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The Mayflies (Insecta: Ephemeroptera) Collected from the Kamchatka Peninsula and the North Kuril Islands in 1996–1997

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Abstract Eight species belonging to four families of mayflies are recorded from the Kamchatka Peninsula and the North Kuril Islands based on material collected during the Expedition to the Kamchatka Peninsula and the North Kuril Islands in 1996 and 1997. *Baetis bicaudatus* Dodds and *B. pseudothermicus* Kluge are recorded for the first time from the Kamchatka Peninsula. The features of the thorax of the adult and those of the egg are given for the first time for *Drunella triacantha* (Tshernova). The thorax of *Ephemerella aurivillii* (Bengtsson) is described for the first time and the description of egg is expanded. The egg of *Cinygma lyriformis* (McDunnough) is described for the first time. Additional descriptions are given for the thorax of *Parameletus chelifer* Bengtsson and *C. lyriformis*.

Key words: mayflies, Ephemeroptera, Kamchatka Peninsula, Kuril Islands.

Up to the present, 21 species and two species of mayflies have been recorded from the Kamchatka Peninsula and the North Kuril Islands, respectively (Ulmer, 1927; Uéno, 1933; Levanidova, 1982; Sinichenkova, 1982; Tshernova and Belov, 1982; Tiunova, 1984, 1986, 1989).

The Biological Expedition to the Kamchatka Peninsula and North Kuril Islands of the Natural History Museum and Institute, Chiba, was carried out in 1996 and 1997. It was a part of a project entitled "The Origin and Biogeography of the Northeast Asian Biota," carried out in co-operation with the Institute of Biology and Pedology and the Institute of Marine Biology of the Far Eastern Branch of the Russian Academy of Sciences, Vladivostok. In the present paper, a list of the mayflies is presented based on the material collected during the expedition.

Diagnostic characters of the thorax of adults and chorionic structure of egg have been evaluated recently (Koss, 1968; Koss and Edmunds, 1974; Kluge, 1988, 1992, 1994, 1998; Kluge et al., 1995; Ishiwata, 1996; Studemann et al., 1995; Studemann and Landolt, 1997). In this paper, the features of the thorax and egg are described for the first time for some species.

Materials and Methods

Specimens were collected from nine sites in the Kamchatka Peninsula, during the periods of 3rd to 17th July 1996, 7th to 10th July 1997 and 27th July to 5th August 1997. In the North Kuril Islands, specimens were collected at one site in Paramushir Island and one site in Shumshu Island during 11th to 24th July 1997. The sampling localities are shown in Figs. 1 and 2 and detailed information is given below.

Kamchatka Peninsula

KP-2: Bystraya River (riverside), 11 km north of Malki (53°26′ N, 157°32′ E), alt. ca. 220 m.
KP-3: Poperechnaya River (upper part), 25 km from Malki Village (53°05′ N, 157°52′ E), alt. ca. 450 m.
KP-4: Bystraya River (riverside), 70 km north of Malki (53°58′ N, 157°45′ E), alt. ca. 470 m.

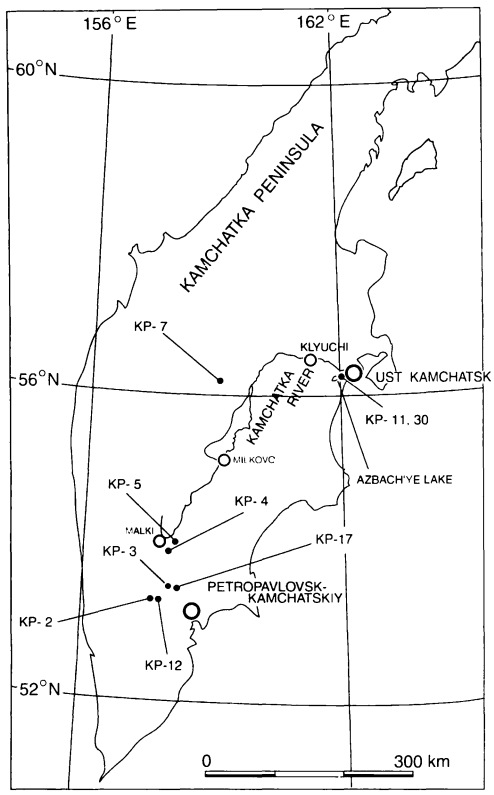

Fig. 1. Map of study sites in the Kamchatka peninsula. For detailed explanations, see text.

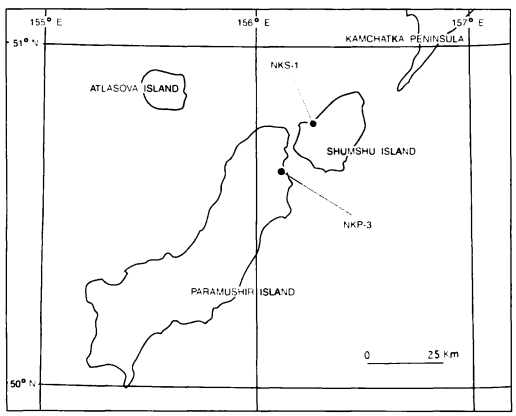

Fig. 2. Map of study sites in the North Kuril Islands. For detailed explanations, see text.

KP-5: Pravaya River (upper part), 23 km south of Pushchino (54°01′ N, 157°51′ E), alt. ca. 540 m.
KP-7: basin of Bystraya river, 10 km southeast of Anavgay (56°02′ N, 159°04′ E), alt. ca. 310 m.
KP-11: Athal Stream near Azhabach'ye Lake (56°11′ N, 161°41′ E), alt. ca. 20 m.
KP-12: Hot Spring (riverside), Malki (52°25′ N, 157°30′ E), alt. ca. 20 m.
KP-17: Poperechnaya River, Bystraya River basin, 17 km from main road (53°22–23′ N, 157°41′ E), alt. ca. 400 m.
KP-30: Bushuika River, near Azhabach'ye Lake (56°05′ N, 161°47′ E), alt. ca. 20 m.

North Kuril Islands: Paramushir Island
NKP-3: 3–8 km south of Severo-Kurilsk (50°38′ N, 156°08′ E), alt. 5–30 m.
North Kuril Islands: Shumshu Island
NKS-1: Lake Bol'shoye (50°46′ N, 156°15′ E), alt. 15 m.

Specimens were collected by the third author using an aquatic net and/or sweep net in and around rivers, and preserved in 70–80% ethyl alcohol. They are deposited in the Natural History Museum and Institute, Chiba (CBM, with a code of ZI), Kanagawa Environmental Research Center and the Institute of Biology and Soil Sciences, Far Eastern Branch of Russian Academy of Sciences, Vladivostok. Figures and descriptions of some species are prepared from the specimens collected in Japan. The subsequent processes and SEM micrographs of eggs were prepared following the method of Ishiwata (1996).

List of Collected Species

The classification of families and genera follows McCafferty (1996).

In the following list, eight species belonging to four families are recorded from the Kamchatka Peninsula and North Kuril Islands: three species of Ephemerellidae, two spp. of Baetidae, one sp. of Siphlonuridae, two spp. of Heptageniidae. *Baetis bicaudatus* Dodds and *Baetis pseudothermicus* Kluge are newly recorded from the Kamchatka Peninsula.

Family Ephemerellidae

Drunella triacantha (Tshernova,1942)

Material examined. KP-2, 1 nymph, 6. VII. 1996.

Additional materials. Satsunai-bridge, Tottabetsu River, Obihiro-shi, Hokkaido, Japan,

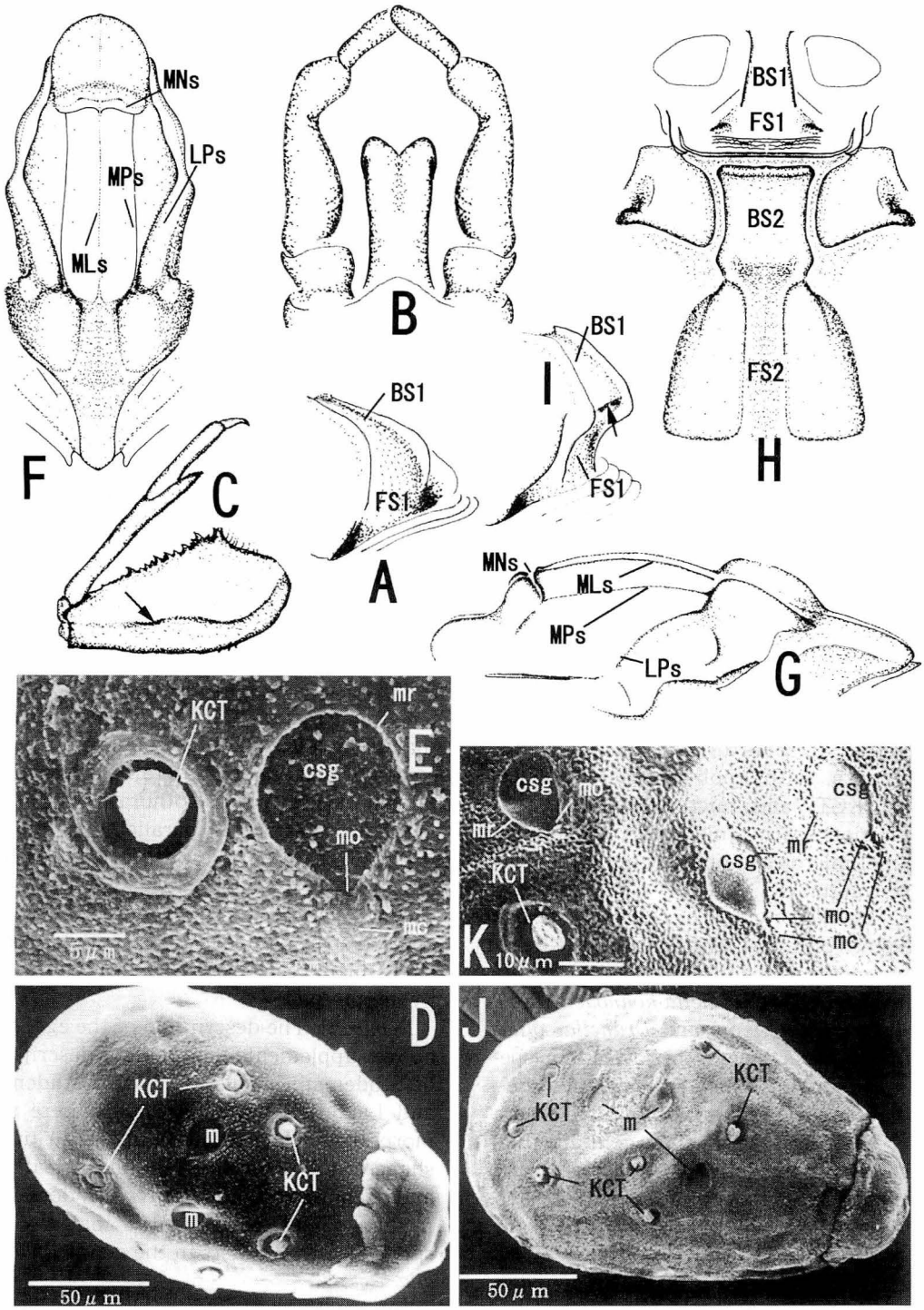

Fig. 3A–E. *Drunella triacantha*, specimen from Nakasatsunai, Tottabetsu River, Obihiro-shi, Hokkaido. A, prosternum (postero-lateral view); B, male genitalia (ventral view); C, right leg (dorsal view); D, egg (general view); E, detail of chorion (showing micropyle and KCT). F–K, *Ephemerella aurivillii*, specimen from Souunkyo, Rubeshinai River, Asahikawa-shi, Hokkaido. F, mesonotum (dorsal view); G, mesonotum (lateral view); H, mesosternum (ventral view); I, prosternum of subimago (posterolateral view, arrow showing transverse ridge); J, egg (general view); K, detail of chorion (micropyles and KCT). For abbreviation, see text.

15 nymphs, 1. VI. 1982, R. B. Kuranishi leg.; Nakasatsunai, Tottabetsu River, Obihiro-shi, Hokkaido, 4 nymphs, 16. VII. 1987; 1 male (imago), 3 females (imago), 16. VII. 1987, adults emerged 24. VII. 1987; 1 male (imago), 16. VII. 1987, adult emerged 27. VII. 1987, S. Ishiwata leg.

Distribution. Russia: Altai, Transbaikalia, Tuva, Kamchatka Peninsula, Sakhalin, Kuril Islands (Kunashir).

Japan (Hokkaido) and Korea.

Description. Adult thorax. Anterior part of mesonotum with mesonotal suture (MNs); MNs terminating at medioparapsidal sutures (MPs); MPs not terminating at lateroparapsidal sutures (LPs); basisternum of prothorax (BS1) with longitudinal carinae; carinae narrow apically (Fig. 3A); prothorax without transverse crest between BS1 and furcasternum of prothorax (FS1); basisternum of meso thorax (BS2) flattened, rectangular (BS2 in female wider than in male); posterolateral margins of BS2 not expanded laterally; furcasternal protuberances of mesothorax (FS2) slightly convergent posteriorly or parallel.

Egg (Figs. 3D, E) oval, with polar cap; chorion smooth, with knob-terminated, coiled threads (KCT) and micropyles; micropyle with chorion sperm guide (csg), micropylar canal (mc), micropylar opening (mo), and micropylar rim (mr).

Remarks. The nymph of *D. triacantha* has three spines on the anterior edge of the head. This character states is also found in *Drunella bifurcata* (Allen), *Drunella kohnoae* (Allen), *Drunella trispina* (Uéno) and *Drunella solida* (Bajkova). Nevertheless, the latter four species can be distinguished from *D. triacantha* by the absence of a longitudinal ridge on the fore femora (Fig. 3C). The male genitalia (Fig. 3B) are similar to that of *D. trispina*, but the lack of a mesial process of the penis-lobe and the presence of swollen apices of the penis lobes in *D. triacantha* separate it from *D. trispina.*

Ephemerella aurivillii **(Bengtsson, 1908)**

Material examined. KP-2, 26 nymphs, 6. VII. 1996; KP-5, 30 nymphs, 7. VII. 1996.

Additional material. Rubeshinai River, Souunkyo, Asahikawa-shi, Hokkaido, Japan, 1 male (imago), 3 females (imago), 10. VII. 1985, adults emerged 14. VII. 1985, S. Ishiwata leg.; Komadome-toge, Hariu, Tazawamachi, Fukushima-ken, 4 nymphs, 15. V. 1988, S. Ishiwata leg.; Hondani, Ichinose, Enzan-shi, Yamanashi-ken 11 nymphs, 26. IV. 1986, S. Ishiwata leg.

Distribution. Russia: northern Ural, Altai, Amur River, Angara River, Primor'ye, Sakhalin, Kamchatka Peninsula, Kuril Islands (Kunashir).

Northern Europe, North America, Korea, Japan (Hokkaido, Honshu).

Description. Adult thorax (Fig. 3F-3I). Anterior part of mesonotum with mesonotal suture (MNs) ; MNs terminating at medioparapsidal sutures (MPs); MPs not terminating at lateroparapsidal sutures (LPs); basisternum of prothorax (BS1) with longitudinal carinae; carinae wide, sometimes narrow apically; prothorax without transverse crest (with transverse ridge in subimago, Fig. 3I) between BS1 and furcasternum of prothorax (FS1); basisternum of mesothorax (BS2) flattened and rectangular (BS2 wider in female than in male); postero-lateral margins of BS2 somewhat expanded laterally; furcasternal protuberances of mesothorax (FS2) convergent posteriorly or parallel.

Egg (Figs. 3J, K) oval, with polar cap; chorion smooth with knob-terminated, coiled threads (KCT) and micropyles; micropyle with chorion sperm guide (csg), micropylar chanal (mc), micropylar opening (mo), and micropylar rim (mr).

Remarks. The description of the egg given above supplements the previous descriptions of Studemann et al. (1995) and Studemann and Landolt (1997). We added here some morphological characteristics. The unique shape of the penes, having long apical lobes and deep median notch only with dorsal and median spines, distinguishes males of this species from all others in the genus *Ephemerella.*

Ephemerella mucronata **(Bengtsson, 1908)**

Material examined. KP-2, 1 nymph, 6. VII. 1996.

Distribution. Russia: Primor'ye, Kamchatka Peninsula, Sakhalin.

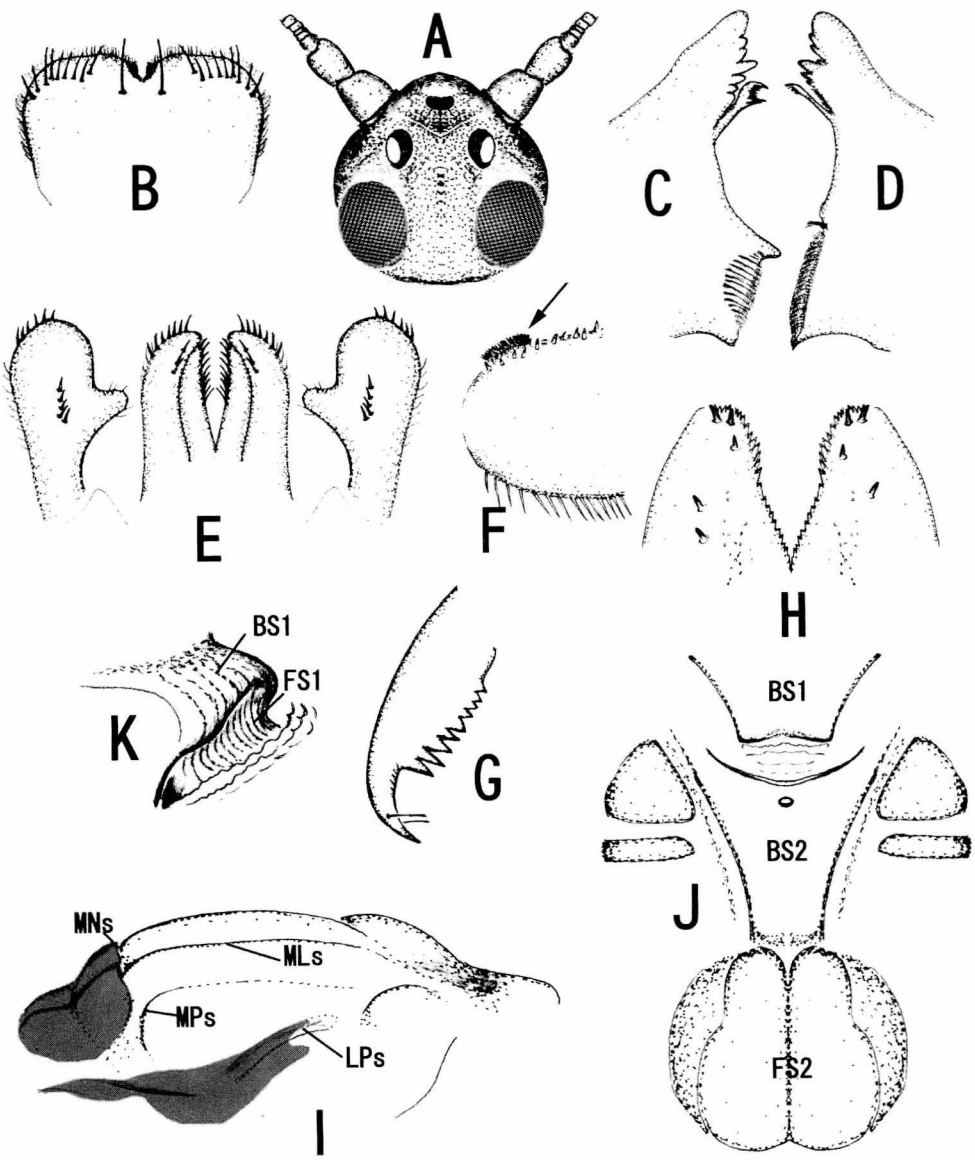

Fig. 4A–H. *Baetis bicaudatus*, specimen from the Kamchatka Peninsula (KP-7): A, head (dorsal view); B, labrum; C, right mandible; D, left mandible; E, labium; F, base of femur (ventral view; arrow showing villopore); G, claw with subapical setae; H, paraprocts. I–K, *Parameletus chelifer*, specimen from the Kamchatka Peninsula (KP-4): I, mesonotum of subimago (dorsolateral view); J, pro- and mesosternum; K, prosternum. For abbreviations, see text.

Northern Europe.

Family Baetidae

***Baetis bicaudatus* Dodds, 1923**

Material examined. KP-2, 2 nymphs, 6. VII. 1996; KP-3, 1 nymph, 6. VII. 1996; KP-7, 17 nymphs, 9. VII. 1996.

Additional material. Ookanba-sawa, Hirogawara, Ashiyasu-mura, Yamanashi-ken, 8 nymphs, 10. X. 1998, S. Ishiwata leg.; Myojin Bridge, Azusagawa River, Kamikouchi, Nagano-ken, 3 nymphs, 11. IX. 1984, N. Kobayashi leg.

Distribution. Russia: Kamchatka Peninsula (new record), Chukotka, Primor'ye, southern

and eastern Siberia, Kuril Islands (Tiunova, unpublished data).

North America, Japan (Hokkaido: Kobayashi, unpublished data; Honshu).

Description. Mature nymph. Body length: 5.3–6.9 mm; caudal filaments 4.6–6.6 mm.

Head (Fig. 4A) without protuberance between antennae; labrum (Fig. 4B) with anteromedian margin concave, with pair of long setae medially and with 7–9 pairs of row of setae. Left mandible (Figs. 4C, 4D) with 3–1–3 canines. Maxillary palpi 2-segmented. Labium (Fig. 4E) with palpi 3-segmented; mesial margin of segment 2 with developed lobe; paraglossae 2 times as wide as glossae.

Thorax. Hind wing pads present; dorsal margin of femora with row of long setae, with femoral villopore (Fig. 4F); claws (Fig. 4 G) with subapical setae.

Abdomen. Terga 1–7 with lamellate gills; paraprocts (Fig. 4H) without prolongation.

Caudal filaments. Terminal filament reduced (with only one segment); cerci with long setae, without distinct band.

Remarks. The unidentified species described by Kobayashi (1987), under the arbitrary name "*Baetis* sp. L" is identified here with *Baetis bicaudatus*. Uéno (1933) recorded nymphs of *Baetis* spp. from the North Kuril Islands (Paramushir and Shumshu Island). One of those nymphs, two tailed specimen, might be assigned to this species.

Baetis pseudothermicus Kluge, 1983

Material examined. KP-2, 27 nymphs, 6. VII. 1996; KP-5, 6 nymphs, 7. VII. 1996; KP-30, 20 nymphs, 13. VII. 1996; NKP-3, 60 nymphs, 13. VII. 1997.

Distribution. Russia: Kamchatka Peninsula (new record), Primor'ye, Kuril Islands (Tiunova, unpublished data), Siberia.

Family Siphlonuridae

Parameletus chelifer Bengtsson 1908

Material examined. KP-4, 2 males (subimago), 1 female (subimago), 7. VII. 1996; KP-5, 1 female, 8. VII. 1996.

Distribution. Russia: Kamchatka Peninsula, Khabarovsk, Siberia, Altai. Northern Europe, Mongolia, North America.

Description. Adult thorax. Anterior part of mesonotum with mesonotal suture (MNs); MNs not terminating at medioparapsidal sutures (MPs); basisternum of prothorax (BS1) without longitudinal carinae; prothorax without transverse crest (with protuberance) (Fig. 4J, K) between BS1 and furcasternum of prothorax (FS1); basisternum of mesothorax (BS 2) with a small cavity anteriorly, somewhat protuberant posteriorly (BS2 of female wider than that of male); lateral pigmented area of mesothorax of subimago (Fig. 4I) elongated along LPs, bifurcated posteriorly.

Remarks. Thoracic (mesothorax) characters of the genus *Parameletus* were discussed by Kluge (1994) and Kluge et al. (1995). A supplemental description of the pro- and mesosternum is added here.

Family Heptageniidae

Cinygma lyriformis (McDunnough, 1924)

Material examined. KP-5, 1 female, 7. VII. 1996.

Additional materials. Mamachigawa River (tributary of Chitosegawa River), Chitose-shi, Hokkaido, Japan, 7 nymphs, 2 males (imago), 1 female (subimago), 21. IX. 1997, S. Ishiwata leg.

Distribution. Russia: northern Ural, Altai, southern Siberia, Khabarovsk, Chukotka, Kamchatka Peninsula, Kuril Islands (Kunashir).

Japan (Hokkaido).

Description. Adult thorax (Figs. 5A-E). Anterior part of mesonotum with mesonotal suture (MNs); lateroparapsidal sutures (LPs) terminating at medioparapsidal sutures (MPs); basisternum of prothorax (BS1) without distinct longitudinal carinae; prosternum without transverse crest between BS1 and furcasternum of prothorax (FS1); basisternum of mesothorax (BS2) depressed anteriorly (BS2 of female wider than that of male); furcasternal protuberances of mesothorax (FS2) convergent anteriorly; coxae of pro- and mesothorax, and katepisternum with fuscous spot.

Egg (Figs. 5J–L) oval, without polar cap; chorion smooth, with micropyles, without knob-terminated, coiled threads (KCT); micropyle with chorion sperm guide (csg), micro-

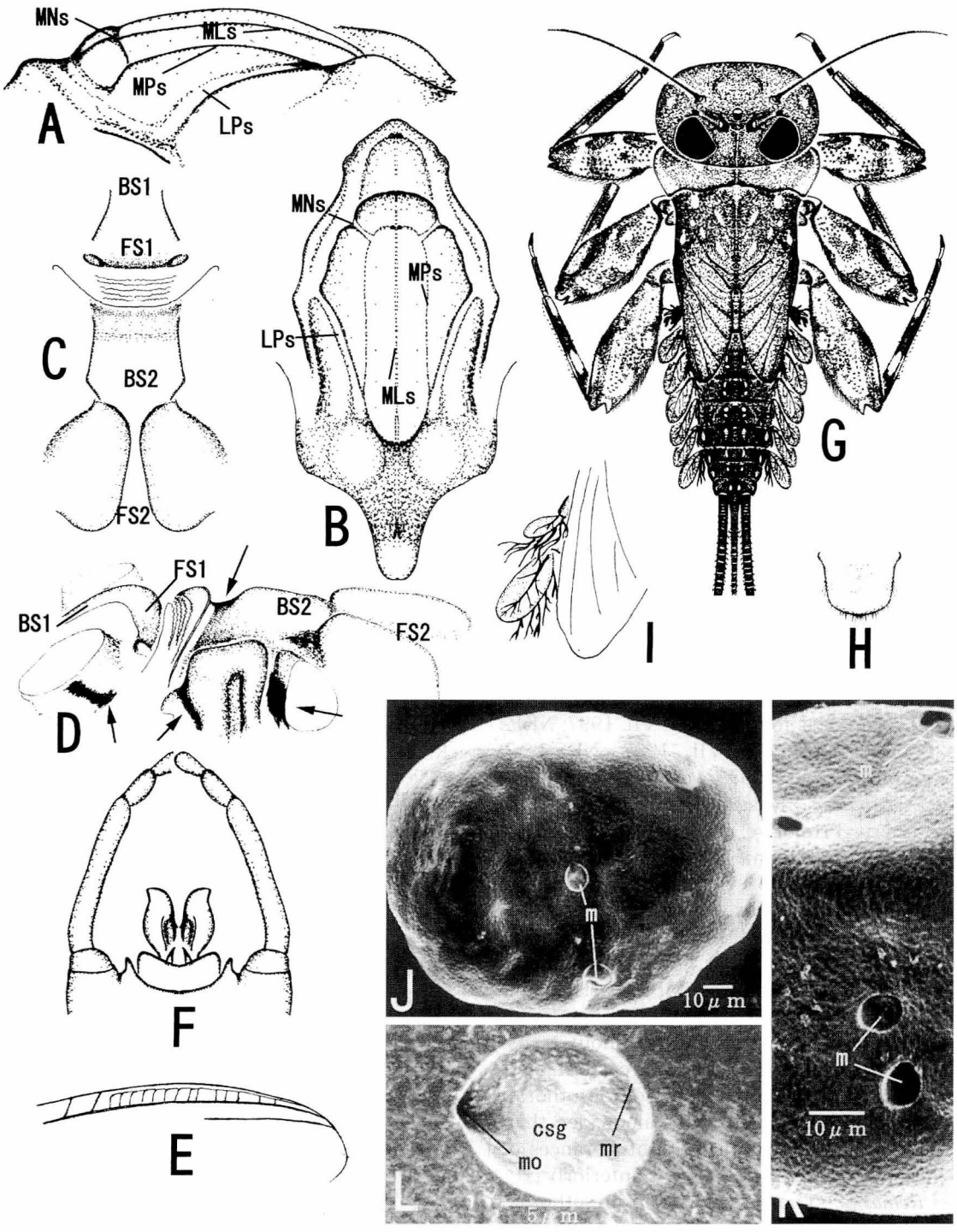

Fig. 5. *Cinygma lyriformis*. A–F, imago (male) from Mamachigawa River, Chitose-shi, Hokkaido: A, mesonotum (lateral view); B, mesonotum (dorsal view); C, pro- and mesosternum (ventral view); D, pro- and mesosternum (lateral view, upper arrow showing depressed aria of BS2, and lower arrows showing markings on each coxa and ketepisternum); E, detail of stigmatic aria; F: male genitalia, G–I, nymph from Mamachigawa River, Chitose-shi, Hokkaido: G: mature nymph (dorsal view); H, labrum; I, left wing-bad and gills on segment 1–2. J–L, egg from specimen from the Kamchatka Peninsula (KP-5): J, egg (general view); K, detail of chorion (micropyles); L, micropyle.

pylar opening (mo), and micropylar rim (mr), but without micropylar canal.

Remarks. Thoracic (mesothorax) characters of adults of the genus *Cinygma* were discussed by Kluge (1988). A supplemental description of the pro- and mesosternum is added here (Fig. 5A, E). Diagnostic characters both of adults and nymphs of this species, shown by Edmunds and Waltz (1996), are also illustrated here (Figs. 5E-I). The unique shape of the penes (Fig. 5F), having long apical lobes with dorsal and medial spines and deep median notch, distinguishes males of this species from all others in *Cinygma.*

Koss and Edmunds (1974) described the chorion of *Cinygma intergum*, which differ from *C. lyriformis* in the chorion surface and the micropylar device.

Cinygmula cava (Ulmer, 1927)

Material examined. KP-2, 3 nymphs, 6. VII. 1996; KP-5, 7 nymphs, 8. VII. 1996; KP-7, 1 male, 11 nymphs, 9.VII.1996; KP-11, 10 nymphs, 15, VII, 1996; KP-17, 1 male, 29.VII. 1997; 1 male (subimago), 27. VII. 1997; NKP-3, 11 nymphs, 13. VII. 1997, NKS-1, 7 nymphs, 22. VII. 1997.

Distribution. Russia: Altai, Transbaikalia, southern Primor'ye, Magadan, Kamchatka Peninsula, Sakhalin, Kuril Islands (Kunashir).

Japan (Hokkaido).

Description. Thorax. Anterior part of mesonotum with mesonotal suture (MNs); lateroparapsidal sutures (LPs) not terminating at medioparapsidal sutures (MPs); basisternum of prothorax (BS1) without distinct longitudinal carinae; prosternum without transverse crest between BS1 and furcasternum of prothorax (FS1); basisternum of mesothorax (BS2) flattened (BS2 of female wider than that of male); furcasternal protuberances of mesothorax (FS2) convergent anteriorly.

Remarks. Thoracic (pro- and mesothorax) characters of adults of this species were illustrated by Ishiwata (1999). A supplemental description of the character is added here.

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1996–1997年に採集されたカムチャツカ半島と北千島のカゲロウ目昆虫

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1996年と1997年に，カムチャツカ半島と北千島で千葉県立中央博物館とロシア科学アカデミーの生物学共同調査が行われ，マダラカゲロウ科3種，コカゲロウ科2種，フタオカゲロウ科1種およびヒラタカゲロウ科2種の合計8種のカゲロウ目を確認した．このうち，*Baetis bicaudatus* Dodds および *Baetis pseudothermicus* Kluge は，カムチャツカ半島から新記録であった．近年，卵および成虫の胸部の外部形態が，カゲロウ目の科，属あるいは種の特徴として重要であることが指摘されていることから，本報告では確認されたカゲロウのうち卵や成虫の胸部が未記載の数種について，新たに図示し，特徴を記載した．さらに卵や成虫の胸部の形態に新知見が得られた種についても，その特徴を記載した．記載した種と内容は以下のとおりである．*Drunella triacantha* (Tshernova), *Ephemerella aurivillii* (Bengtsson)：卵，成虫胸部；*Cinygma lyriformis* (McDunnough)：幼虫，卵，成虫胸部；*Baetis bicaudatus*：幼虫；*Parameletus chelifer* Bengtosson, *Cinygmula cava* (Ulmer)：成虫胸部．