ISSN 0031-0301, Paleontological Journal, 2009, Vol. 43, No. 4, pp. 428–432. © Pleiades Publishing, Ltd., 2009.
Original Russian Text © A.S. Shmakov, 2009, published in Paleontologicheskii Zhurnal, 2009, No. 4, pp. 68–72.

The Oldest Members of the Families Aeolothripidae and Thripidae (Insecta: Thysanoptera) from the Lower Cretaceous of Transbaikalia

A. S. Shmakov

Borissiak Paleontological Institute, Russian Academy of Sciences, Profsoyuznaya ul. 123, Moscow, 117997 Russia
e-mail: ashmakov@hotmail.com

Received August 4, 2008

Abstract—*Fusithrips crassipes* Shmakov, gen. et sp. nov. (Aeolothripidae) and *Convexithrips robustus* Shmakov, gen. sp. nov. (Thripidae), the oldest members of these families, are described from the Lower Cretaceous of the Baissa locality. This allowed the improvement of the time of emergence of the Recent Thysanoptera assemblage, which includes phloeothripids along with aeolothripids and thripids.

DOI: 10.1134/S003103010904011X

Key words: Thysanoptera, Aeolothripidae, Thripidae, new taxa, Lower Cretaceous, Transbaikalia, Russia.

INTRODUCTION

The order Thysanoptera (Thripida sensu stricto), commonly referred to as thrips, includes approximately five thousand species of small insects displaying highly diverse life histories. The standard system of the order (Priesner, 1964) recognizes the suborder Terebrantia, with four Recent families, and the suborder Tubulifera, with a single Recent family. Mound et al. (1980) and Mound and Morris (2007) recognized three additional families in Terebrantia and elevated the taxonomic ranks of one subfamily of Terebrantia and two subfamilies of Tubulifera to the family rank.

Most researchers currently agree with Zherikhin (1980) and Vishnyakova (1981) that thrips are closely related to the extinct family Lophioneuridae, which links barklice and thrips. Lophioneurids are sometimes included in Thripida sensu lato as a separate suborder (Zherikhin, 2002). In the present paper, the order is considered in its traditional scope.

Characters of Triassic *Triassothrips virginicus* Grimaldi et Fraser, 2004 and *Kazachothrips triassicus* Shmakov, 2004 (Triassothripidae) corroborate the idea of close relationships between thrips and lophioneurids (Grimaldi et al., 2004).

Jurassic thrips include *Karataothrips jurassicus* Sharov (Sharov, 1972) and *Liassothrips crassipes* (Martynov, 1927), which belong to the families Karataothripidae and Liassothripidae, respectively. A similarity in the secondary segmentation of the last antennomere between the Liassothripidae and Recent Tubulifera was erroneously indicated by Shmakov (2008) because actually the Recent Tubulifera lack this type of segmentation (L.A. Mound, personal communication). Nevertheless, the Liassothripidae are apparently the oldest and most primitive representatives of Tubulifera. The above thysanopteran taxa from the Mesozoic display the most archaic morphology and represent the earliest stage in the development of the order. In addition, exclusively plesiomorphic tubuliferans have been described from the Cretaceous (Strassen, 1973; Grimaldi et al., 2004). *Moundthrips beatificus* Nel, Azar et Nel, recently described from the Lebanese amber (Nel et al., 2007), is probably a lophioneurid rather than a true thrips.

Already Zherikhin (2002) has demonstrated that the Early Cretaceous was dominated by advanced thrips, which undoubtedly belonged to the Recent families. The material described in the present publication comes from the Lower Cretaceous lacustrine deposits of the well-known Transbaikalian locality Baissa (Russia, Buryatia, left bank of the Vitim River, 3 km downstream from the mouth of the Baissa River; Lower Cretaceous, Zaza Formation). The stratigraphy, paleoecology, flora, and fauna of that locality have been reviewed by Martinson (1961) and Zherikhin et al. (1999). Thrips remains come from gray thin-layer marls. A total of 115 specimens, mostly females, have been collected. Two-thirds specimens have counterparts. Most insect impressions from Baissa are excellently preserved; 93 specimens were identified to family and 49, to genus. All the genera (at least 12) are new. In the present paper, representatives of two recent families are described.

All the specimens examined are housed in Borissiak Paleontological Institute of the Russian Academy of Sciences, Moscow (PIN).

SYSTEMATIC PALEONTOLOGY

Order Thysanoptera

Suborder Terebrantia

Family Aeolothripidae Uzel, 1895

Genus *Fusithrips* Shmakov, gen. nov.

Etymology. From the Latin *fusus* (spindle) and the generic name *Thrips*.

Type species. *F. crassipes* sp. nov.

Diagnosis. Head distinctly transverse, broadly rounded anteriorly. Eyes large, reaching posterior one-third of head length, with many large facets; ventrally, with distinct posterior angle. Antennae moniliform; scape and pedicel similar in size, cylindrical, with straight sides; flagellum five-segmented, with double-segmented style. Pedicel with large sensilla of Thripidae type. Third and fourth antennomeres without prominent sensilla. Antennae densely covered with long setae. Prothorax transverse, not particularly wide, with straight sides. Pterothorax slightly transverse. Division of mesosternum unusually well pronounced. Meso- and metasterna separated by distinct suture. Metasternum rounded, without distinct furca. Wings heteronomous, all wide, with long fringe. Forewings with at least two longitudinal veins and two apical crossveins (Rs_1 and M_2). Crossveins straight, oriented perpendicularly to longitudinal axis of wing. Both forewings and hindwings reach beyond anterior margin of tergite VIII. Hindwing venation obscure, possibly absent. Fringes on both wing pairs without additional cilia. Fore and hind legs unusually massive. Tarsal formula, 2-2-2. Abdomen elongate, with all segments distinctly transverse, except for terminal one. Posterior margins of tergite VIII and sternites VI, VII, and VIII deeply dissected (tergites I and II dissected particularly deeply). Integument with rough, transverse striation.

Species composition. Type species.

Comparison. The new genus differs from other genera of the family in the seven-segmented antennae, the pedicel with the thripid-type sensilla, the dissected first abdominal tergite, the dissected posterior margins of sternites, and in the thickened legs.

Fusithrips crassipes Shmakov, sp. nov.

Etymology. From the Latin *crassipes* (thick-legged).

Holotype. PIN, no. 3064/8547, female; Baissa locality; Lower Cretaceous, Zaza Formation, layer 31.

Description (Fig. 1). The body is uniformly dark. The antennae, middle, and hind legs are as strongly pigmented as the body. The fore femora are mostly light-colored, darkened only at the bases; the fore tibiae are entirely light.

Measurements, mm and ratios: body length of female, 1.27–1.41; forewing length, 0.61–0.65; hindwing length, 0.57–0.62.

Length-to-width ratios of: scape, 0.91–0.93; pedicel, 0.66–0.68; antennal flagellomeres: I, 2.24–2.27; II, 2.17–2.25; III, 1.83–1.88; IV, 2.65–2.68;V, 2.57–2.59; head, 0.65–0.71; prothorax, 0.56–0.63; pterothorax, 0.85–1.03; forewing, 12.43–12.6; hindwing, 11.2–11.32; abdominal segments: I, 0.29–0.31; II, 0.24–0.27; III, 0.24–0.25; IV, 0.21–0.23;V, 0.23–0.26; VI, 0.21–0.24; VII, 0.23–0.24; VIII, 0.24–0.28; IX, 0.43–0.48; X, 0.91–0.96; femora: fore, 1.56–1.64; middle, 2.76–2.83; hind, 1.77–1.85; tibia: fore, 1.83–1.92; middle, 2.54–2.6; hind, 2.55–2.59. Ratio of hindwing posterior margin fringe to hindwing width: 3.43–3.62.

Material. In addition to the holotype, paratypes PIN, nos. 3064/8552, 4210/2260, 4210/2269, 4210/2331, and 4210/5455, from the same locality, all females.

Family Thripidae Stephens, 1829

Genus *Convexithrips* Shmakov, gen. nov.

Etymology. From the Latin *convexus* (convex) and the generic name *Thrips*.

Type species. *C. robustus* sp. nov.

Diagnosis. Head very slightly transverse, trapeziform. Eyes large, with many large facets; ventrally, with poorly pronounced posterior angle; dorsally, without posterior angle. Three ocelli present; anterior one slightly smaller than posterior ones. Antennae moniliform; scape strongly expanded towards apex, with outer lateral process; pedicel large, poculiform, with crown of short, strong setae along its distal margin; flagellum with five segments, considerably narrower than pedicel; style with two segments. Third and fourth antennal segments without prominent sensilla. Prothorax distinctly transverse, almost rectangular. Pterothorax transverse, with its sides distinctly rounded. Wings heteronomous, narrow, with somewhat rounded apices. Forewings reaching anterior margin of tergite VII; hindwings reaching anterior margin of tergite IX. Forewings with two longitudinal veins, anterior vein not fused with C. Hindwing venation obscure, possibly absent. Both wing pairs with long and straight fringe, without additional cilia. Legs shortened. Middle legs strongly enlarged, with their femora and tibiae both massive; fore and hind tibiae elongated. Tarsal formula, 2-2-2. Abdomen elongate; all abdominal segments distinctly transverse, except for two terminal ones. Posterior margins of at least tergites VII and VIII deeply dissected. Integument with rough transverse striation.

Species composition. Type species.

Comparison. The new genus differs from other genera of the family that have seven-segmented antennae in the massive middle legs and in the deeply dissected posterior margins of the abdominal tergites.

Remarks. The genus *Convexithrips* is also referable to the Thripidae based on the wing's shape and

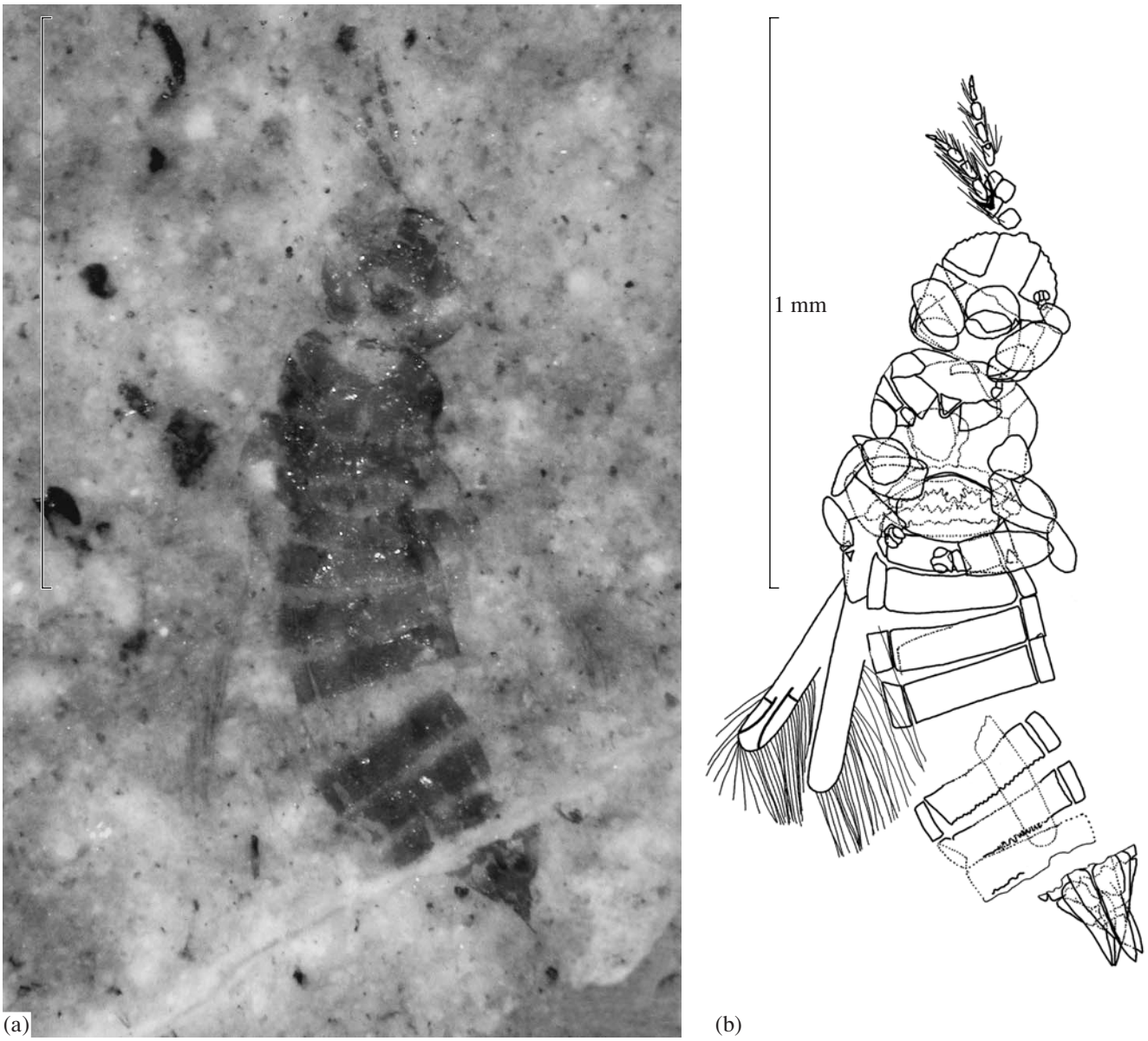

Fig. 1. *Fusithrips crassipes* gen. et sp. nov., holotype PIN, no. 3064/8547, female, ventral view: (a) general view and (b) details of structure.

venation: narrow, with barely rounded tip, and without crossveins or oblique veins.

***Convexithrips robustus* Shmakov, sp. nov.**

Etymology. From the Latin *robustus* (strong, powerful).

Holotype. PIN, no. 4210/2268, female; Baissa locality; Lower Cretaceous, Zaza Formation, layer 4.

Description (Fig. 2). The body is dark; the head and prothorax are particularly strongly pigmented. The antennae are dark. The femora of the fore and hind legs are uniformly dark; the middle leg femora are dark only at their bases. The fore and middle tibiae are pigmented; the hind tibiae are light.

Measurements, mm and ratios: body length of female, 1.42–1.47; forewing length, 0.76–0.83; hindwing length, 0.68–0.75; diameter of anterior ocellus, $18–20 \times 10^{-3}$; diameter of posterior ocelli, $21–22 \times 10^{-3}$; distance between anterior ocellus and line connecting posterior ocelli, $23–26 \times 10^{-3}$; distance between posterior ocelli, $34–40 \times 10^{-3}$.

Length-to-width ratios of: scape, 0.48–0.50; pedicel, 0.98–1.04; antennal flagellomeres: I, 1.76–1.8; II, 2.11–2.15; III, 2.09–2.12; IV, 1.76–1.83;V, 1.54–1.56; head, 0.83–0.92; prothorax, 0.42–0.49; pterothorax, 0.75–0.83; forewing, 12.43–13.05; hindwing,

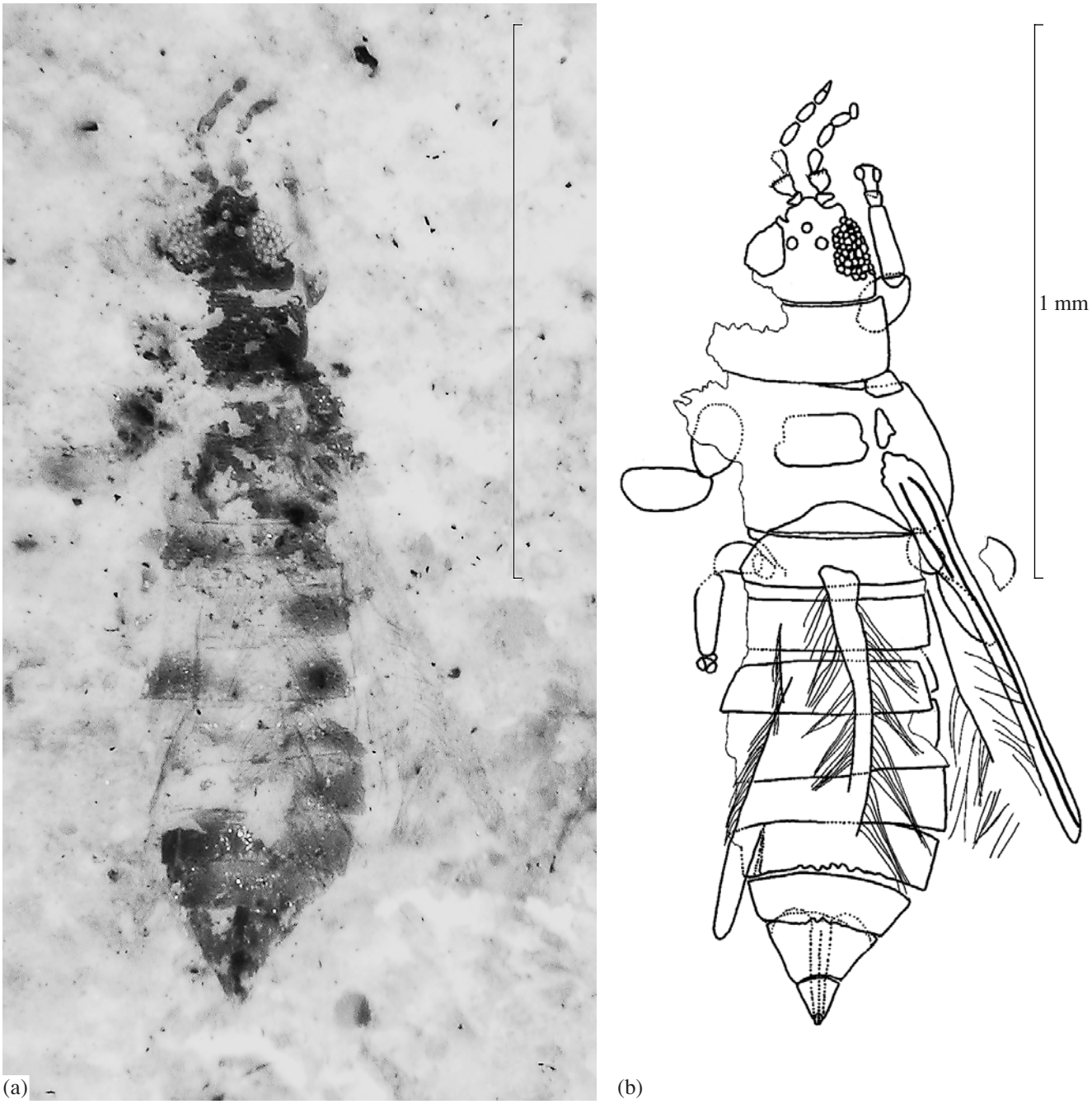

Fig. 2. *Convexithrips robustus* gen. et sp. nov., holotype PIN, no. 4210/2268, female: (a) general view and (b) details of structure.

14.75–15.23; abdominal segments: I, 0.21–0.24; II, 0.26–0.29; III, 0.27–0.30; IV, 0.25–0.27; V, 0.22–0.26; VI, 0.24–0.28; VII, 0.25–0.28; VIII, 0.31–0.33; IX, 0.57–0.62; X, 0.9–0.95; femora: fore, 1.52–1.7; middle, 1.55–1.63; hind, 1.51–1.68; tibiae: fore, 3.16–3.21; middle, 2.05–2.15; hind, 3.18–3.27. Ratio of hindwing posterior margin fringe to hindwing width: 3.04–3.85.

M a t e r i a l. In addition to the holotype, paratypes PIN, nos. 3064/8550, 4210/2273, 4210/2317, and 4210/5449 from the same locality, all females.

DISCUSSION

Unlike representatives of the extinct families, all of which had the antennae with nine or ten segments, rep-

resentatives of both new genera have a small number of antennal segments. Long fringe on wings was uncharacteristic of Triassic and Jurassic taxa, but already occurred in Cretaceous taxa (Strassen, 1973); and it is typical of recent thrips. Sclerotization of the pterothorax is closely similar to that of recent taxa. It should be kept in mind that sclerotization of Mesozoic forms remains poorly understood. The strong transverse striation of the integument, which is presently widespread in the order, has not been recorded from before the Cretaceous and is considerably less developed in species from the Cretaceous Lebanese amber.

The dissected posterior margins of tergites and sternites of the two Cretaceous species described above are much more interesting. No analogues of this character have been recorded among the Recent Terebrantia, although, in some recent Tubulifera, for example, the genus *Chirothripoides* (Stannard, 1968), the posterior margins of sternites are dissected to an even greater extent. In *Fusithrips*, in addition to the posterior margins, the anterior margins of tergites I and II also appear dissected. Since this condition is not known among Recent taxa, one should treat this observation with caution. It is possible that, in these impressions, dissected posterior margins of the pterothorax and the first abdominal tergite are superimposed onto the anterior margins of the first and second abdominal tergites, respectively.

Modification or considerable reduction of abdominal tergite I (forming the so-called pelta) is also typical of Tubulifera. The modified first tergite of *Fusithrips* resembles the pelta of Phlaeothripidae (Tubulifera); however, in recent tubuliferans, this tergite is reduced to a much greater extent (Mound and Palmer, 1983). It is possible that, in the genus described, the first tergite became reduced independently of its reduction in Phlaeothripidae.

The wide fore and hind wings of *Fusithrips*, with the already modified venation, i.e., with Rs_1 and M_2 being crossveins rather than oblique veins, suggest that the genus belongs to Aeolothripidae. No additional veins have been found. The genus has forked sensilla on the antennal segments, which occur among recent taxa only in Thripidae. Yet, in the species described, these sensilla are situated on the second antennomere; in contrast, in recent taxa, they are present on the third and fourth antennomeres, while the second antennomere almost always lacks any sensilla (Dyadechko, 1964). Therefore, the sensilla described are most probably a plesiomorphic condition.

ACKNOWLEDGMENTS

I am deeply grateful to the late Head of the Laboratory of Arthropods (PIN) V.V. Zherikhin for his invaluable assistance with the project. I am also thankful to G.V. Farafonova (Biological Faculty of Moscow State University) for consultations. Special thanks are due to the researchers of the Laboratory of Arthropods (PIN) Yu.A. Popov, D.E. Shcherbakov, and I.D. Sukacheva for their kind support and advice.

REFERENCES

1. N. P. Dyadechko, *Thripses (Thysanoptera) of the European USSR* (Urozhai, Kiev, 1964) [in Russian].

2. D. Grimaldi, A. Shmakov, and N. Fraser, "Mesozoic Thrips and Earliest Evolution of Order Thysanoptera (Insecta)," J. Paleontol. **78** (5), 941–952 (2004).

3. G. G. Martinson, "Mesozoic and Cenozoic Mollusks from the Continental Beds of the Siberian Platform, Transbaikalia and Mongolia," Tr. Baikal. Limnol. Stants. Akad. Nauk SSSR, **19**, 1–332 (1961).

4. A. V. Martynov, "Jurassic Fossil Insects from Turkestan," Bull. Acad. Sci. URSS **7**, 768 (1927).

5. L. A. Mound, B. S. Heming, and J. M. Palmer, "Phylogenetic Relationships between the Families of Recent Thysanoptera (Insecta)," Zool. J. Linnean Soc. **69**, 111–141 (1980).

6. L. A. Mound and D. C. Morris, "The Insect Order Thysanoptera: Classification versus Systematics," Zootaxa, No. 166, 395–411 (2007).

7. L. A. Mound and J. M. Palmer, "The Generic and Tribal Classification of Spore-feeding Thysanoptera (Phloeothripidae: Idolothripinae)," Bull. Brit. Mus. Natur. Hist. (Entomol.) **46** (1), 1–174 (1983).

8. P. Nel, D. Azar, and A. Nel, "A New 'Primitive' Family of Thrips from Early Cretaceous Lebanese Amber (Insecta, Thysanoptera)," Cret. Res. **28**, 1033–1038 (2007).

9. H. A. Priesner, "Ordnung Thysanoptera," Bestimmun. Bodenfauna Eur. **2**, 1–242 (1964).

10. A. G. Sharov, "On Phylogenetic Relationships of the Order Thysanoptera," Entomol. Obozr. **51** (4), 854–858 (1972).

11. A. S. Shmakov, "The Jurassic Thrips *Liassothrips crassipes* (Martynov, 1927) and Its Position in the System of the Order Thysanoptera (Insecta)," Paleontol. Zh., No. 1, 48–54 (2008) [Paleontol. J. **42** (1), 47–52 (2008)].

12. L. I. Stannard, "The Thrips or Thysanoptera of Illinois," Bull. Illinois Natur. Hist. Surv. **29** (4), 1–383 (1968).

13. R. Strassen, zur., "Fossile Fransenflügler aus mesozoischem Bernstein des Libanon," Stuttg. Beitr. Naturk. Ser. A (Biol.) **256**, 1–50 (1973).

14. V. N. Vishnyakova, "New Paleozoic and Mesozoic Lophioneurida (Thripida)," Tr. Paleontol. Inst. Akad. Nauk SSSR **183**, 43–63 (1981).

15. V. V. Zherikhin, "The Order Thripida," Tr. Paleontol. Inst. Akad. Nauk SSSR **175**, 69–72 (1980).

16. V. V. Zherikhin, "Order Thripida Fallen, 1914 (= Thysanoptera Haliday, 1836): The Thrips," in *History of Insects*, Ed. by A. P. Rasnitsyn and D. L. J. Quicke (Kluwer, London, 2002), pp. 133–143.

17. V. V. Zherikhin, M. B. Mostovski, P. Vrsansky, et al., "The Unique Lower Cretaceous Locality of Baissa and Other Contemporaneous Insect-bearing Sites in North and West Transbaikalia," in *Proceedings of the 1st Palaeoentomological Conference, Moscow, 1998* (Amba Proj., Bratislava, 1999), pp. 185–192.