

Traces of the interspecies interactions of mites (Acari) in the fossil record as a model of paleoecological and paleobiogeographical research

Mites are a group of diminutive arachnids (the length of their bodies usually does not exceed one millimeter), which inhabit the Earth since its first Palaeozoic terrestrial ecosystems. Although the awareness of the multiplicity of roles and their numerosity in the environment remains poor (except, i.a., those of relevance to our health, e.g., ticks, dust mites), biodiversity research indicates the immense richness of morphological, ecological, and behavioral forms, as well as their considerable participation in the functioning of those systems. These animals are involved in many different interspecific interactions, an example of which is a phoresy or the movement of mites with the aid of larger animals (especially insects) into new, often ephemeral (short-lived) environments. Acari remain the least-studied group of arthropods despite described ca. 55 thousand species, this is especially true for their sparse fossil record, whose formal description includes only about 260 fossils (not each of them is a separate species). Most fossil specimens occur as inclusions in amber. Amber is the name of resins, which at first had leaked from the trees of ancient forests, then, they were deposited into the sediment in which the process of fossil formation and structural change of the substance occurred. The sticky resin was a trap for small organisms that embedded inside it. Despite the passage of millions of years, these organisms left remains and their holographic imprints recognized as inclusions. Besides, traces of intra- and interspecific interactions (copulation, predation, parasitism, phoresy, etc.) have been recorded in amber, providing valuable information on the ecology and behavior of components of past ecosystems. Many inclusions are characterized by an ideal offprint of the original organisms, and therefore, they are available for research (especially morphological) almost in a form like their present-day relatives.

The project aims to study the traces of interspecific interactions of mites with other organisms in the fossil record, to use them as a model of paleoecological and paleobiogeographical research. Hence, answers for the following questions will be obtained:

1. Does the nature of traces of fossil interspecific interactions between mites and other organisms display any differences with those recognized nowadays?
2. How different is the distribution of mite genera (and families) and organisms they interact with, present in the fossil record and those living today?

Firstly, in order to conduct the project, the most valuable paleontological collections located in European and American museums will be visited to explore and complement the research material. Amber nuggets will be subjected to grinding methods in order to obtain smaller samples, suitable for beneficial microscopic observation of microinclusions. One of the tools for this purpose will be a stereoscopic microscope, planned for purchase in the project, with a large (almost 300 times) magnification. The high-resolution images obtained at this stage will be the basis for the interpretation of recorded interspecific relationships and then for the preparation of manuscripts of scientific publications. Also, a visit to the synchrotron radiation center is planned, in which microtomography techniques will allow obtaining 3D models of inclusions. Hence, classical taxonomic studies will be enriched with the use of additional imaging methods.

As a result of the project, discoveries of new mite groups for science are expected, as well as descriptions of unpublished traces of interspecies interactions between mites and other organisms. Thanks to the results obtained and the analyses carried out, our knowledge will be extended by an outline of the partial structure of extinct ecosystems, the nature and age of parasitic, phoretic relationships, etc. and possible indirect traces of relations between plants and mites. Analysis of the past and present distribution of organisms will allow formulating hypotheses about changes in acarofauna, not only in the spatial context but also in time. The implementation of the project may outline further research directions in paleoacarology, a niche science, but the interdisciplinary one which sets new, ambitious challenges in order to discover the fragments of performances taking place on our planet millions of years before our debut.