

Arthropods in amber and other resins, both extant and extinct: recent results obtained at the Paleontological Institute, RAS, Moscow, Russia

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Paleontological Institute RAS in Moscow amasses its own amber collections and conducts amber researches almost since the palaeontomological laboratory has been established there 75 years ago. However, intensity of these researches was rather low till early 1970-ies, when an ambitious project for collection and study of the Cretaceous and Palaeocene fossil resins of USSR has been launched by Vladimir Zherikhin. The impressive results of that project are widely appreciated. Wider researches of the Late Eocene European amber (Baltic, Rovno, Saxonian, and Scandinavian ones) started later on but produced significant results as well. This report is devoted mainly, but not exclusively, to new discoveries in this field.

The first item which merits attention of colleagues is an analysis of arthropod inclusions in resin of living conifer trees in northern Eurasia (mainly but not exclusively in Russia) aimed to compare it with composition of the inclusion assemblages in various amber (ZHERIKHIN et al. 2009). More than 4800 arthropods were isolated and identified in 133 samples of total weight some 13 kg, taken from pine, fir, spruce, and larch trees ranging from Poland to Japan and from Taimyr to Crimea (Fig. 1). The results are diverse (Fig. 2), with the most unexpected being a sharp decline of the nematoceran dipterons (various midges, gnats, crane-flies, and their relatives). Equally striking but expectable was explosion of the ant abundance.

Another example of important recent results is a comparison of ant faunas in four main European Upper Eocene ambers (DLUSKY & RASNITSYN 2009). In addition to the classic publications by MAYR (1868) and WHEELER (1915), more than 5500 ant inclusions have been identified in almost twenty main European collections including two Polish ones. Totally, 173 ant species of 61 genera have been recorded. Comparison of taxonomic composition of ant assemblages in the Baltic, Rovno, Saxonian, and Scandinavian ambers reveal all of them as distinct (Fig. 3) even though coeval. The results indicate origin of each of these assemblages in different territories within the Eocene Europe (Fig. 4). The most similar in their arthropod composition are found the Baltic and Saxonian ambers, and most distinct the Scandinavian amber, as LARSSON (1978) has predicted long ago.

Noteworthy is also an attempt to reveal biocoenotic structure of the past amber forest using composition of the amber syninclusion. The notion of syninclusion has been introduced by famous Polish entomologist Jan Koteja who predicted a key role of cases of multiple organic

inclusions in one and the same piece of amber for understanding of the biotic structure of past environments (KOTEJA 1989). This approach makes currently only its first steps, and our work is based on a limited material. And yet a statistical analysis of the taxonomic composition of syninclusion in three representative samples of the Rovno amber reveals some significant results (Fig. 5). Because of insufficient material we have to rely on the most persistent connections between the syninclusion components rather than on the highest correlation values which produce a rather chaotic pattern. In contrast, the positively correlated pairs of taxa that reveal in each of three representative samples (enclosed in ovals in Fig. 5) are easily interpretable. Apparently they represent three distinct guilds in the past amber forest, viz., a guild of air planctic insects (midges and biting midges; solid ovals), a guild of visitors and dwellers of live tree trunks (dolichopodid flies and long-beaked *Germaraphis* aphids; dashed ovals), and visitors/dwellers of dead tree trunks (*Sciara* zone Diptera, i.e. those are mycetophilous and flying near forest flour, and the common amber mite; chain ovals). There are serious reasons to believe that the second guild includes also *Lasius* ants, for the living *Stomaphis* aphids, a close living analog of the extinct *Germaraphis*, represent an obligate symbiont of living *Lasius*. Unfortunately, the currently available material is insufficient to reveal this connection formally. Only very preliminary results of this approach are published by now (PERKOVSKY et al. 2010).

Worth mentioning is also a study of amber mites currently re-started at PIN. Among more important results is a re-description of the enigmatic even if most common amber mite *Acarus rhombeus* KOCH & BERENDT, 1854 (Fig. 6). This mite is found to represent a family of its own (Glaesacaridae SIDORCHUK & KLIMOV, 2011). Another study contrasts to the above one in that it reveals an oribatid mite *Scutoribates perornatus* SELLENI (Fig. 7) as being hardly distinguishable from a widespread living species. As a result, two generic names of living mites (*Kunstella* KRIVOLUTSKY, 1974 in Oribatellidae and *Koreoribates* CHOI, 1994 in Unduloribatidae) are synonymized under *Scutoribates* SELLENI, 1918 (SIDORCHUK & NORTON 2011). Both these important publications became possible due to an original method of preparation of tiny six-side-polished amber blocks for microscope study (Fig. 8) (SIDORCHUK 2011).

And the last to refer to herein are the results by Kopylov (in preparation) on ichneumon flies in the Cretaceous fossil resin of Siberia. Ichneumon flies are parasitic wasps forming a huge and ecologically very important family Ichneumonidae. In the modern fauna, these wasps are mainly moderately small to moderately large insects which parasitize a diverse array of prey, usually of body size comparable to themselves. The niche of tiny parasitic wasps is occupied nowadays mainly by various proctotrupomorph wasps, of which only Chalcidoidea are both diverse and polyphagous. Kopylov reveals a diverse extinct fauna of tiny Late Cretaceous Ichneumonidae (Fig. 9) which is practically lost by now. This lost diversity reflects changes in the biocenotic organization since Cretaceous. Characteristic of that time was deficiency of minute polyphagous arthropod parasites, the niche which was gradually filling in, mainly with the explosively diversifying chalcidoid wasps, only during Cenozoic. Prior to that, Ichneumon flies were apparently one of entering a vast underexplored ecological space.

I appreciate extensive help by colleagues, as well as their permission to present their results here. My thanks are to D.S. Kopylov, E.A. Sidorchuk, and I.D. Sukacheva of A.A. Borissiak Paleontological Institute, Russian Academy of Sciences; G.M. Dlussky of Biological Faculty, M.I. Lomonosov Moscow State University; and S.P. Rasnitsyn of E.I. Martsinovsky Institute of Medical Parasitology and Tropical Medicine (all in Moscow, Russia); as well as E.E. Perkovsky and A.P. Vlaskin of I.I. Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine (Kiev, Ukraine).

Figures

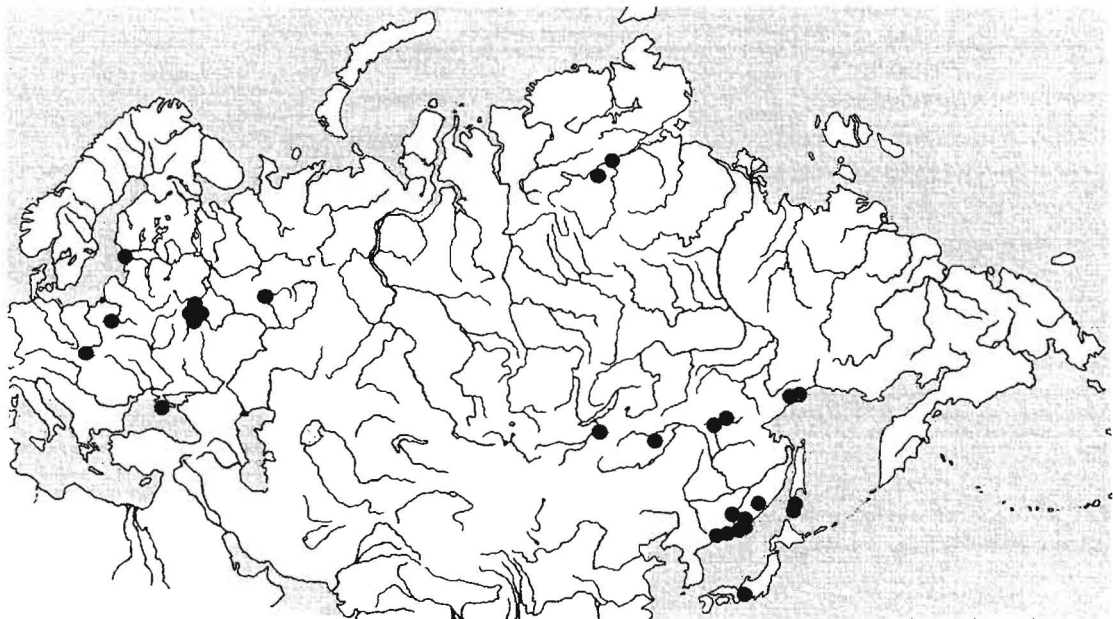


Fig. 1. Map of collecting sites of contemporary resin.

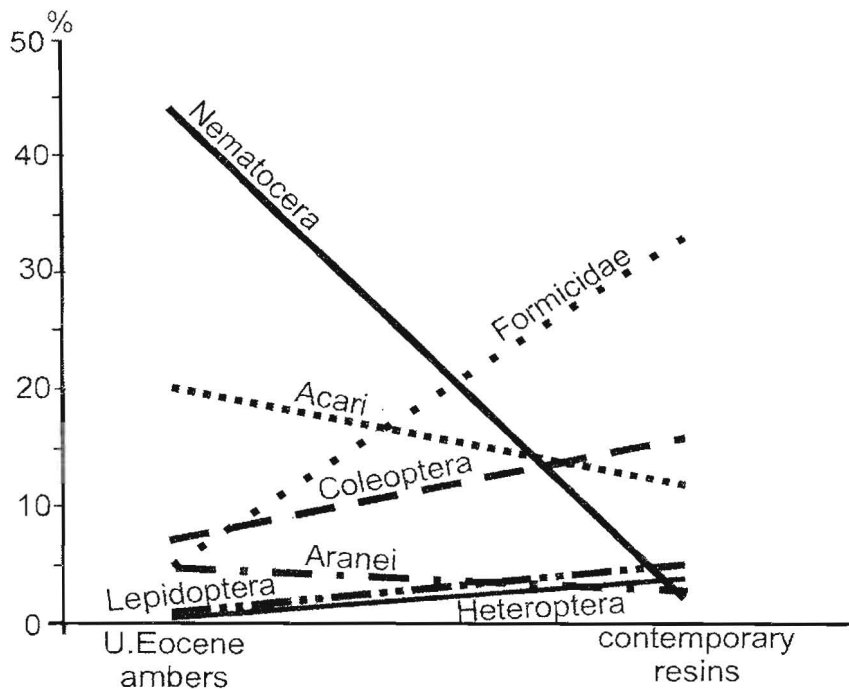


Fig. 2. Diagram of abundance dynamics of taxa entrapped in the Late Eocene amber and in the contemporary resin.

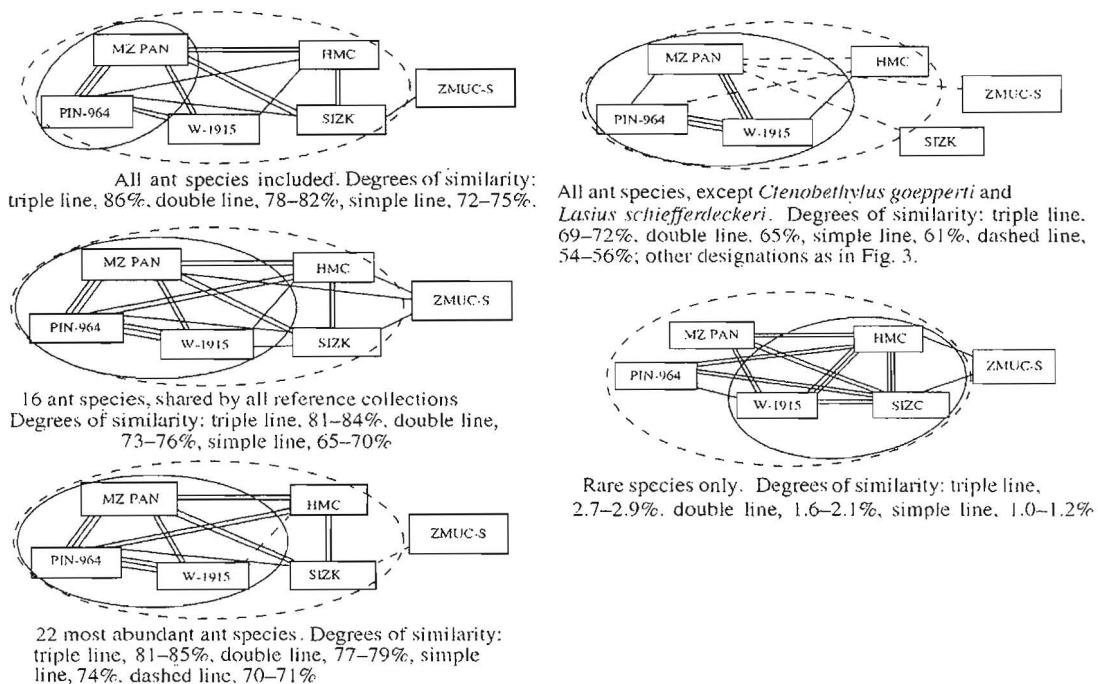


Fig. 3. Similarity structure of the ant amber assemblages in four main varieties of the amber (Succinite), as revealed by the reference amber collections: Baltic amber (W-1915 – collections described by Wheeler, 1915; MZ PAN – collection kept at Polish Academy of Sciences Museum of the Earth in Warsaw, PIN-964 – collection -964 kept at the Paleontological Institute, Russian Academy of Sciences in Moscow), Saxonian amber (HMC – collection kept at Humboldt Museum, Berlin), Rovno amber (SZK – collection kept at I.I. Schmalhauren Institute of Zoology, National Academy of Sciences of Ukraine, Kiev), and Scandinavian amber (ZMUC-S – collection kept at Zoological Museum of University Copenhagen). Solid and dashed ovals circumscribe the collections displaying similarity of two highest degrees (DLUSSKY & RASNITSYN 2009).

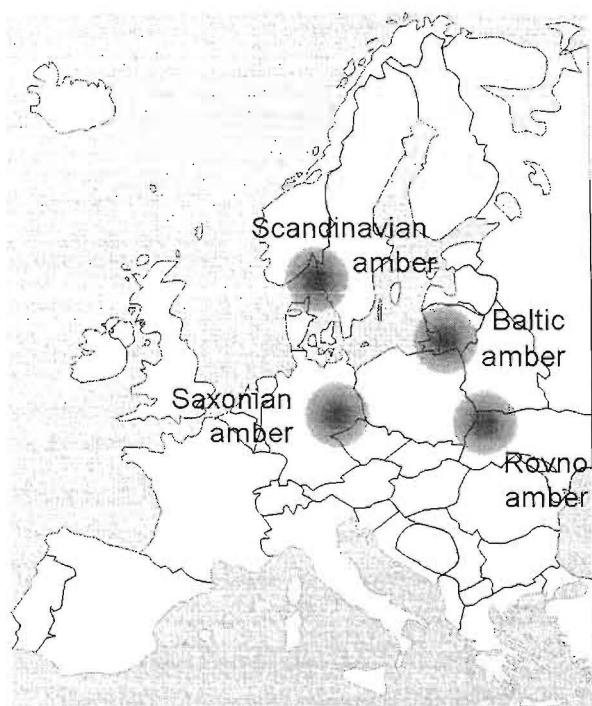


Fig. 4. Location of Succinite deposits in Europe

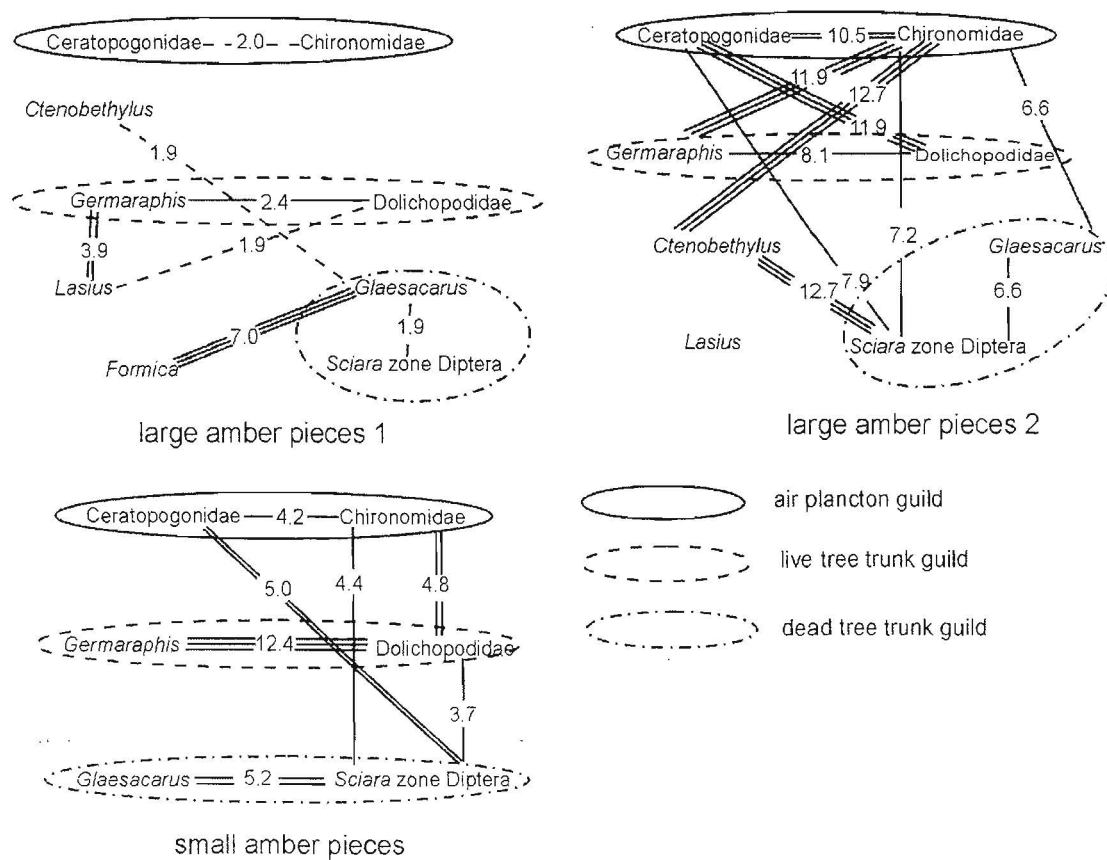


Fig. 5. Correlation structure of syninclusia components in three representative samples of the Rovno amber.

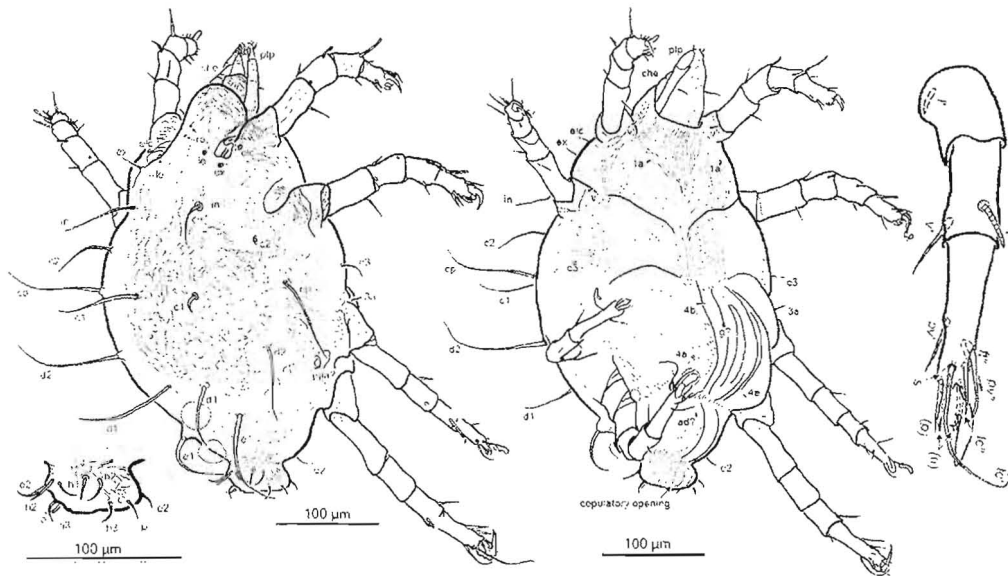


Fig. 6. *Glaesacarus rhombeus* KOCH & BERANDT (Glaesacaridae), a representative figure of female dorsal and ventral view to show minuteness of interpretation (SIDORCHUK & KLIMOV 2011).

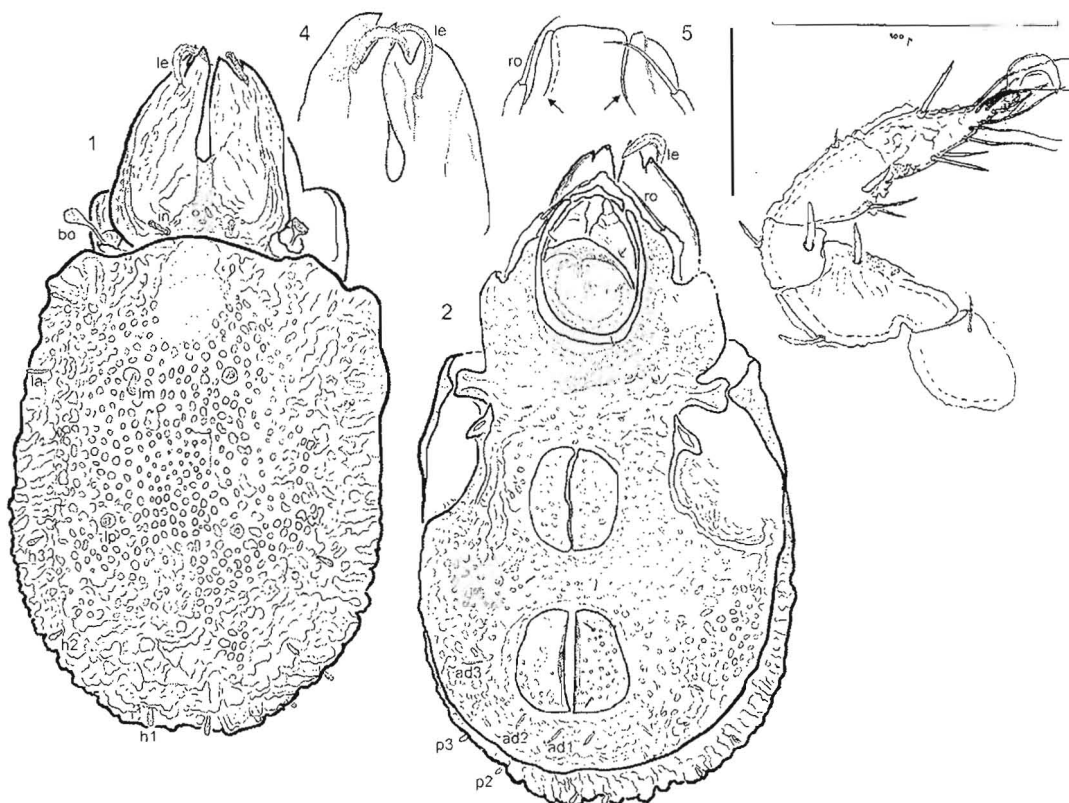


Fig. 7. *Scutoribatus perornatus* SELLNICK, 1918 (Unduloribatidae), a representative figure of adult dorsal and ventral view to show minuteness of interpretation (SIDORCHUK & NORTON 2011).

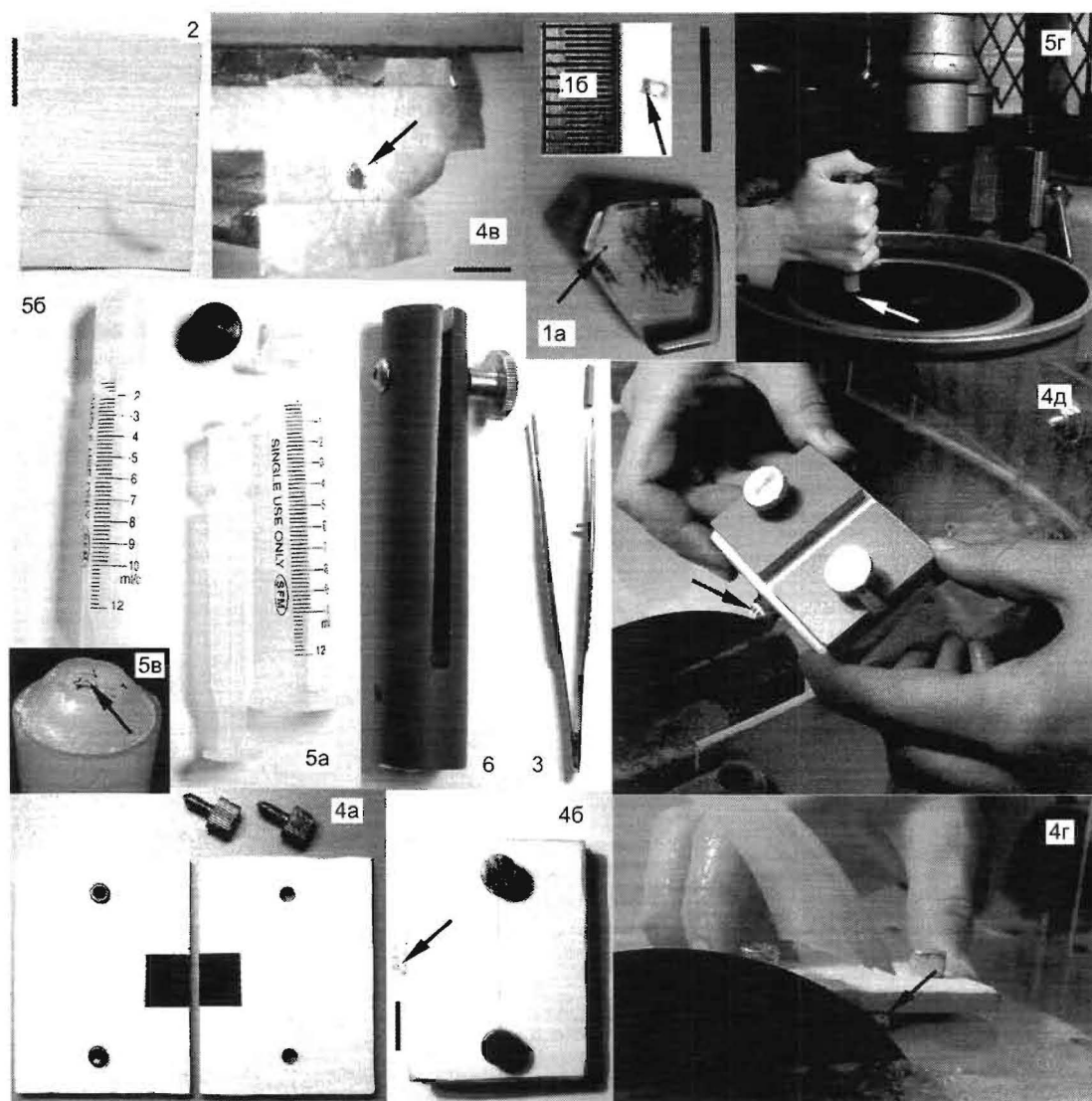


Fig. 8. Set of devices designed to trim and polish extra small amber blocks for microscope study (SIDORCHUK 2011).

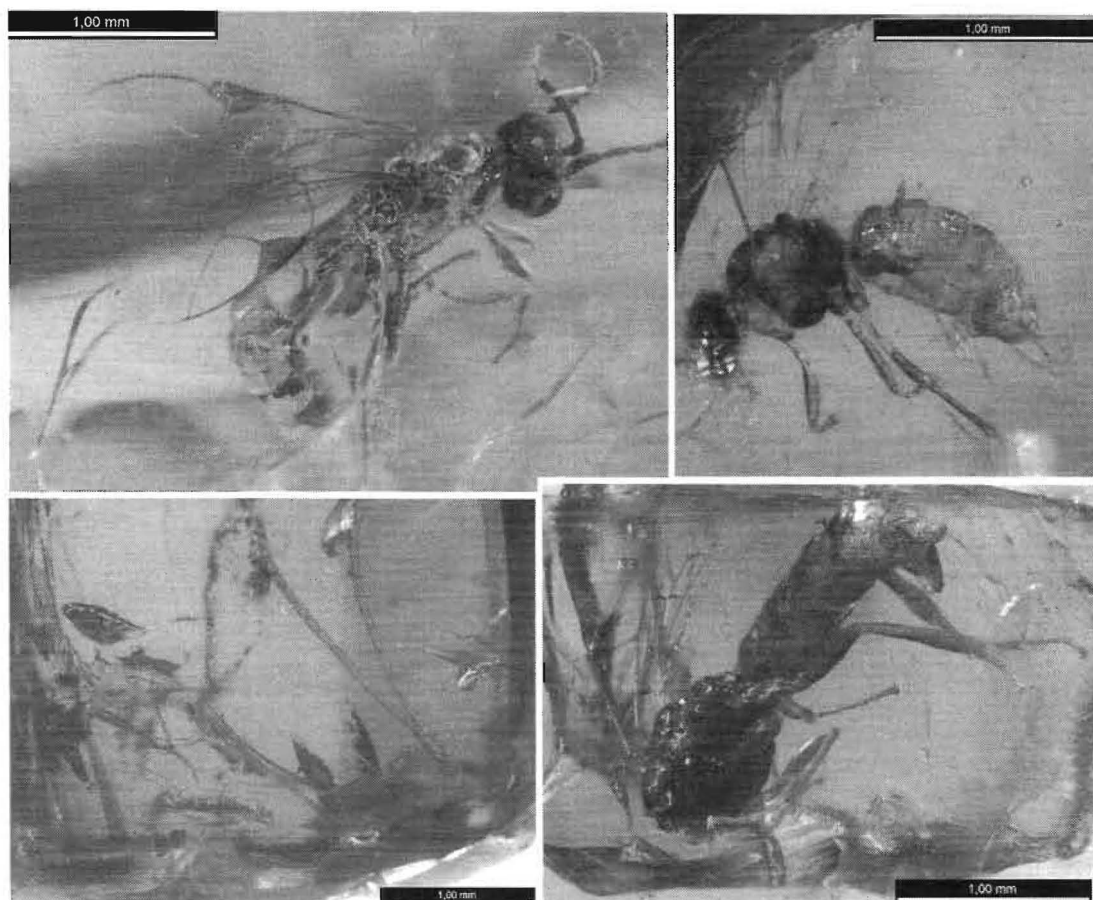


Fig. 9. Miniature Ichneumonidae fossils discovered by Kopylov (in prep.) in various Upper Cretaceous resins of North Siberia.

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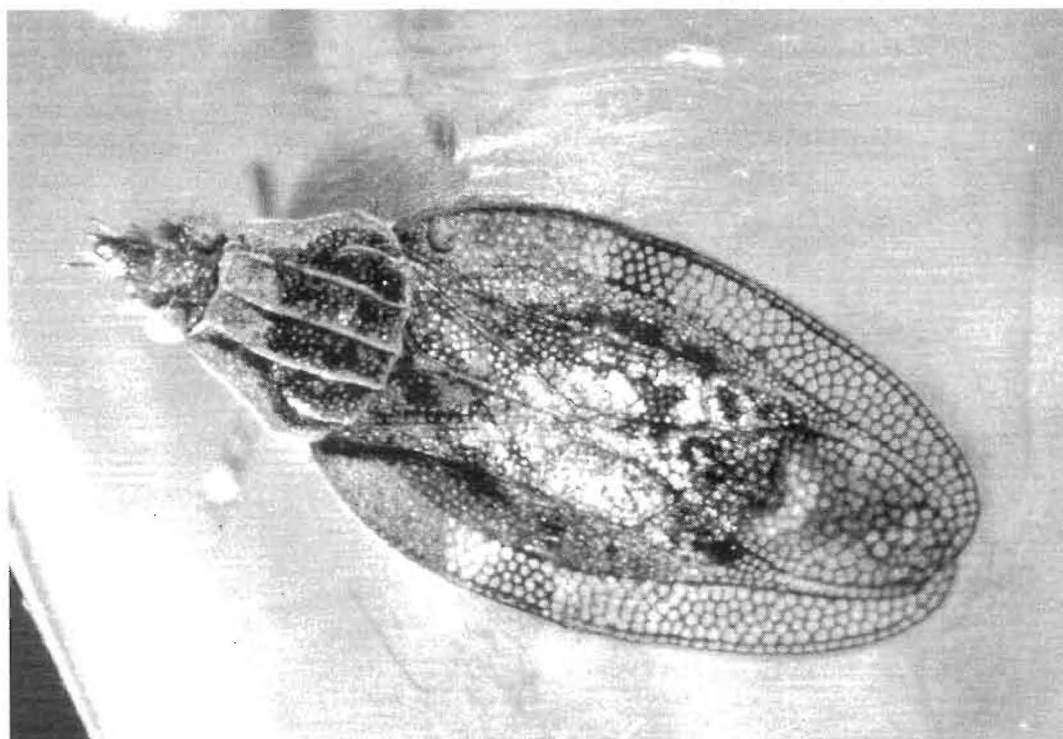
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