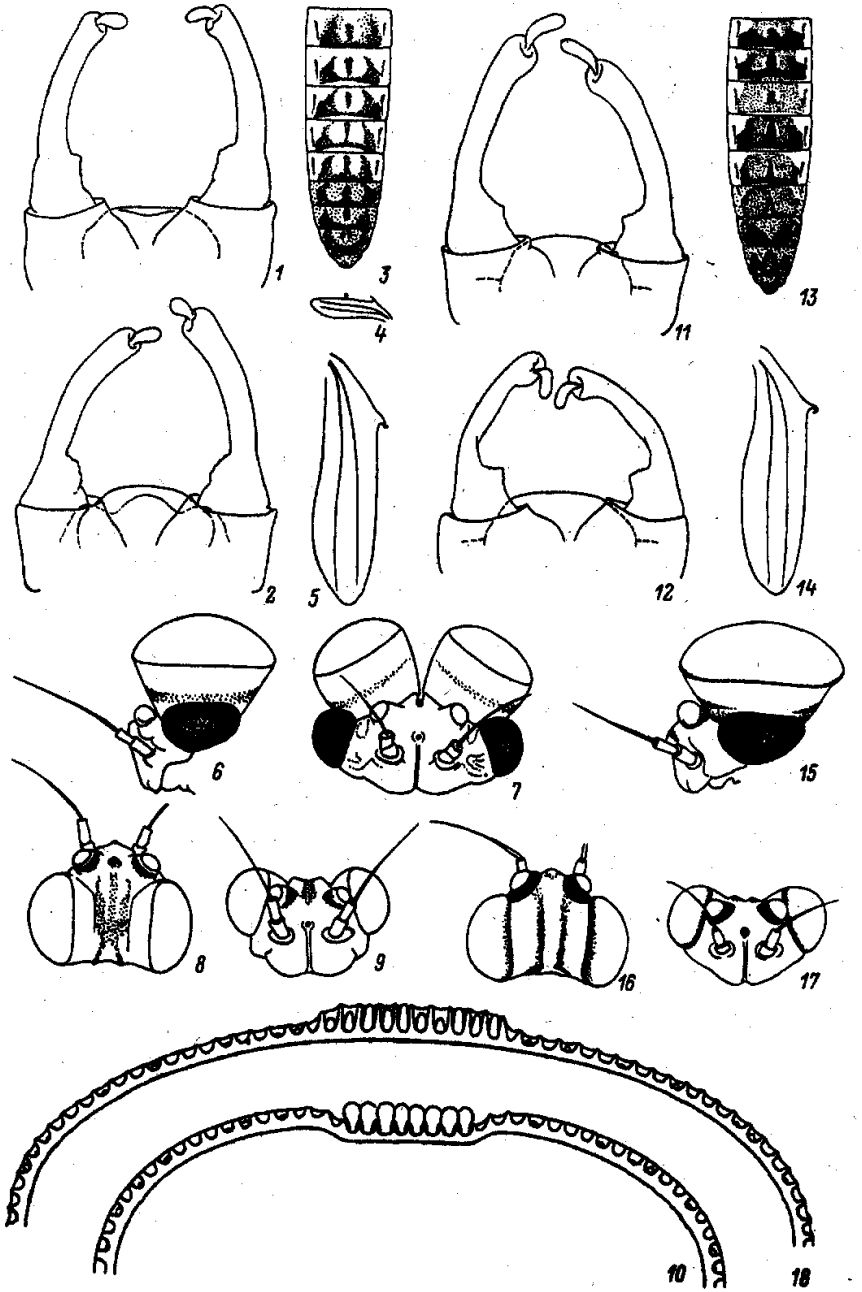

Fig. 10. *Cloeon (Procloeon) macronyx* sp. n. and *C. (Pseudocentroptiloides) nana* Bogoescu, imago and egg. *1-10*) *C. (P.) macronyx* sp. n. (*2, 5-7* - holotype), *11-18*) *C. (P.) nana*. *1-7, 11- 15*) ♂: *1, 2, 11, 12*) genitalia, ventral view; *3, 13*) abdominal tergites, spread, in preparation; *4*) hindwing (same scale as in 3); *5, 14*) same, at greater magnification; *6, 15*) head, lateral view; *7*) same, anterior view, *8, 9, 16, 17*) ♀ head: *8, 16*) dorsal view; *9, 17*) lateral view. *10, 18*) Diagrammatic section of chorion of half of egg.

Imago, ♂. Turbinate eyes light yellow. Thorax in dorsal view brownish, sternites pale yellowish (in individuals from Lithuania), or entire thorax pale yellow (in individuals from Kazakhstan). Abdominal tergites with annular markings along posterior margin from which three tongues extend anteriorly; in individuals from Lithuania these markings bright reddish brownish, in individuals from Lithuania these markings bright reddish brownish, in individuals from Kazakhstan indistinct, pale reddish yellow. Light section of tergites and sternites pale yellowish. First segment of forceps elongate, with small shelf on inner margin; terminal segment small, length approximately equal to width of tip of preceding segment.

Imago, ♀. Coloration similar to ♂. Head between eyes with reddish longitudinal bands.

Length of front wing 5-6 mm.

Eggs. Along equator encircled by belt of densely placed high tubercles with rounded tips arranged in regular rows; this belt submerged in annular depression so that tips of tubercles approximately at same level as rest of surface of egg. Remaining surface of egg with alveolate sculpturing; these cells and tubercles of belt may appear externally to be entirely or partially covered tightly with a film. Under light microscope in incident light eggs appear alveolate with distinctly isolated equatorial belt; in cleared preparation lumen of wall of egg appearing thin at polar points and concave and strongly thickened along equator.

Comparison. Larvae of this species were previously described in the literature, but were ascribed either to *"Centroptilum" nana* (Kazlauskas, 1964; Keffermuller and Sowa, 1984) *"Centroptilum" potamonensis* (Jacob, 1973). We reassigned *C. nana* to the subgenus *Pseudocentroptiloides* (see below). The adult ♂ of the new species differs from *Cloeon (Pseudocentroptiloides) nana* in having a small apical segment on the forceps in the shape of the first segment of the forceps and in the coloration of the abdomen and turbinate eyes. The eggs of the new species, as in *C. (P.) nana,* have a belt, but unlike *C. (P.) nana,* the belt does not consist of cells, but rather tubercles and is submerged in a depression. The name *C. potamonensis* is a synonym of *Cloeon (Procloeon) pulchrum* because the holotype of *C. potamonensis* is an adult ♂ identical to *C. (P.) pulchrum* (synonymy established by Keffermüller and Sowa, 1984). The adult ♂ of the new species differs from *C. (P.) pulchrum* in the presence of characteristic markings on the abdominal tergites and the dark coloration of the dorsal side of the thorax (in particular, in the European form). The larva of the new species is well distinguished from *C. (Procloeon) pulchrum* by the deeply cleft mandibular teeth and long undarkened claws, and from *C. (Pseudocentroptiloides) nanum* in the structure of mouth apparatus and other characters.

Subgenus ***Pseudocentroptiloides*** Jacob, 1986

Pseudocentroptilum: Kazlauskas, 1964 (larva) (non Bogoescu, 1947).

Pseudocentroptiloides: Jacob and Glazaczow, 1986 (larva, imago); Waltz and McCafferty, 1989 (larva, imago).

Psammonella Glazaczow: Jacob and Glazaczow, 1986.

Type species *Pseudocentroptilum shadini* Kazlauskas, 1964 (= *Centroptilum nana* Bogoescu, 1951).

Larva. Structure of mouth apparatus differing sharply from that of all other Baetidae in having all mouth parts strongly shortened in median parts. Maxillary palpus 3-segmented, 3rd segment approximately half as long as second. Apical segment of labial palpus strongly expanded, with rounded

inner angle. Frontal suture acutely angulate. Pronotum not shortened. Caudal filaments without extended bare terminal segments, in distal part of cerci each segment bearing on inner margin one very long and thick spine (as in subgenus *Procloeon:* Fig. 9, *19*). Tergalii bilamellate or unilamellate.

Imago. Penis rounded (Fig. 10, *11, 12*). Eyes of ♀ large, approximated, inner margins parallel, distance between them equal to eye length; eyes also clearly protruding above head (Fig. 10, *16, 17*). Hindwing present or absent.

Discussion. *Pseudocentroptiloides* is recognized as a separate genus based on the unusual structure of the mouth parts of the larvae (Jacob and Glazaczow, 1986; Waltz and McCafferty, 1989). In our opinion, this group phylogenetically is very close to the subgenus *Procloeon;* this is confirmed by the structure of the eyes in the adult ♀ and cerci in the larva, identical in both groups, and by the similar structure of the labial palpus of the larva. Based on the characters of the imago, *Pseudocentroptiloides* in no way differs from *Procloeon;* in addition, there are problems with their differentiation at the species level free [see **Comparison** for *C. (Procloeon) macronyx* and *C. (Pseudocentroptiloides) nana*]. Therefore, we believe it reasonable to consider *Pseudocentroptiloides* a subgenus of the genus *Cloeon.*

Examined species: *Cloeon (Pseudocentroptiloides) nana* (Bogoescu, 1951), **comb. n.**

Cloeon (Pseudocentroptiloides) nana (Bogoescu, 1951), **comb. n.** (Fig. 10, *11-18*).[1]

Centroptilum romanicum Bogoescu, 1949 (partim: ♀ nec ♂); Bogoescu, 1958 (partim: ♀ non ♂) (eggs); Keffermüller and Sowa, 1984 (partim: ♀ non ♂, non nymph) (eggs).

Centroptilum nana Bogoescu, 1951 (imago); Bogoescu, 1958 (imago); Kazlauskas, 1964 (partim: imago, non nymph); *C. nanum:* Keffermüller, 1967 (imago, larva); Keffermüller and Sowa, 1984 (partim: imago, non nymph).

Pseudocentroptilum shadini Kazlauskas, **syn. n.**: Kazlauskas, 1964 (larva); Kazlauskas, 1977 (larva).

Centroptilum shadini Keffermüller, 1978; Keffermüller and Sowa, 1984 (imago, larva).

Pseudocentroptiloides shadini Jacob and Glazaczow 1986 (imago, larva).

Material. Lithuania, Neris River above Vilnius (near Salyut pioneer camp), 28-30.VI.1988, 2 ♂ and 4 ♀ imagines (all reared from larvae) (Klyuge); same locality, 18.VII.1961, 1 larva (Kazlauskas). Poland, Bug River, 14.VI.1984, 1 larva (Keffermüller). Oka River below Kaluga, 20.VI.1959, preparation of parts of a larva (lectotype of *Pseudocentroptilum shadini* by present designation); same locality, 27.VI.1959, preparation of parts of larva (paralectotype of *P. shadini*). Bashkiria, Belaya River at Okhlebinino (above Ufa), 18.VIII.1989, 1 ♀ imago (reared from larva), 2 larvae (Klyuge). Evenkiya, Taymura River at mouth of Neptene River, 20-25.VII.1982, 2 ♂ and 22 ♀ imagines (Zherikhin).

Larva. Described in literature.

Subimago. Mesonotum with brown lateral sutures. Tarsi darkened.

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[1]The species name *nana* replaces *nanum* (Keffermüller, 1967; and others); however, in addition to the adjective *nana* (dwarf), in Latin there is a noun *nana* (female dwarf), so that the ending of this word does not have to agree grammatically with the genus name and it should be used as in the original description (ICZN, 3rd ed., art. 31 b I).

Imago, ♂. Turbinate eyes strongly expanded dorsally, faceted surface yellowish brown or red-yellow, with narrow dark brown edging along margin; upper half of stalk yellowish, lower part brown. Thoracic tergites brown, sternites pale. Legs whitish. Abdominal tergites brown ochreous, with reddish brown markings, most intensive on tergites 2, 3, 5, 6, and 9; tergites 4 and 6 paler. Abdominal sternites pale. Forceps and caudal filaments whitish. First segment of forceps wide and short, not narrowed apically, with distinct inner apical angle; apical segment comparatively large, length considerably exceeding width of tip of preceding segment.

Imago, ♀. Coloration of thorax, abdomen, legs, and caudal filaments as in ♂.

Forewing length 5-6 mm.

Eggs. Surface of egg with alveolate sculpturing, in equatorial region alveolae highest, forming distinct convex belt. Alveolae may be entirely or partially closely covered with a film.

Discussion. Imago of this species in both sexes were described by Bogoescu from Romania under the name *Centroptilum nana.* Somewhat earlier this author described imagines of both sexes of *C. romanicum.* Judging by these descriptions, ♀s of *C. nana* and *C. romanicum* differ in the structure of the eggs: in *C. nana* the belt contains 7 rows of papillae (according to Keffermüller and Sowa, 1984, from 7 to 9 rows), and in *C. romanicum* 13 rows of papillae (according to Keffermüller and Sowa, 1984, from 13 to 15 rows). In fact, various eggs of the same ♀, reared by us from larvae from Neris River, contain from 7 to 13 rows of high alveolae. Thus, the differences noted from ♀s of *C. romanicum* and *C. nana* are not species specific. The ♂ genitalia of *C. romanicum* are clearly inaccurately drawn in the description, evidently they are from a crumpled specimen so that the taxonomic position of this ♂ is not clear.

Kazlauskas (1964) described larvae mistakenly assigned by him to *C. nana.* Imagines were not reared from larvae but were assigned to one species based only on the fact that the imago and larva were captured in the Neris River. According to Kazlauskas, only two species of *Centroptilum* occur in the Neris River: *C. pennulatum* and *C. nana.* In fact, in this river three similar species occur together: *Cloeon (Procloeon) pulchrum* (which was mistaken for *C. pennulatum, C. (Pseudocentroptiloides) nana,* and *C. (Procloeon) macronyx* sp. n. Larvae of the latter species were also mistaken for larvae of *C. nana,* while Kazlauskas in the same article described the true larvae of *C. (P.) nana* under the name *Pseudocentroptilum? shadini.* Somewhat later, Keffermüller (1967) described larvae and adult ♂s of *C. nana* based on reared individuals. However, Keffermüller subsequently redetermined this material as *C. shadini* after accepting on faith the published preliminary description by Kazlauskas of a larva of *C. nana* (Keffermüller, 1978). This incorrect idea regarding *C. nana* was maintained until recently.

Neizvestnova-Zhadina (1931) described larvae from Oka River under the name Baetidae gen. sp. Judging by the structure of the maxilla and labium, they belong to the subgenus *Pseudocentroptiloides,* but differ from *C. (P.) nana* in the presence of an upper lamella at least on tergalii 2.

PHYLOGENY

In the dendrogram (Fig. 11) the numbers represent the following complexes of synapomorphic characters: 1) special method of fitting rudiments of forceps of subimago under larval exuviae; one of the pair of marginal intercalary veins in each space between longitudinal veins of the forewing is reduced (similar reduction occurred independently as well in some genera not belonging to the Cloeoniae); 2) loss of capability of larval tergalii to make respiratory movement (independently of the Baetinae and some non-Palearctic groups); 2-segmented labial palpus with pointed second segment; 3) adaptation of mouthparts to predation; 4) truncate third segment of labial palpus; arched row of setae at

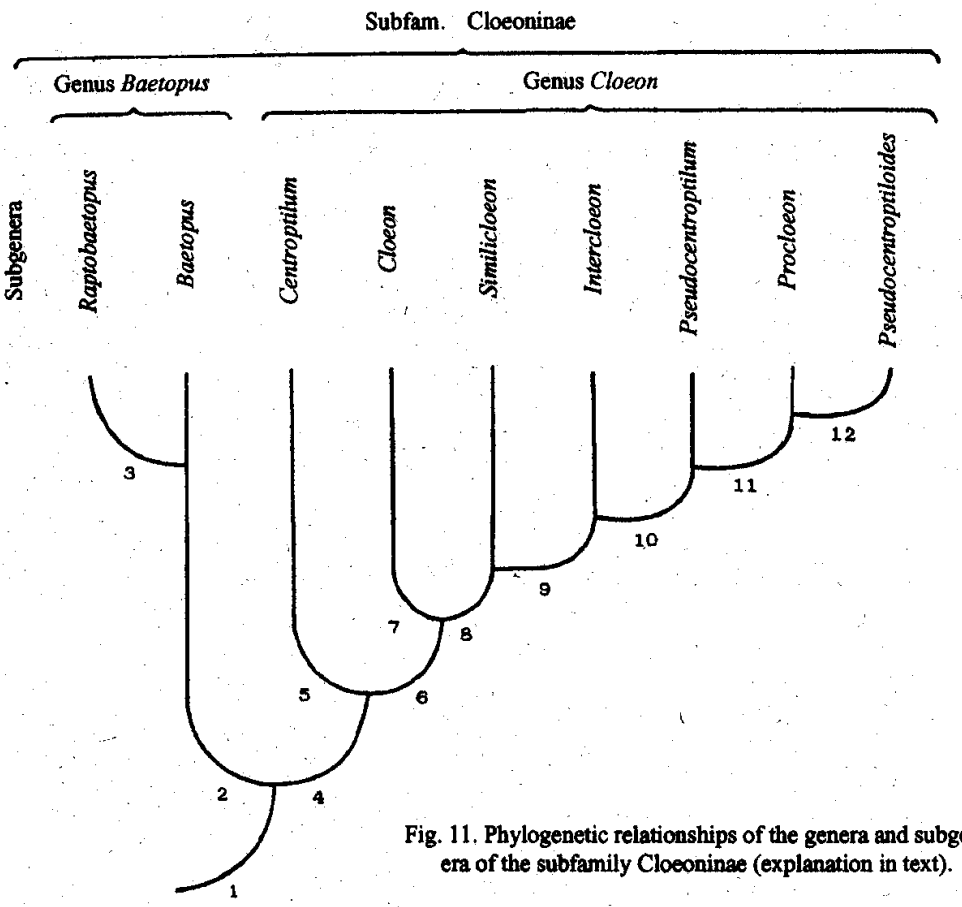

Fig. 11. Phylogenetic relationships of the genera and subgenera of the subfamily Cloeoninae (explanation in text).

patellotibial suture in larva; lateral spinules on abdomen of larva; dark rings on every fourth segment of caudal filaments of larva; 5) special shape of mandibular teeth, labial palpus, frontal suture, and pronotum of larva; medial crest on mesonotum of imago; 6) reduced terminal segment of forceps; 7) expanded tergalii of larva (adaptation to life in stagnant waters); viviparity; 8) broad outer margin (rounded or truncate) of penis; 9) special shape of labial palpus of larva; 10) reduced slender nonpubescent ends of caudal filaments of larva; 11) thickening of spine in distal part of cerci of larva; enlarged, approximate, and raised eyes of adult ♀; 12) specialized mouthparts of larva.

Reduction of the hindwings occurred independently in the subgenera *Raptobaetopus, Centroptilum, Cloeon, Similicloeon, Intercloeon, Procloeon,* and *Pseudocentroptiloides;* in addition, in the subgenera *Raptobaetopus, Centroptilum, Procleon,* and *Pseudocentroptiloides* representatives are known with developed hindwings and without hindwings.

The subgenus *Centroptilum* and the genus *Baetopus* share a common apomorphic character not found in other groups of the Baetidae: presence of median crest on mesonotum of imago. However, the presence in the subgenus *Centroptilum* and other subgenera of the genus *Cloeon* of a complex of

synapomorphic characters absent in *Baetopus* forces us to believe that *Centroptilum* and *Baetopus* are not directly related.

LITERATURE CITED

BENGTSSON, S. 1914. Bemerkungen über die nordischen Arten der Gattung *Cloeon* Leach. Entomol. Tidsk. 1 (35): 210-220.

BOGOESCU, C. 1947. Un genre nouveau d'éphéméroptère en Roumanie. Bull. Sect. Sci. Acad. Roum. 29 (9): 602-604.

BOGOESCU, C. 1949. Noi studii sistematice si biologice asupra ephemeropterelor din Republica Populară Română. An. Acad. R. P. R., Seria A, 2 (31): 793.

BOGOESCU, C. 1951. Două specii noi de ephemeroptere in R. P. R. Comun. Acad. Repub. Rom. 1 (8): 781-786.

BOGOESCU, C. 1958. Ephemeroptera. Fauna R. P. R. 7, fasc. 3: 187 pp.

BRAASCH, D., and T. SOLDAN. 1983. Baetidae in Mittelasien. III (Ephemeroptera). Entomol. Machr. Ber. 27 (6): 266-271.

CHERNOVA, O. A. 1941a. Mayfly fauna of the Soviet European North. Zool. zhurn. 20(2): 213-236.

CHERNOVA, O. A. 1941b. Mayflies collected from Ili River by an expedition from the Zoological Museum in 1937. [In Russ.]. In: Sb. trud. Gos. zool. muz. Mosk. Gos. Univ. 6: 239-244.

CHERNOV, O. A., et al. 1986. Ephemeroptera. In: Opredel. nasek. Dal'n. Vost. SSSR. 1+ 99-142.

EDMUNDS, G. F., S. L. JENSEN, and L. BERNER. 1976. The mayflies of North and Central America. Minneapolis, Univ. of Minn. Press: 330 pp.

JACOB, U. 1973. Ein *Centroptilum* des Stenopteryx-Komplexes aus dem mitteleuropäischen Flachland (Baetidae, Ephemeroptera). Reichenbachia 14 (21): 163-170.

JACOB, U. and A. GLAZACZOW. 1986. *Pseudocentroptiloides*, a new baetid genus of Palaearctic and Oriental distribution (Ephemeroptera). Aquat. In. 8 (4): 197-206.

KAZLAUSKAS, R. S. 1964. Data on mayflies of the Oka River. [In Russ.]. Tr. Zool. Inst. Akad. Nauk SSSR 32: 164-176.

KAZLAUSKAS, R. S. 1972. Neues über das System der Eintagsfliegen der Familie Baetidae (Ephemeroptera). Tr. XIII Mezhdunarodn. entomol. kongr., Leningrad 3: 337-338.

KAZLAUSKAS, R. S. 1977. Ephemeroptera. In: Opredel. presnovod. bespozv. evrop. chasti SSSR (Key to Freshwater Invertebrates of the European USSR). Leningrad: 288-303.

KEFFERMÜLLER, M. 1967. Badania nad fauna jetek (Ephemeroptera) Wielkopolski. III. Bad. Fizjogr. Pol. Zach., Poznan 20: 15-28.

KEFFERMÜLLER, M. 1978. Badania nad fauna jetek (Ephemeroptera) Wielkopolski. VI. Bad Fizjogr. Pol. Zach., Poznan 31, Ser. C., Zool.: 95-103.

KEFFERMÜLLER, M., and R SOWA. 1984. Survey of Central European species of the genera *Centroptilum* Eaton and *Pseudocentroptilum* Bogoescu (Ephemeroptera, Baetidae). Pol. Pismo Entomol. 54: 309- 340.

KLYUGE, N. Yu. 1989. Question of the homology of the tracheal gills and paranotal processes of mayfly larvae and insect wings in connection with the taxonomy and phylogeny of mayflies (Ephemeroptera) [In Russ.]. Chten. pamyat. N. A. Kholodovskogo 1988 (Lectures in Memory of N. A. Kholudovskiy, 1988). Leningrad: 48-77.

LANDA, V., and T. SOLDAN. 1983. Ephemeroptera from Mongolia. Folia Entomol. Hungar. Rovart. Közl. 44 (2): 189-204.

McCAFFERTY, W. P., and R. D. WALTZ. 1990. Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. Trans. Amer. Entomol. Soc. 116 (4): 769-799.

MÜLLER-LIEBENAU, I. 1978. *Raptobaetopus*, eine neue carnivore Ephemeropteran-Gattung aus Malaysia (Insecta, Ephemeroptera, Baetidae). Arch. Hydrobiol. 82 (1-4): 465-481.

NEIZVESTNOVA-ZHADINA, E. S. 1931. Mayfly larvae from the Oka River and its basin based on collections of the Oka Biological Station. [In Russ.]. Rab. Oksk. Biol. St. 6 (1-3): 159-171.

NOVIKOVA, E. A. 1987. A new species of mayfly (Ephemeroptera, Baetidae) from Amur River. Vestn. Leningr. Gos. Univ., Ser. 3, No. 1 (No. 3): 103-107.

NOVIKOVA, E. A., and N. Yu. KLYUGE. 1987. Systematics of the genus *Baetis* (Ephemeroptera, Baetidae) with description of a new species from Soviet Central Asia. [In Russ.]. Vestn. zool. 4: 8-19.

WALTZ, R. D., and W. P. MCCAFFERTY. 1989. New species, redescription and cladistics of the genus *Pseudocentroptiloides* (Ephemeroptera: Baetidae). J. N. Y. Entomol. Soc. 97 (2): 151-158.

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