

A New Enigmatic Group of Insects (Psocidea, Tshekarcephalidae) from Tshekarda (Lower Permian of the Middle Urals)

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Abstract—*Tshekarcephalus bigladipotens* gen. et sp. nov. (Tshekarcephalidae fam. nov.) is described from the Lower Permian (Kungurian) of the Middle Urals as *Insecta incertae sedis* possibly related to the superorder Psocidea.

INTRODUCTION

The insect fauna collected from the Lower Permian locality Tshekarda, well known due to abundant complete (i.e., not fragmentary) fossils (Ponomareva *et al.*, 1998) has not yet been described in full. Besides some Grylloblatida, Odonata, Palaeomanteida and several other insects of known systematic position, an enigmatic group of uncertain taxonomic position is still not placed taxonomically, some features of its specialization apparently having no analogues in the Paleozoic. These peculiar insects are described below.

The collections of the Paleontological Institute, Russian Academy of Sciences (PIN) and the Permian State University (PU) were studied; all the material is deposited in the Arthropoda Laboratory, PIN.

SYSTEMATIC PALEONTOLOGY

Ordinis incertis.

Family Tshekarcephalidae Novokshonov et Rasnitsyn, fam. nov.

Type genus. *Tshekarcephalus* gen. nov.

Diagnosis. Small insects (body length about 5 mm) with the very large, prognathous head and long, curved, stylet-like mandibles; in some males (macrognathous form) the head especially large and mandibles considerably elongated. Antennae short, thin, setaceous, composed of elongate segments. Labrum small, with rounded anterior margin. Maxillary palps not distinctly modified. Eyes small, weakly convex, placed laterally. Head capsule with curved transverse carina posterodorsally, with strong arcuate sutures on ventral surface running moderately close to each other in the middle and markedly diverging forwards and especially backwards (probably the parts of the occipital suture). Occipital foramen small. Pronotum nearly twice as narrow as the head, very short, with the median longitudinal suture and the margins slightly attenuated to the

humeral angles. Mesonotum rounded triangular, normally subdivided, nearly as wide as, or (in macrognathous males) much narrower than the head. Metanotum much shorter than mesonotum and (as judged from preserved scutellar sutures) likewise normally subdivided (its structure obscured by underlying middle leg bases). Meso- and metathorax with pleural parts markedly sloped, on ventral surface with median suture (discrimen) and common opening of furcal arms. Legs (especially fore and middle legs) short. Hind coxae small, conical, closely adjacent to midventral line; trochanters short; hind femora longer and thicker than the fore and middle ones; tibiae straight, slender. Tarsus not shortened, with small, paired claws and small arolium. Wings clearly projecting beyond abdominal apex in repose, probably folded roof-like (left and right ones never broadly overlapping in known specimens), veins very weak (not preserved in all specimens). Abdomen fusiform, no wider than thorax, separated from the latter by clear constriction. Male genitalia not forming distinct genital capsule (abdominal apex without any sclerotized structures). Ovipositor short (its length comparable to that of hind femur), normally developed, scarcely projecting beyond abdominal apex.

Composition. Type genus.

Remarks. The bases of fore and middle legs are not preserved; the number of tarsomeres is unknown. The insufficient preservation and peculiarity of the known structures preclude us from determining the systematic position of these insects with certainty, but it is possible to make some suppositions. Apterygote insects and "palaeopterous" insects, which have permanently outstretched wings are excluded from consideration at once. The mesothoracic midventral suture combined to the common opening of the furcal arms, as well as the roof-like wing position exclude Gryllones; the stylet-like mandibles, thin setaceous antennae, reduced pronotum, small contiguous hind coxae, and well

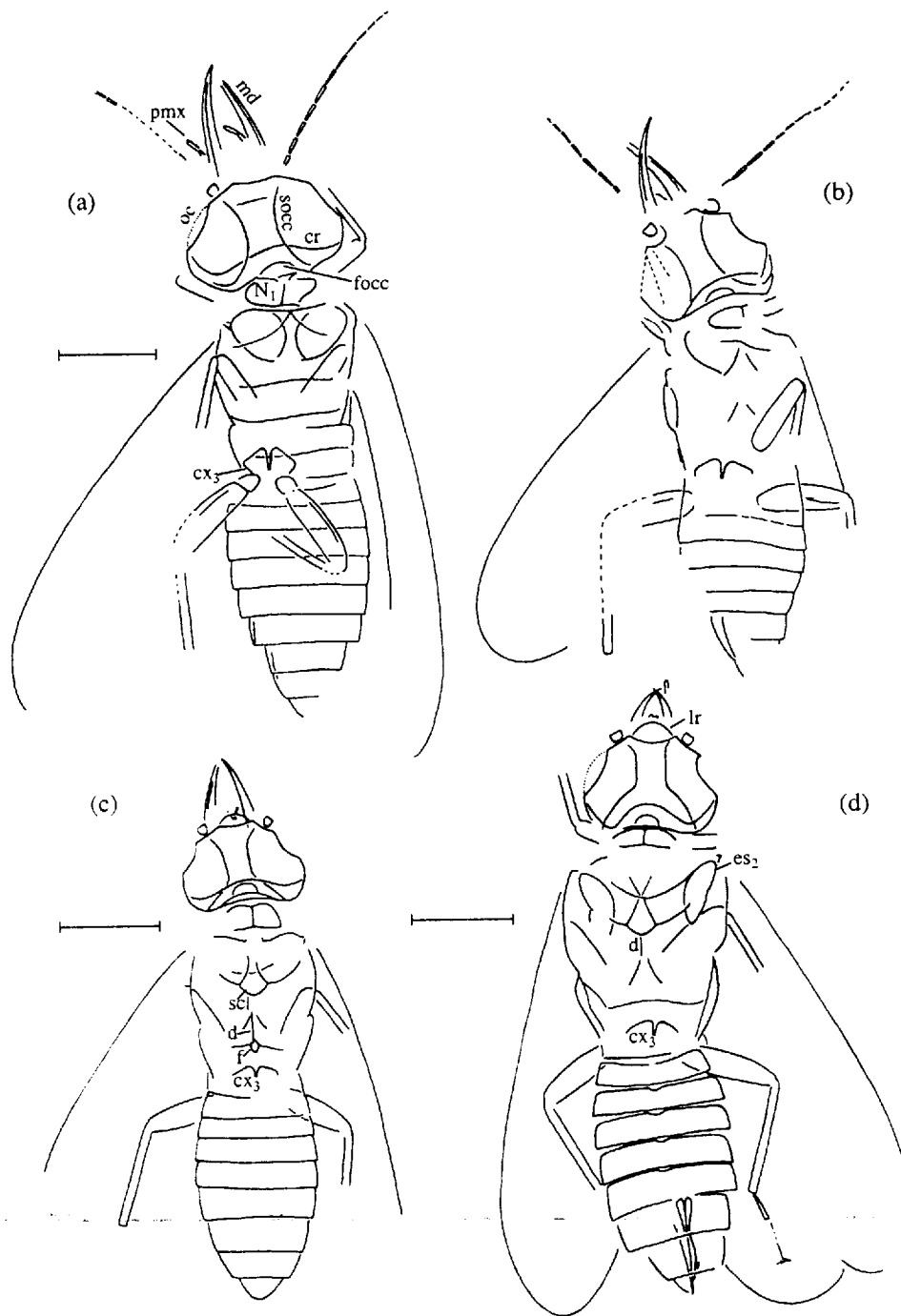
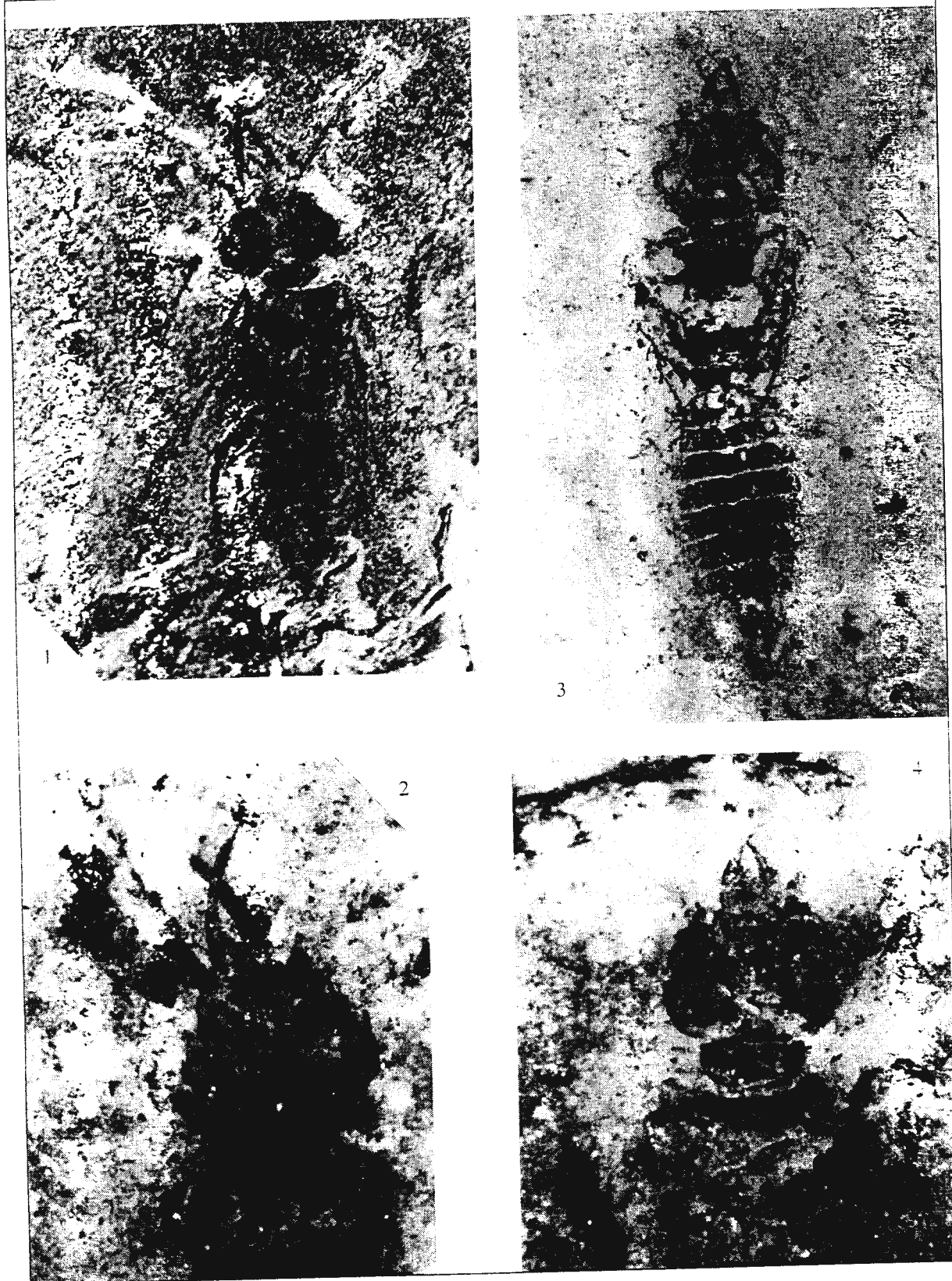


Fig. 1. *Tshekarcephalus bigladiptens* sp. nov.: (a, b) macrognathous males: (a) holotype PIN, no. 1700/3187; (b) PIN, no. 1700/4757; (c) micrognathous male PU, no. 2/353; (d) female PU, no. 2/117. Symbols: cr, carina on posterior part of head; cx₃, hind coxa; d, midventral suture (discrimen); es₂, mesepisternum; f, furcal opening; focc, occipital foramen; lr, labrum; md, mandible; N₁, pronotum; oc, eye; pmx, maxillary palp; scl, scutellum; socc, occipital suture. Scale bar 1 mm.

developed, but almost concealed ovipositor are also uncharacteristic of Gryllones. Remaining possibilities are the Cimiciformes (Hemiptera, Psocidea) or their archaic Paleozoic relatives, or the Zorotypida (= Zoraptera), (see Rohdendorf and Rasnitsyn, 1980; Rasnitsyn, 1999), or holometabolous insects. Among the archaic Cimiciformes small forms with impoverished venation occur

only in the orders Hypoperlida (suborder Hypoperlina) and Zorotypida, but the pronounced mandible modification is unknown in these taxa. On the contrary, Hemiptera are too specialized and possess a quite well developed piercing rostrum. Specializations resembling those of *Tshekarcephalus* gen. nov. are encountered in some Psocidea and holometabolous insects. However.



Explanation of Plate 5

Figs. 1-4. *Tshekarcephalus bigladiopotens* sp. nov.: (1) macrognathous male, holotype PIN, no. 1700/3187, $\times 18$; (2) head of macrognathous male, PIN, no. 1700/475, $\times 27$; (3) female, PIN, no. 2/117, $\times 18.3$; (4) head of female, PIN, no. 2/119, $\times 26.5$.

in the latter group analogous modifications of the mouthparts appear only in the Mesozoic (the piercing rostrum of some true flies and flea ancestors), and the similar stylet-like mandibles not united into a rostrum (in *Corydalus* (Corydalida = Megaloptera)) even later. Within Psocidea, the lineage resulting in thrips (Thysanoptera) with their stylet-like mandibles had already arisen in the Permian (Rohdendorf and Rasnitsyn 1980). Therefore we tentatively place the family in question near Psocidea.

The structure of the mandibles apparently indicates the specific feeding strategy of the insect. So far as the stylet-like mandibles are set far apart basally, curved towards each other and thus operated independently (not as a single tool), and so far as no other structures adapted for the sucking feeding are revealed, one should assume the mandibles were used to open microsporangia, the pollen being extracted through the resulting opening with aid of the elongate maxillary palps.

Possibly this family comprises also *Kungurmica sojanensis* Aristov, 1998 from the Upper Permian of Arkhangelsk Region (Aristov, 1998). This insect differs from the type species, *K. tshekardensis* Novokshonov, 1998 (Grylloblattida, Permembiiidae; Novokshonov, 1998) in the thin antennae, short pronotum and longer hind legs. The characters listed along with acute, curved, stylet-like mandibles relate it to *Tshekarcephalus* gen. nov. Positive decision is not yet possible due to insufficient preservation of the *K. sojanensis* holotype.

***Tshekarcephalus* Novokshonov et Rasnitsyn, gen. nov.**

E t y m o l o g y. From the locality name and Greek *kephalon* (head).

T y p e s p e c i e s. *T. bigladiptens* sp. nov.

D i a g n o s i s. Antennae nearly twice as long as the head, with about 15 segments; scape large, about as long as wide; pedicel not preserved; flagellomeres several times narrower than scape, markedly elongate, becoming shorter and even narrower towards apex. Mandibles weakly converging near base, with a longitudinal rib, in macrognathous male longer than head, in micrognathous male shorter, in female half the length of the head. Maxillary palps in macrognathous male much shorter than mandible, in female projecting beyond its apex. Hind tibia shorter than the head width (even in female), but longer than femur. Hind tarsus shorter than femur. Ovipositor nearly as long as hind femur, valvifer occupying about 0.3 of its length.

C o m p o s i t i o n. Type species.

Tshekarcephalus bigladiptens Novokshonov et Rasnitsyn, sp. nov.

Plate 5, figs. 1-4

E t y m o l o g y. From Latin *bigladiptens* (possessing two swords), after the shape of mandibles.

H o l o t y p e. PIN, no. 1700/3187, macrognathous male; left bank of the Sylva River near the mouth of the

Tshekarda River, Suksun District, Perm Region; Lower Permian, Kungurian, Koshelevka Formation.

D e s c r i p t i o n (Fig. 1). The head and thorax are dark; the hind femora of the male, the abdomen and the ovipositor are darkened to various extents in different specimen; remaining appendages (including the mandibles) are moderately pale.

M e a s u r e m e n t s (mm):

Specimen no.	Sex, variety	Body length	Length from anterior head margin to bases of hind femora	Head width	Mandible length
1700/3187	macrognathous male	5.5	3.1	1.5	1.2
1700/4757	macrognathous male	4.7	2.8	1.35	1.0
2/353	micrognathous male	4.9	2.7	1.25	0.8
2/358	micrognathous male	4.8	2.7	1.25	?
2/117	female	5.5	3.1	1.3	0.6
2/119	female	5.5	3.0	1.3	0.6
1700/3189	female	5.3	3.1	1.3	0.7
2/352	female	5.2	?	1.2	?
1700/3186	female	5.0	3.1	1.25	0.6
2/376	female	4.9	?	1.1	0.5
1700/629	female	4.6	2.6	1.1	0.5
2/357	female	4.4	2.5	1.05	0.45

M a t e r i a l. Besides the holotype: macrognathous male PIN, no. 1700/4757; micrognathous males PU, nos. 2/353, 358 and PIN, no. 1700/382; females PU, nos. 2/117, 119, 352, 357, 376 and PIN, nos. 1700/629, 2934, 3025, 3186, 3189, 3190.

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