*Paleontological Journal, Vol. 38, No. 2, 2004, pp. 182–186. Translated from Paleontologicheskii Zhurnal, No. 2, 2004, pp. 64–68.*


# Jurassic Insects (Insecta) from the Sai-Sagul Locality (Kyrgyzstan, Southern Fergana)

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Received August 23, 2002

**Abstract**—A caddisfly *Dolophilodes* (*Sortosella*) *shurabica* subgen. et sp. nov. (Philopotamidae) is described from the Jurassic of Kyrgyzstan, from the Sai-Sagul locality. The ecology and taphonomy of this locality are analyzed, and the insects described from the Sai-Sagul locality are listed.

*Key words*: Insects, new taxa, Trichoptera, Jurassic, taphonomy, Central Asia.

## INTRODUCTION

The Jurassic insect Sai-Sagul locality (sometimes designated as Shurab 3 or Svodovoe Ruslo) is situated in southern Fergana in the Batkenskii District of the Osh Region, Kyrgyzstan, at the boundary with the Isfarinskii District of the Leninabad (Khodzhent) Region, Tajikistan. Several sites with common geology and taphonomy are gathered under this name. The first insect fossils were found in this region by staff members of the institution *Sredazuglegeologiya*, N.I. Plakhuta in 1935 and, later, by L.S. Chastikova in 1957. During subsequent years (1958 to 1971), collecting was continued mainly by staff members of the Paleontological Institute of the Academy of Sciences of the USSR, currently, the Russian Academy of Sciences (PIN). The material housed at the PIN is registered as eleven collections, nos. 459, 1332, 1526, 1546, 1547, 1724, 2032, 2061, 2345, 2389, and 3073. The total number of collected insects is 3356; the composition of the majority of these collections is shown in the table.

Within the region under consideration, Early–Middle Jurassic localities form a narrow belt stretching from the southwest to the northeast for about 50 km. We consider the westernmost south Fergana assemblage of this system, which was discovered south of the town of Shurab. In the Jurassic, the area surrounding Lake Sagul (Shurab), where the insects were buried, was apparently characterized by a humid climate and rich vegetation, but without the features of coal accumulation, which were typical for that time. It was a territory of the northern coast of the tropical Tethys Ocean covered with wet and warm ginkgoaceous and cycadaceous forests.

Among autochthonous insects, only corixoid water bugs of the family Shurabellidae (Popov, 1971) have been found in these shallow waters; they were described exactly from these localities (Becker-Migdisova, 1949) and are characteristic of the Early and Middle Jurassic of Central Asia, including the Mongolian localities of Bahar, Bayan-Teg, and Tushilga. More than 670 specimens of adults and nymphs of all instars are known from Sagul Lake. Similar to all corixoids, shurabellids were apparently debris-feeding and algophagous insects typical for shallow and well warmed water bodies (Popov, 1971). Remains of hemipterans other than shurabellids have not been recorded in Sagul.

The proportion of *Shurabella* in different collections varies considerably (table); it is abundant in collections nos. 459, 2032, 2061, and especially in collection no. 1724, while in collections nos. 2345, 2389, and 3073, it is scarce. The last three collections display the most diverse taxonomic composition. They were collected during the last expeditions to Sai-Sagul in 1964 to 1971, when mass remains of *Shurabella* had already been treated and might be consciously ignored. It may be hypothesized that an actual proportion of shurabellids is observed in collections nos. 459, 2032, and 2061, whereas collections nos. 2345, 2389, and 3073 are representative of other insect orders.

It should be noted that the last three collections are not uniform with reference to taxonomic composition. In particular, dipterans, miomopterans, and, to a lesser extent, dragonflies and scorpionflies are disproportionally abundant in collection no. 3073. The increased proportion of dipteran wings is probably associated with a more careful collecting of small remains. Acceptable explanation of other mentioned differences cannot be currently found.

Among remains of the Coleoptera, isolated sclerites dominate (more than 350 specimens); remains of other insects are also represented by either wings or isolated

The order composition of the main insect collections from the Sai-Sagul locality housed at the PIN: coll. no. 459, Shurab 3, collected by Plakhuta in 1935; coll. nos. 1526 and 1546, Svodovoe Ruslo, collected by Novojilov in 1958; coll. no. 1724, Shurab 3 (southwestern Shurab), Bed 1, collected by Novojilov in 1959; coll. no. 2032 Shurab 3 (southwestern Shurab), almost all insects from Bed 1, collected by Becker-Migdisova in 1961; coll. nos. 2061 and 2389, Sogul Formation, collected by Sharov in 1962 and 1964; coll. no. 2345, Sogul Formation, collected by Novojilov in 1964; coll. no. 3073, Sai-Sagul, Sogul Formation, collected by Pritykina in 1969 and 1971

| | 459 | 1526 | 1546 | 1724 | 2032 | 2061 | 2345 | 2389 | 3073 | Total number | % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Odonata | 3 | 4 | | 3 | 8 | 1 | 11 | 16 | 44 | 90 | 2.7 |
| Homoptera | 28 | 37 | 5 | 46 | 157 | 33 | 153 | 237 | 232 | 928 | 27.7 |
| Heteroptera | 47 | 28 | | 222 | 245 | 46 | 44 | 13 | 26 | 671 | 20.1 |
| Miomoptera | | | | 4 | | | 9 | 2 | 81 | 96 | 2.9 |
| Coleoptera | 30 | 5 | 2 | 41 | 84 | 10 | 37 | 78 | 67 | 354 | 10.6 |
| Neuroptera | 3 | 6 | | 5 | 14 | 11 | 55 | 84 | 101 | 279 | 8.3 |
| Glosselytrodea | | 2 | | | | | | | 5 | 7 | 0.2 |
| Mecoptera | 5 | 12 | | 9 | 25 | 8 | 24 | 50 | 94 | 227 | 6.8 |
| Trichoptera | | | | | 1 | | | | | 1 | <0.1 |
| Diptera | | | | | 5 | | 2 | 9 | 34 | 50 | 1.5 |
| Hymenoptera | | | | | | | 3 | 2 | 11 | 16 | 0.5 |
| Blattodea | 46 | 14 | | 20 | 29 | 10 | 35 | 96 | 68 | 318 | 9.5 |
| Grylloblattida | 1 | | | 5 | 4 | 2 | 13 | 10 | 20 | 55 | 1.6 |
| Plecoptera | | 1 | 2 | | 2 | 1 | 4 | 12 | 18 | 40 | 1.2 |
| Orthoptera | 11 | 9 | | 12 | 7 | 3 | 21 | 22 | 34 | 119 | 3.6 |
| Incertae sedis | 4 | | 3 | 11 | 22 | | | 1 | 53 | 94 | 2.8 |
| Total | 178 | 118 | 12 | 378 | 603 | 125 | 411 | 632 | 888 | 3345 | 100 |

body parts. However, a suggested conclusion about long transportation of insect remains by water flows is hardly probable, because such allochthonous taphocenoses are usually enriched with rigid elytra of beetles, cockroaches, and cicadas (Zherikhin, 2002). In this locality, delicate and often large wings of neuropterans, which are not capable of long transportation, are plentiful, being just a little less abundant than elytra of beetles and cockroaches.

Another notable feature of the Sagul insect assemblage is the absence of dragonflies of the suborder Anisoptera and the family Heterophlebiidae, which are characteristic of the Lias of Western Europe (Pritykina, 1980).

Thus, characteristic features of the oryctocenosis of Sai-Sagul, related to the taphonomy of the locality and distinguishing it from many other limnogenic deposits of the Mesozoic, are, first, the almost monospecific composition of the autochthonous aquatic entomofauna, and, second, the fragmentariness of remains combined with the absence of clear signs of long transportation. This concerns not only insects, but also crustaceans, which are represented in Sai-Sagul by abundant unidentifiable fragments. Important for the interpretation of these features of the oryctocenosis is its presumable thermophily, which is attested by the abundance of myrmeleontoid-like neuropterans (Ponomarenko, personal communication) and the absence of hymenopterans of the family Xyelidae, which are good indicators of a cool climate in the post-Early Lias (Rasnitsyn, 1980). Essential is the presence of coal in the underlying and overlying deposits, which testifies to a relatively humid climate during the formation of the locality.

Similar monodominant oryctocenoses are often formed by bugs of the family Corixidae, which is close to shurabellids (Ponomarenko and Popov, 1980). Corixids are famous for their tolerance of high salinity and other aberrations of the hydrochemical regime of a water body. However, so-called corixid lakes are more typical for an arid climate (Sinitshenkova, 2002), which is hardly characteristic of the Sagul oryctocenosis. In this case, other analogies are suggested. The impoverished autochthonous Jurassic Central Asian and Chinese assemblages dominated by water bugs are substituted in the north by limnic assemblages dominated by stoneflies, dragonflies, and mayflies (Sinitshenkova, 2002). This suggests the influence of temperature, in particular, on the amount of dissolved oxygen, the deficiency of which mayfly and, especially, stonefly larvae are known to be sensitive to. A deficiency of dissolved oxygen has already been noted for the Sagul oryctocenosis (Lukashevich, 2000).

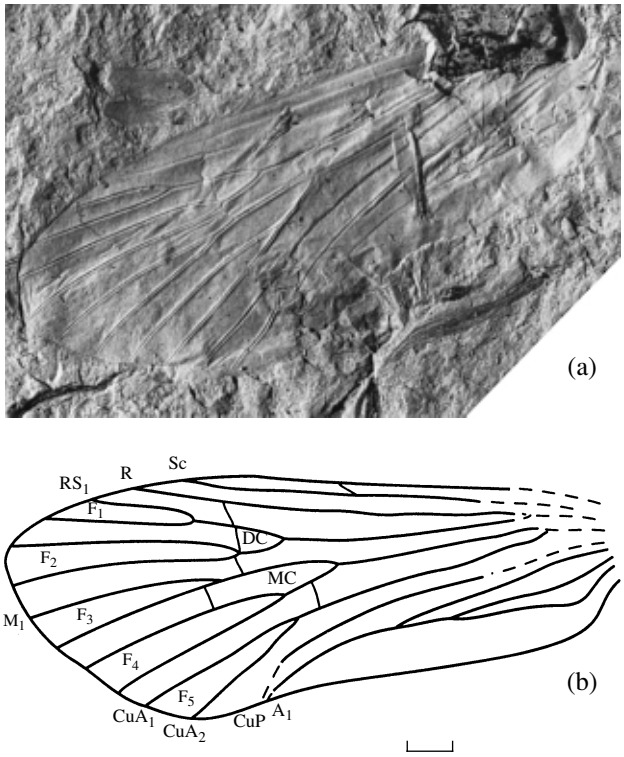


**Fig. 1.** *Dolophilodes* (*Sortosella*) *shurabica* Sukatcheva, sp. nov., holotype PIN, no. 2032/553, forewing: (a) general appearance, ×6.5; and (b) venation pattern (veins of nonpreserved base of the wing are shown by dashed lines). Vein abbreviations standard. Scale bar, 1 mm.

The temperature conditions of the lake combined with intense organic influx should provide high bacterial activity. In particular, the activity of chitin-decomposing bacteria rapidly utilizing thin articular membranes may be responsible for the fragmentariness of the insect and crustacean remains.

To date, the age of the Sai-Sagul locality has not been established precisely. According to paleobotanical data, it is believed to be the Middle–Upper Lias (Kuzichkina *et al.*, 1958). A total of 70 fossil insect species have been described from Sai-Sagul and certain closely located sites designated as Shurab 3 (Martynov, 1937; Becker-Migdisova, 1949, 1985; Rasnitsyn, 1968, 1975, 1977, 1982, 1983, 1993; Sharov, 1968; Pritykina, 1970, 1980; Ponomarenko, 1977; Popov, 1982, 1985; Sinitchenkova, 1987; Storozhenko, 1990; Novokshonov, 1993, 1997; Lukashevich, 2000; see list below). However, nearly all these species are endemic. An exception is *Shurabia angustata*, Martynov, 1937 which was also recorded in the Ust'-Balei locality (Baikal Region) and aged as Upper Lias (Pliensbachian–Early Toarcian) (Kirichkova and Travkina, 2000). The genera described from Sai-Sagul are either endemic or, on the contrary, distributed too widely to make clear the age of the insect-bearing beds within the upper Lower Jurassic to the lower Middle Jurassic.

## SYSTEMATIC PALEONTOLOGY

Order Trichoptera

**Family Philopotamidae Stephens, 1829**

**Subfamily Philopotaminae Stephens, 1829**

**Genus *Dolophilodes* Ulmer, 1909**

**Subgenus *Sortosella* Sukatcheva, subgen. nov.**

Etymology. From the closely related subgenus of *Sortosa*.

Type species. *S. shurabica* sp. nov.

Diagnosis. Forewing wide, only 2.8 times as long as broad. Wing apex situated between $RS_3$ and $RS_4$. R straight. RS branching noticeably distal to wing midlength. RS stem 4.6 times as long as closed cell DC. Five apical forks present; all of them, except for $F_1$, sessile and long. CuP and $A_1$ terminating at the same point on posterior margin of wing.

Specific composition. Type species.

Comparison. This new subgenus is similar to the majority of genera of the subfamily Philopotaminae in the number of apical forks. It is especially similar to the subgenera *Sortosa* Navas, 1918 and *Dolophilodes* Ulmer, 1909 of the Recent genus *Dolophilodes*, differing in the unusually short cell DC compared to the RS stem, long forks $F_3$ and $F_4$, and in the entirely straight R.

***Dolophilodes* (*Sortosella*) *shurabica* Sukatcheva, sp. nov.**

Etymology. From the Shurab locality.

Holotype. PIN, no. 2032/553, fairly well-preserved forewing; Kyrgyzstan, Osh Region, Batkenskii District, Sai-Sagul (Shurab 3), 12 km southwest of the town of Shurab; upper part of the Lower Jurassic–lower part of the Middle Jurassic, Sogul Formation.

Description (Fig. 1). Forewing. The veins are heavily sclerotized and strong. The anterior margin of the wing is straight; the apical margin, apex, and tornus are rounded. Sc has a slight apical curvature and one oblique supplementary branch proximal to the wing midlength. The costal area is narrow. The subcostal area is evenly wide. R lacks apical curvature. The DC cell is very short, as short as the $F_1$ stem. All other apical forks are sessile. $F_2$ is 4.3 times as long as $RS_{3+4}$. $F_3$ is 1.6 times as long as $M_{1+2}$. $F_4$ is 3.2 times as long as $M_{3+4}$. The MC cell is closed and long. The M fork starts a little proximal to the wing midlength. The TC cell is closed by the transverse vein $m_{3+4}$–cua, which is located a little distal to the wing midlength. Transverse veins r–$rs_{1+2}$ and $rs_4$–$m_{1+2}$ are present. The $F_5$ fork is rather short and wide, its base is located noticeably distal to the wing midlength. CuA and $A_1$ meet in one point, which is also located distal to the wing midlength. CuP is long and gently curving before its tip toward the posterior margin of the wing. $A_2$ and $A_3$ are long, $A_1$ is only 1.7 times as long as $A_2$.

Measurements, mm: wing length, 12.5; wing width, 4.

R e m a r k s. The new species is only formally assigned to the genus *Dolophilodes*, an extant dweller of mountain streams, since this is performed on the basis of wing characters alone, which are subordinate in the systematics of this group. There is no ground for extending ecological characteristics of Recent representatives to this new species.

M a t e r i a l. Holotype.

List of Insects Recorded in the Sai-Sagul Locality (Shurab 3)

Order Odonata Fabricius, 1792
- Family Liassophlebiidae Tillyard, 1925
  - *Ferganophlebia insignis* Pritykina, 1970
  - *Hypsophlebia scalaris* Pritykina, 1970
  - *Oreophlebia lata* Pritykina, 1970
  - *Sagulia ansinervis* Pritykina, 1970
  - *Sarytashia gracilis* Pritykina, 1970
  - *Xanthohypsa praeclara* Pritykina, 1970
  - *X. tillyardi* Pritykina, 1970
- Family Oreopteridae Pritykina, 1980
  - *Adelophlebia obsoleta* Pritykina, 1980
  - *Amblyopteron breve* Pritykina, 1980
  - *Sordopteron elongatum* Pritykina, 1980
  - *S. legebile* Pritykina, 1980
  - *S. lere* Pritykina, 1980
  - *Pauropteron exile* Pritykina, 1980
  - *P. miserum* Pritykina, 1980
- Family Karatawiidae Martynov, 1925
  - *Gampsophlebia modica* Pritykina, 1980
- Family Archithemistidae Tillyard, 1917
  - *Cyclothemis sagulica* Pritykina, 1980
  - *Shurabiola nana* Pritykina, 1980
  - *Sogdothemis modesta* Martynov, 1937
- Family Paralogidae Handlirsch, 1906
  - *Oligotypus relictus* Martynov, 1937

Order Hemiptera Linnaeus, 1758
- Family Protopsyllidiidae Carpenter, 1931
  - *Cicadellopsis shurabensis* Becker-Migdisova, 1985
- Family Dysmorphoptilidae Handlirsch, 1906
  - *Mesoatracis reducta* Becker-Migdisova, 1949
- Family Palaeontinidae Handlirsch, 1906
  - *Palaeocossus giganteus* Becker-Migdisova, 1949
  - *Palaeontinodes shabarovi* Martynov, 1937
  - *Phragmatoecicossus shurabensis* Becker-Migdisova, 1949
  - *Plachutella rotundata* Becker-Migdisova, 1949
  - *P. derupta* Becker-Migdisova, 1949
  - *P. (?) vitripennis* Becker-Migdisova, 1949
  - *Plachutella* sp.: Becker-Migdisova, 1949
  - *Shurabocossus gigas* Becker-Migdisova, 1949
  - Palaeontinidae gen. sp. 1: Becker-Migdisova, 1949
  - Palaeontinidae gen. sp. 2: Becker-Migdisova, 1949
- Family Hylicellidae Evans, 1956
  - *Mesocixiella extensa* Martynov, 1937
  - *M. furcata* Martynov, 1937
  - *M. major* Martynov, 1937
  - *M. parvula* Martynov, 1937
- Family Procercopidae Handlirsch, 1906
  - *Cycloscytina plachutai* Becker-Migdisova, 1949
  - *Cycloscytina* sp.: Becker-Migdisova, 1949
- Family Tettigarctidae Distant, 1905
  - *Shuraboprosbole plachutai* Becker-Migdisova, 1949
- Family Progonocimicidae Handlirsch, 1906
  - *Cicadocoris affinis* (Yu. Popov, 1982)
  - *Mesoscytina abdita* (Yu. Popov, 1982)
  - *M. ambigua* (Yu. Popov, 1985)
  - *M. cognata* (Yu. Popov, 1982)
  - *M. fida* (Yu. Popov, 1982)
  - *M. modesta* (Yu. Popov, 1985)
  - *M. paulina* (Yu. Popov, 1982)
- Family Shurabellidae Yu. Popov, 1971
  - *Shurabella lepyroniopsis* Becker-Migdisova, 1949

Order Palaeomanteida Handlirsch, 1906
- Family Permosialididae Martynov, 1928
  - *Permonka jurassica* A. Rasnitsyn, 1977
  - *P. sagulica* A. Rasnitsyn, 1977

Order Coleoptera Linnaeus, 1758
- Family Coptoclavidae Ponomarenko, 1961
  - *Necronectes latus* Ponomarenko, 1977

Order Panorpida Latreille, 1802
- Family Bittacidae Enderlein, 1910
  - *Asiobittacus sajsagulis* Novokshonov, 1993
  - *Plesiobittacus martynovi* Novokshonov, 1997
  - *P. primigenius* Novokshonov, 1997

Order Trichoptera Kirby, 1815
- Family Philopotamidae Stephens, 1829
  - *Dolophilodes* (*Sortosella*) *shurabica* Sukatcheva, sp. nov.

Order Diptera Linnaeus, 1758
- Family Eoptychopteridae Handlirsch, 1906
  - *Eoptychoptera shurabica* Lukashevich, 2000

Order Hymenoptera Linnaeus, 1758
- Family Xyelydidae A. Rasnitsyn, 1968
  - *Ferganolyda cubitalis* A. Rasnitsyn, 1983
  - *F. radialis* A. Rasnitsyn, 1983
  - *F. sogdiana* A. Rasnitsyn, 1983
  - *Sagulyda arcuata* A. Rasnitsyn, 1983
  - *S. ferganica* A. Rasnitsyn, 1983
  - *S. magna* A. Rasnitsyn, 1983
- Family Karatavitidae A. Rasnitsyn, 1963
  - *Proapocritus praecursor* A. Rasnitsyn, 1975
- Family Sepulcidae A. Rasnitsyn, 1968
  - *Onokhoius sogdianus* A. Rasnitsyn, 1993
  - *Sepulenia syricta* A. Rasnitsyn, 1968
  - *Shurabisca liassica* A. Rasnitsyn, 1968
- Family Gigasiricidae Bilbergh, 1920
  - *Liasirex sogdianus* A. Rasnitsyn, 1968

Order Grylloblattida Warker, 1914
- Family Blattogryllidae A. Rasnitsyn, 1976
  - *Mesoblattogryllus longipennis* Storozhenko, 1990
- Family Geinitziidae Handlirsch, 1906
  - *Shurabia angustata* Martynov, 1937
  - *Sh. magna* A. Rasnitsyn, 1982
  - *Sh. parvula* A. Rasnitsyn, 1982

Order Perlida Latreille, 1802
- Family Perlariopseidae Sinitchenkova, 1985
  - *Karanemoura brevis* Sinitchenkova, 1987
  - *Perlariopsis gravis* Sinitchenkova, 1987
  - *Fritaniopsis inflata* Sinitchenkova, 1987

Order Orthoptera Oliver, 1789

Family Haglidae Handlirsch, 1906
*Tschorkuphlebia shurabica* Sharov, 1968
Family Elcanidae Handlirsch, 1906
*Archelcana shurabica* Sharov, 1968
Family Locustopseidae Handlirsch, 1908
*Locustopsis shurabica* Sharov, 1968

## ACKNOWLEDGMENTS

We are grateful to I.L. Dobrokhotova (PIN) for statistical data on the collections studied and to E.D. Lukashevich (PIN) for technical assistance and discussion of results.

This work was supported by the Russian Foundation for Basic Research, project no. 01-05-64741.

## REFERENCES

1. E. E. Becker-Migdisova, *Mesozoic Homoptera from Central Asia* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1949) [in Russian].
2. E. E. Becker-Migdisova, *Extinct Psyllomorph Insects* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1985) [in Russian].
3. A. I. Kirichkova and T. A. Travkina, Stratigr. Geol. Korrelyatsiya **8** (6), 89 (2000).
4. Yu. M. Kuzichkina, E. A. Repman, and T. A. Sikstel', in *Stratigraphic Chart of the Jurassic Strata of Central Asia* (Gosgeoltekhizdat, Moscow, 1958), pp. 112–121 [in Russian].
5. E. D. Lukashevich, Acta Geol. Hisp. **35** (1–2), 25 (2000).
6. A. V. Martynov, *Insects from the Lias of the Shurab and Kizil-Kiya Localities* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1937) [in Russian].
7. V. G. Novokshonov, Russ. Entomol. J. **2** (1), 75 (1993).
8. V. G. Novokshonov, *Early Evolution of Scorpionflies* (Nauka, Moscow, 1997) [in Russian].
9. A. G. Ponomarenko, in *Mesozoic Coleopterans* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1977), pp. 17–104 [in Russian].
10. A. G. Ponomarenko and Yu. A. Popov, Paleontol. Zh. **21** (3), 3 (1980).
11. Yu. A. Popov, *Historical Development of True Bugs of the Infraorder Nepomorpha (Heteroptera)* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1971) [in Russian].
12. Yu. A. Popov, Paleontol. Zh. **23** (2), 80 (1982).
13. Yu. A. Popov, in *Jurassic Insects from Siberia and Mongolia* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1985), pp. 28–47 [in Russian].
14. L. N. Pritykina, Paleontol. Zh. **11** (1), 104 (1970).
15. L. N. Pritykina, in *Extinct Mesozoic Insects* (Nauk. Dumka, Kiev, 1980), pp. 119–131 [in Russian].
16. A. P. Rasnitsyn, in *Jurassic Insects from the Karatau* (Nauka, Moscow, 1968), pp. 190–236 [in Russian].
17. A. P. Rasnitsyn, *Higher Hymenopterans from the Mesozoic* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1975) [in Russian].
18. A. P. Rasnitsyn, Paleontol. Zh. **18** (1), 64 (1977).
19. A. P. Rasnitsyn, *The Origin and Evolution of Hymenopterous Insects* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1980) [in Russian].
20. A. P. Rasnitsyn, Paleontol. Zh. **23** (3), 78 (1982).
21. A. P. Rasnitsyn, in *Mesozoic Insects and Ostracodes* (Paleontol. Inst. Ross. Akad. Nauk, Moscow, 1993), pp. 80–99 [in Russian].
22. A. G. Sharov, *Phylogeny of Orthopterous Insects* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1968) [in Russian].
23. N. D. Sinitchenkova, *Historical Development of Stoneflies* (Paleontol. Inst. Akad. Nauk SSSR, Moscow, 1987) [in Russian].
24. N. D. Sinitshenkova, in *History of Insects* (Kluwer Acad., Dordrecht, 2002), pp. 388–426.
25. S. Yu. Storozhenko, Paleontol. Zh. **31** (4), 57 (1990).
26. V. V. Zherikhin, in *History of Insects* (Kluwer Acad., Dordrecht, 2002), pp. 17–63.