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Report

Assessment of the scientific value of Mrs Karin Nordmann Ernst's amber collection (NCIR), Skagen, Denmark

Introduction

Amber is amorphous mixture of organic compounds, defined as solid, discrete material derived from resins exuded from prehistoric trees then fossilised, formed through a complex series of physical, chemical and geological processes over millions of years. The expression amber is regarded in principle as a collective term for solidified resins of various botanical, geographical and geological origin, differing in physical and chemical properties, hardness, colour, and clarity. Deposits of fossilised resins are found in several regions around the world and ambers (and other fossilised and semi-fossilised resins) originate from plants of various families both gymnosperms and angiosperms. The resin, when exuded, was a trap for many organisms and their parts, these impurities, called inclusions, together with fractures, stress lines, blemishes, bubbles, etc. are witnesses of ancient world and processes changing viscose resin to hard amber. The oldest amber comes from Carboniferous period, 320 Mya, from North America, the oldest amber with insect inclusion comes from the Late Triassic of Italy, 230 Mya. Baltic amber is the largest group of fossilised resins from Europe, the most common and the most investigated kind of amber, with an estimated age of 47-37 Ma, from the Eocene epoch. The origin of Baltic amber is located mainly in former area of Fenno-Sarmatia (Scandinavian Peninsula and northern part of European Russia), but deposits in Rivne in Ukraine, Górká Lubartowska in Poland and Bitterfeld in Germany originated in the areas on the southern banks of the Eocene Paratethys and Northern Sea. The inclusions of plants and animals in Baltic amber give the unique opportunity to know and understand the past habitats, their biotic composition and changes, at the times of global environmental and climatic changes, from warm and wet hot-house conditions to dry and cool ice-house at terminal Eocene.

The collection

The amber collection of Mrs Karin Nordmann Ernst consists of about 58,000 pieces of amber. This is the Baltic amber collection, with specimens gathered in various localities: Denmark, Baltic coast (Poland, Russia, Lithuania), Bitterfeld in Germany and Ukraine, purchased from companies, amber collectors and exchanged

with the others. The collection was formed during last 40 years and it is one of the biggest, if not the biggest private collection of Baltic amber and Baltic amber inclusions. The collection is very rich, comparable to or richer than most public museum collections (e.g. Museum of the Earth, Polish Academy of Sciences in Warsaw houses ca. 25,000 amber specimens, incl. ca. 15,000 inclusions; Museum of Amber Inclusions, University of Gdańsk, ca. 16,000 specimens with inclusions; Naturkunde Museum Stuttgart, houses, ca. 30,000 specimens (inclusions in Baltic, Dominican, Lebanese and other ambers), Naturhistorisches Museum in Berlin, ca. 60,000 specimens of amber from Baltic and Bitterfeld, deposits, Geowissenschaftliches Museum of Göttingen University houses ca. 16,000 Baltic amber objects (inclusions, archaeological and art pieces) + ca. 3000 of Bitterfeld of about 100,000 collected in the former Königsberg Amber Collection). The inclusions preserved in the NCIR collection cover all the major groups already known from Baltic amber: plants (which are in general rare among the inclusions in Baltic amber), fungi, remnants of vertebrates, e.g. bird's feathers; the vast majority of inclusions are arthropods: insects, spiders, myriapods, etc. Part of the collection, ca. 8% (about 4300 specimens) is identified to family level by Dr Stig Andersen (ZMUC Copenhagen) - mainly flies, Collembola, part of Hemiptera, some families e.g. long-legged flies Dolichopodidae are preliminarily checked and identified by Dr Dan Bickel, Australian Museum, aphids (Hemiptera, Aphidomorpha) by Professor Ole E. Heie (NHMD), scale insects (Hemiptera: Coccidomorpha) by Professor Jan Koteja (Agriculture University in Kraków), spiders (Araneae) partly examined by Dr Jörg Wunderlich.

Taxonomic content

The taxonomic structure of the collection reflects the frequency of particular groups found as Baltic amber inclusions. The dominating group of the inclusions are various flies (Diptera), especially nematoceran flies. A number of families are identified, the most common are nematocerans, e.g., Chironomidae, Ceratopogonidae, Cecidomyiidae, Mycetophilidae, less common are Limoniidae, Sciaridae, Psychodidae and relatively rare are, e.g., Simuliidae; the most common brachyceran flies are Dolichopodidae, Empididae, more rare are Keroplatidae, Rhagionidae and Phoridae, very rare are Diopsidae. Important part of the collection are inclusions of various beetles (Coleoptera), including rare among inclusions families Melandryidae and Mordellidae; bees, wasps, ants and relatives (Hymenoptera) and hemipterans, e.g., aphids, scale insects, planthoppers, leafhoppers and true bugs (Hemiptera). The very interesting and valuable part of the collection is inclusions of Collembola (often neglected in the collections), cockroaches (Blattodea) and termites (Isoptera), the two latter groups being important for reconstructions of biotas and conditions of the ancient Baltic amber forests. The collection houses also very exclusive inclusions: stick insects (Phasmatodea), bees (Hymenoptera: Apoidea), twisted-wing parasites (Strepsiptera). It must be pointed out that almost all insect orders already listed as inclusions in Baltic amber are represented in the NCIR collection. Important part of the collection are representatives of other arthropods, especially spiders (Araneae), mites (Acari), pseudoscorpions (Pseudoscorpiones), the two latter groups are still poorly examined. The collection preserves also inclusions of various millipedes and centipedes (Myriapoda) and unique inclusions of woodlice and relatives (Isopoda). The unique and very valuable portion

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of the collection are inclusions of plants, as well preserved specimens with this kind of fossils are rare among Baltic amber inclusions.

Some groups present in the NCIR collection were examined in more detail, including holotype and paratype (reference specimens for scientific descriptions) designations, e.g. wasps of the families Platygastridae: *Acerotella krylovi* Buhl, *Fidiobia microscopica* Buhl, *Inostemma methusalem* Buhl, and Diapriidae: *Synacra microptera* Buhl, *Acropriesta janzeni* Buhl, some species of spider families Linyphiidae and Cyatholipidae described by Wunderlich. Roughly estimated number of specimens already designated as types counts about twenty (number of specimens are still under formal description), but this number will surely be greatly multiplied with future research.

Of separate and special value of the collection is the rich portion of amber from Bitterfeld deposit in Germany. This locality is no longer available for collecting, and only a few institutions house substantial numbers of specimens which could be representative for this deposit. The NCIR collection houses about 1500 pieces of Baltic amber from this locality, placing it among the richest and most representative collections of amber from Bitterfeld in Europe.

Perspectives

The NCIR collection is of great potential, interest and value for taxonomic investigations. It could be the base of short-term, descriptive works and long-term phylogenetic and evolutionary research projects. Its value is not only in its content of various taxonomic groups, but also in diversity and representativeness of arthropods, other invertebrates and plants. The number of new species which could be discovered and described from this collection is hard to estimate, but if compared with figures from other collections it could run to hundreds of new species. This collection gives important opportunity to trace taxonomic diversity of extinct biota of the Baltic amber forest. Another point must be addressed in respect to the specimens housed in NCIR collection – it is a wide perspective of studies on morphological disparity represented by the inclusions. The taxonomic diversity and morphological disparity of the organisms preserved as inclusions is a source for description and understanding of the ancient ecosystem of the Baltic amber forest. The inclusions present not only taxonomic or morphological value – thanks to the unique character of preservation in resin, we are able to trace also behavioral aspects of ancient organisms. Examples of such palaeobehaviors are also represented in the NCIR collection, e.g. swarming behavior, reproductive behavior, developmental stages and processes, phoretic and parasitic associations between organisms, etc.

The NCIR collection of amber from Bitterfeld deposit gives the unique opportunity for comparative studies with Baltic amber from other deposits at Baltic coast, Denmark and Ukraine. These could cover taxonomic and evolutionary investigations, but also palaeoecological, palaeoclimatological and palaeobiogeographical ones. The rich sample of amber from Bitterfeld is of special value not only for biological and palaeontological studies, it could be studied in terms of its chemical and physical properties, botanical origin (possible explanation of higher ratio of accessory resins in the Bitterfeld deposit), geochemical investigations etc.

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The wide range of research projects which could be based on this collection are not limited to taxonomic and ecological ones, focused on insects, other invertebrates or plants. The collection could be a very good base for studies in taphonomy – processes of fossilization and preservation of fossils, analyses of syninclusions, their frequency, gathering data for palaeoecological and palaeoclimatological reconstructions and models. The collection covers various types of resin leakages: layered, drops and droplets, icicles, etc. and these aspects should be also be investigated and considered in reconstructions of Baltic amber forests palaeohabitats. Last, but not least another aspect of extreme value of this collection is possibility to use it in museum studies on compartment of amber in deposit and after its extraction, influence of various conditions on amber specimens, preparation, preservation and conservation of amber material, prevention from deterioration, and permanent storage in the scientific and museum collections.

Conclusion

The amber collection of Mrs Karin Nordmann Ernst (NCIR) could be placed among the most valuable, important and interesting collections deposited in various museums and institutions in Europe and in the World. It is of great importance for science and humanity, and presents enormous potential for scientific investigations in areas of biological and geological sciences as taxonomy, morphology, palaeoecology, palaeobiogeography, palaeontology, taphonomy, analytical sciences as chemistry and physics, interdisciplinary museology investigations and humanities. This collection is unique, very interesting for scientists and public, important for its scientific content and deserves to be preserved in the NHMD collection as a national and world heritage.

The undersigned of present report

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- | | |
|--------------------------------|--------------------|
| books | 2 |
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