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KEYNOTE

The preservation of the insect record – complementing amber.

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The extraordinary record of insects as amber inclusions tends to steal the paleoentomological show but other Konservat Lagerstätten extend the data base in time and space, and in ecological settings. Much remains to be learned about the impact of taphonomy on our knowledge of the evolutionary history of insects. New discoveries, morphological studies, imaging techniques, geochemical analyses, and experiments all have a role to play in interpreting biases and targeting settings to fill the gaps.

Fossil leaves reveal drivers of herbivore functional diversity during the Cenozoic

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Herbivorous arthropods constitute the overwhelming majority of multicellular species on Earth. Identifying the factors that contribute to this diversity could help to understand the mechanisms that generate and maintain biodiversity. Here, we fit a general model of diversity to fossil data on herbivore-induced leaf damage from the Cenozoic. We show that partitioning of host plants by functional groups of herbivores rather than host plant diversity was the dominant driver of dynamics in herbivore functional diversity. Our study provides a paleoecological perspective on the long-standing debate about the importance of herbivore specialization and plant diversity in driving the functional diversity of herbivorous arthropods.

Mitehunter: Studies on Ectoparasitic Mites and Their Hosts in Amber Inclusions

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Mites (Acari) are among the most frequently reported organisms displaying parasitic behaviour in amber. Still, fossil mites remain relatively understudied. The larvae of the group Erythraeoidea (long-legged velvet mites; ingroup of Parasitengona) are parasitic on other representatives of Euarthropoda. Here we present our current studies on the shape variation of the larvae of Erythraeoidea from fossil to extant representatives, as well as their aggregations found in amber. We also show amber syninclusions revealing host-parasite associations between representatives of Diptera and mites.

Novel aquatic insects' fauna from Miocene of Australia

Viktor Baranov, Michael Frese, Robert Beattie, Tara Djokic and Matthew R. Mccurry

In this communication we are presenting a diverse aquatic insect fauna from McGraths Flat, a Miocene Lagerstätte in central New South Wales, Australia. The aquatic insect fossils from this deposit consist predominantly of larvae. These include a new species of phantom midge (Chaoborus abundans Baranov, Frese et McCurry **sp. nov.**). The large number of fossil specimens allowed us to study the ontogeny of this midge species. We discerned growth rates in fossil larvae, using morphometry of all four instars of Chaoborus. The presence of taxa associated with still water, together with those normally associated with flowing water, supports the hypothesis that McGraths Flat was deposited in an isolated waterbody (oxbow lake/billabong) with influence from a river during high-water events.

The morphology of metamorphosis in arthropods – a before and after

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Metamorphosis in arthropods describes a highly complex molting process with substantial morphological change, although a precise definition of the term is more complex. Substantial morphological change however can be quantified. Here, we show examples of morphological changes throughout development that show that metamorphosis can be substantial, but non-metamorphic molts can be substantial as well. We highlight these aspects based on examples of the groups Neuropteriformia and Brachyura.

Palaeo-Venomics: was, wie, warum?

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Venomics ist eine Disziplin, die sich mit der Evolution, Chemie, Physiologie, Morphologie und anderen Aspekten giftiger Tiere beschäftigt. Giftige Tiere, die Beute töten oder lähmen oder Angreifer abschrecken, gibt es bereits seit Millionen von Jahren. Bei fossilen Tieren kann im Bereich Venomics vor allem die funktionelle Morphologie im Mittelpunkt und darauf basierend rekonstruiertes Verhalten stehen. Hier werden verschiedene Beispiele fossiler Tiere diskutiert, die Giftinjektionsapparate besitzen, und wie diese Fossilien dazu beitragen unser Verständnis von Gifttieren zu verbessern.

Diversifications and extinctions of “flying crustaceans” and how to recognise them

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Pterygota, the group of “flying crustaceans”, represents a major share of the modern biodiversity. Therefore, understanding the diversifications and extinctions within this group should be of central importance for biodiversity research. I explore different methods that may inform us about increase and decrease of pterygotan diversity: e.g. taxonomic measures, phylogenetic reconstructions, quantitative morphology. These differ in sensitivity for different aspects and therefore provide (sometimes diametrically) different signals. Fossils play a crucial role in improving this situation.

New Wing Venation Terminology of Phoridae: An Evolutionary Perspective from the Cretaceous to the Present

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The study of phorid wing venation characters, particularly within the fossil record, is crucial to understanding the evolutionary diversity of this group through time. It also provides insight into the potential evolutionary pressures they may have faced and sheds light on their relationships with other phorid outgroups. Our initial approach, incorporating established and newly discovered fossil data in conjunction with a thorough literature review, has highlighted certain challenges associated with the wing terminology used in species descriptions. In addition, this re-evaluation has highlighted the relatively low variability of radial and medial wing veins in ancient specimens compared to their modern counterparts.

Flohzirkus – Übersicht der Flöhe (Siphonaptera) im Baltischen Bernstein

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Parasiten wie Zecken und Flöhe sind als ...en erhalten. Aktuell sind aus dem Baltischen und Bitterfelder Bernstein 9 ... bekannt, weitere aus dem Dominikanischen und Burma Bernst...

Die Inklusen wurden in die rez... ...tenophthalmidae gestellt. Beschriebene Arter... ...910), *Palaeopsylla dissimilis* Peus (1968), ...nderlich (2001) und *Palaeopsylla groehni* Be... Museen ebenso wie *P. dissimilis* aus der Bit... ...are liegen in drei privaten Sammlungen, die ... ...einem Fall als neues Taxon ansprechen lass...

Es werden di... ...u den beschriebenen Taxa diskutiert und auf die... ...nigen Inklusen hingewiesen.

Reconstructing raptorial behaviour based on fossils: Examples of insects in amber

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Fossil insects in amber can [illegible] the past, their morphology, distribution ar[illegible]. Especially in the reconstruction of food w[illegible] representatives is a crucial aspect. Howev[illegible]sils directly, approaches using cases such a[illegible]lues from morphology are helpful. In this pr[illegible] predatory lifestyle of insects preserved in a[illegible]

Inductive vs. Deductive Reasoning: Sherlock Holmes' Connection to Insects in Amber

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Amber inclusions from rare cases where individuals were enclosed in resin during oviposition, mating, or other interactions (‘frozen behaviour’) as well as morphology, trace fossils or the inclusion of several individuals can provide information on lifestyle and behaviour of extinct insects. As no direct observation is possible, there is a high risk of misinterpretation and a differentiated analysis important. We present amber inclusions of different ages that can lead to possible misinterpretations and discuss methods for reconstructing behaviour and lifestyles based on fossil insects.

Fossil record of lithobiomorphan centipedes, new representatives of Henicopidae from Kachin amber

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Chilopoda (centipedes) is a species-rich group of exclusively predatory animals, presenting a transformation of their first pair of trunk appendages into venom claws. Their fossil record goes back to the Silurian period, but it is scarce and unequal between the ingroups. We described three new fossils of lithobiomorphan centipedes, from different ontogenetic stages. Their exceptional state of preservation within Kachin amber, Myanmar (~110 Ma) allows for the recognition of even minute characters. We also discuss the general fossil record of centipedes.

ARTHROPOD-NEWS FROM THE UPPER CARBONIFEROUS PIESBERG SITE NEAR OSNABRÜCK (LOWER Saxony, Germany)

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New Holotype insect wings, published since 2021 are 5 Palaeodictyopterida, 2 dragonflies, 3 Archaeorthoptera and 1 caddisfly-like holometabolan.

Yet undescribed insect fossils are: a Palaeodictyopteran nymph, a palaeodictyopteran probably related to Lithomanteidae, an Archaeorthoptera with sickle-shaped ovipositor. First records for the Piesberg are a Blattinopsid, a tiny wing, related to Psocidiidae and an Apterygote.

Some arthropods are presented: the real spider *Arthrolycosa wolterbeeki* **nov. sp.**; nearly complete Phalangiotarbid and scorpion and the first Piesberg record of an Eurypterid.

All shown Arthropods and former published ones give a glimpse into the highly diverse fauna of the Upper Carboniferous Piesberg site.

Larvae of Neuropteriformia over different time periods

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The fossil record provides clues to improve our understanding of the changes in biodiversity. Of the diverse group Holometabola representatives are known from ambers of different ages. The holometabolan ingroup Neuropteriformia comprises five larger groups, among them beetles. The larvae of neuropteriformians often fulfil very different ecological functions than their adults. Hence, it is important to consider the larvae for a better understanding of the evolution of ecosystems and diversity. Here, fossil larvae from the Triassic onwards were considered to reveal changes in diversity over time.

Plastic Underground: Preservation of soil organisms in amber

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Soil organisms play a crucial role in modern terrestrial ecosystems as they maintain a range of ecological functions and take part in numerous biogeochemical cycles. We can expect that they were of similar importance in past ecosystems, but we are lacking information to evaluate these assumptions, as soil does often not represent an ideal habitat for fossil preservation. We report some cases of soil organisms preserved in amber. Among them are especially many representatives of the group Insecta and especially also larval forms of beetles and other holometabolans.

Comparative analysis of entrapment bias in distinct resin-producing tree taxa

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Amber is renowned for its remarkable preservation of biological inclusions. However, not all sedimentary amber deposits yield such inclusions, and the abundance of entrapped organisms can vary considerably due to ecological and taphonomic factors. In this study, we carried out a comparative analysis of arthropod inclusions in resin samples obtained from *Agathis* (gymnosperm, New Caledonia) and *Hymenaea* (angiosperm, Madagascar) trees, and in sticky traps placed at different heights on the trunks of these two tree genera. Our aim was to understand the main factors influencing resin entrapment over different geological time periods. Surprisingly, we found that resin collected from *Agathis spp*. trees contained only a limited number of bioinclusions. In contrast, the abundance of arthropods in *Hymenaea verrucosa* resin was unexpectedly high. These results highlight the importance of considering inclusion bias and the faunal composition of different environments when reconstructing palaeontological scenarios.

Changes in morphological diversity of Palaeozoic immatures of Insecta

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The group Insecta is dominating most modern non-marine ecosystems and started to diversify during the Carboniferous. Because most modern insects spend the majority of their life span as immatures, the ontogeny and especially immature stages are of high importance for understanding the evolutionary success of the group. We used quantitative morphology, more exactly shape analyses of the whole body and different body regions to assess the morphological diversity of immatures during the Palaeozoic. The results indicate evolutionary quantitative changes from the Carboniferous to the Permian.

The first social wasp (Vespidae: *Vespula*? *hassiaca*) from the Eocene fossil site Messel

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The fossil wasp *Vespula? hassiaca* was described by Abels & Wedmann (2022) from the Eocene Fossillagerstätte Messel in Germany. The species can be assigned to the eusocial vespine wasps with high confidence, but assignment to the genus is not so sure. Analysis of the fossil specimen was done both with classical morphological methods as well as geometric morphometrics. Social wasps are very rare in the fossil record.

Abels, J. & Wedmann, S. (2022): A fossil wasp (Hymenoptera: Vespidae: *Vespula? hassiaca*) from the Eocene of Messel. Palaeontographica A, 323: 105-117.

Brood care in Jurassic water boatman *Karataviella popovi*'

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Brood care enhances offspring fitness and survival, has evolved independently multiple times in animals. However, few fossil insects document such an ephemeral behavior directly. New exceptional fossils of the water boatman *Karataviella popovi* from the Middle–Late Jurassic Daohugou biota of China, with adult females bearing clutches of eggs on their left mesotibia, representing a unique brooding strategy and the earliest direct evidence of brood care among insects. Besides, the specialized trawl-like filter-capture apparatus of *K. popovi* probably represents pre-adaptions originally used for trapping coeval anostracan eggs for food.

Wood-associated larvae in different ambers

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Wood-associated beetle larvae lead secluded lives, hidden within the wood tissues. However, even within a single wood, the larvae show differences in lifestyles and feeding habits. Some bore within hardwood or softwood, some feed on fungi-infested wood, and some are predaceous. This holds true also for ecosystems of the past. Based on their food such beetles show differences in mouthparts. Some have additional specializations for feeding, for example, spoon-like mandibles or sucking mouthparts. We show here the morphological diversity of wood-associated beetle larvae in different ambers