Research sheds light onto the debut of insect life on Earth

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(Phys.org) —"Insects dominate our world," according to University of Kansas researcher Michael Engel. Thus, anything scientists can learn about the evolution of insects leads to a better grasp of how biology in general has changed over time.

"More than half of all known species on the planet are insects, and they rule virtually all terrestrial and freshwater ecosystems," said Engel, a professor of ecology and evolutionary biology. "Many insect lineages are ecologically ubiquitous—such as bees, ants, termites—and they impact our daily lives in a big way. They pollinate our crops; they are the

sources of many of our medicines or other chemicals; and some are tied to the spread of disease."

Understanding the factors that led to insect origins and fueled their successes, as well as what pushed particular groups to extinction, such as the influence of climate change, is vital to human health and security.

Engel has just co-authored a paper in the prestigious journal *Nature* that sheds new light on the evolution of the Eumetabola, a scientific term for the group of organisms that includes most insect species.

"Beetles, bees, ants, wasps, flies, butterflies, moths, fleas, lacewings, lice, thrips, aphids, true bugs and all of their close relatives are eumetabolous insects," said Engel. "If you are talking about insects, then you are likely talking about a eumetabolan insect."

The researcher, who also serves as a senior curator at KU's Biodiversity Institute, said that in spite of the importance of this group of insects, their earliest origins have been difficult to pin down.

"There's been a lack of identifiable fossils from the Carboniferous Period or earlier deposits," Engel said. "Until now, the first definitive specimens assignable to the Holometabola, the big chunk of the already massive Eumetabola, were from the early Permian—but those aren't the most primitive of their kind, except in a few cases, and pointed to much earlier diversification events. From the Carboniferous, the immediately preceding time period, we only had specimens of much more primitive insect lineages. "

The size of the fossils makes them difficult to detect, according to Engel.

"They're tiny, so unless you are hunting for them, they would be easy to

overlook," he said. "Also, fossils from these deposits aren't preserved with a strong contrast between them and the surrounding rock. Thus, it takes specialized lighting to get them to easily pop out."

Nevertheless, Engel and his co-authors in Nature describe newly discovered specimens and fragments that can be confidently tied to holometabolan lineages. More significant, the specimens are not of the typical orders but are far more primitive.

"For example, there's a species related to the lineage that eventually would give rise to the wasps in Triassic," he said. "It wasn't a wasp itself and instead would look more like some kind of generalized primitive group, but it already had a few of the evolutionary novelties that would later be part of the order of wasps, ants and bees."

Among the other five species Engel and his colleagues describe in Nature, one is an early relative of true bugs and their relatives; one is an early relative of barklice, and then ultimately true lice; and one is an early relative of the lineage that would give rise to the beetles in the Permian.

KU is a leader in paleontology generally, and Engel's lab is one of a few worldwide with expertise in the fossil record of insects—and, among those labs, an even smaller subset have sufficient expertise in the Paleozoic.

Engel said an understanding of ancient development and origins of insects is vital for an understanding of our modern world.

"Our own evolution—biotic and cultural—is inextricably woven into the lives of insects," he said. "Insects have been on the planet for at least 410 million years and were first to fly, first to develop agriculture and first to form complex societies. We like to talk about the 'Age of Dinosaurs' or

the 'Age of Mammals,' but all of these are greatly dwarfed by an overarching 'Age of Insects.' If humans vanished from the Earth it would have only a beneficial effect on the greater biota. If insects disappeared, then life itself would struggle to persist."

Provided by University of Kansas