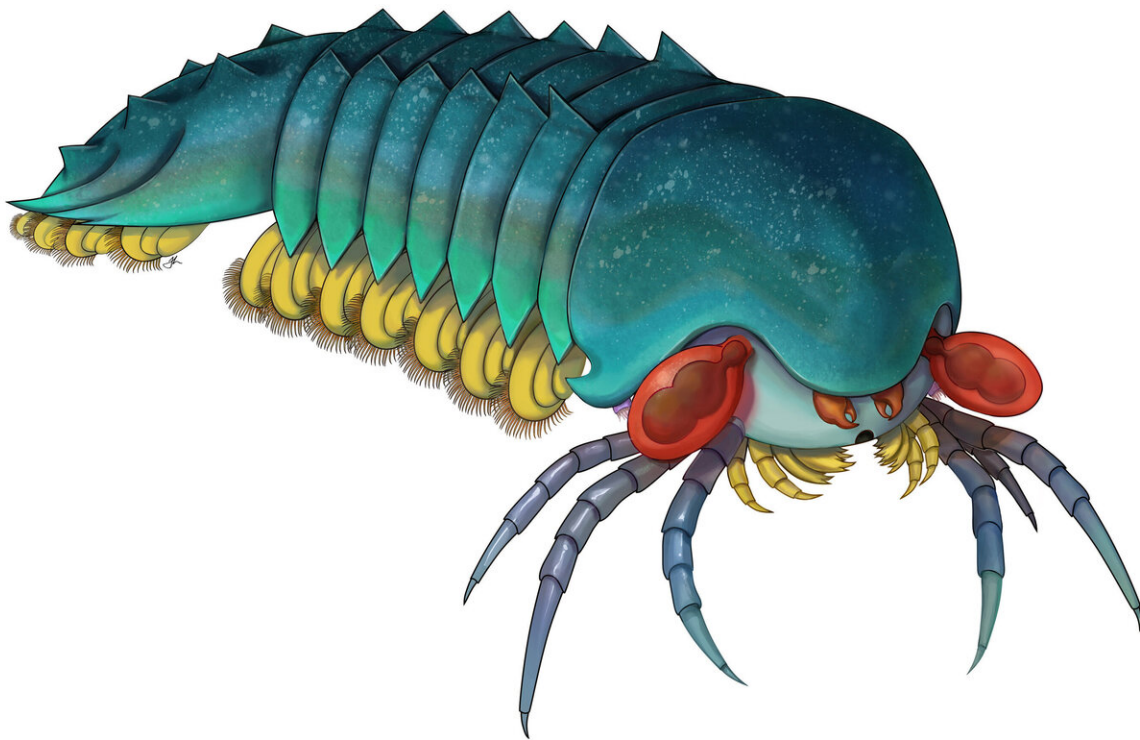


Half-a-billion-year-old tiny predator unveils the rise of scorpions and spiders

September 11 2019



Reconstruction of *Mollisonia plenovenatrix*, by Joanna Liang. *Mollisonia* was only about 2.5 cm long. Credit: Joanna Liang, © Royal Ontario Museum

Two palaeontologists working on the world-renowned Burgess Shale have revealed a new species, called *Mollisonia plenovenatrix*, which is presented as the oldest chelicerate. This discovery places the origin of this vast group of animals—of over 115,000 species, including horseshoe crabs, scorpions and spiders—to a time more than 500 million years ago. The findings are published in the prestigious journal *Nature* on September 11, 2019.

Mollisonia plenovenatrix would have been a fierce predator—for its size. As big as a thumb, the creature boasted a pair of large egg-shaped eyes and a "multi-tool head" with long walking legs, as well as numerous pairs of limbs that could all-together sense, grasp, crush and chew. But, most importantly, the [new species](#) also had a pair of tiny "pincers" in front of its mouth, called chelicerae. These typical appendages give the name to the group of scorpions and spiders, the chelicerates, which use them to kill, hold, and sometimes cut, their prey.

"Before this discovery, we couldn't pinpoint the chelicerae in other Cambrian fossils, although some of them clearly have chelicerate-like characteristics," says lead author Cédric Aria, a member of the Royal Ontario Museum's Burgess Shale expeditions since 2012, and is presently a post-doctoral fellow at the Nanjing Institute of Geology and Palaeontology (China). "This key feature, this coat of arms of the chelicerates, was still missing."

Other features of this fossil, including back limbs likened to gills, further suggest that *Mollisonia* was not some "primitive" version of a chelicerate, but that it was in fact already close morphologically to modern species.



Mollisonia plenovenatrix preserved in dorsal view, showing the large eyes, the walking legs and the small chelicerae at the front. Credit: ROMIP 62978, Jean-Bernard Caron© Royal Ontario Museum

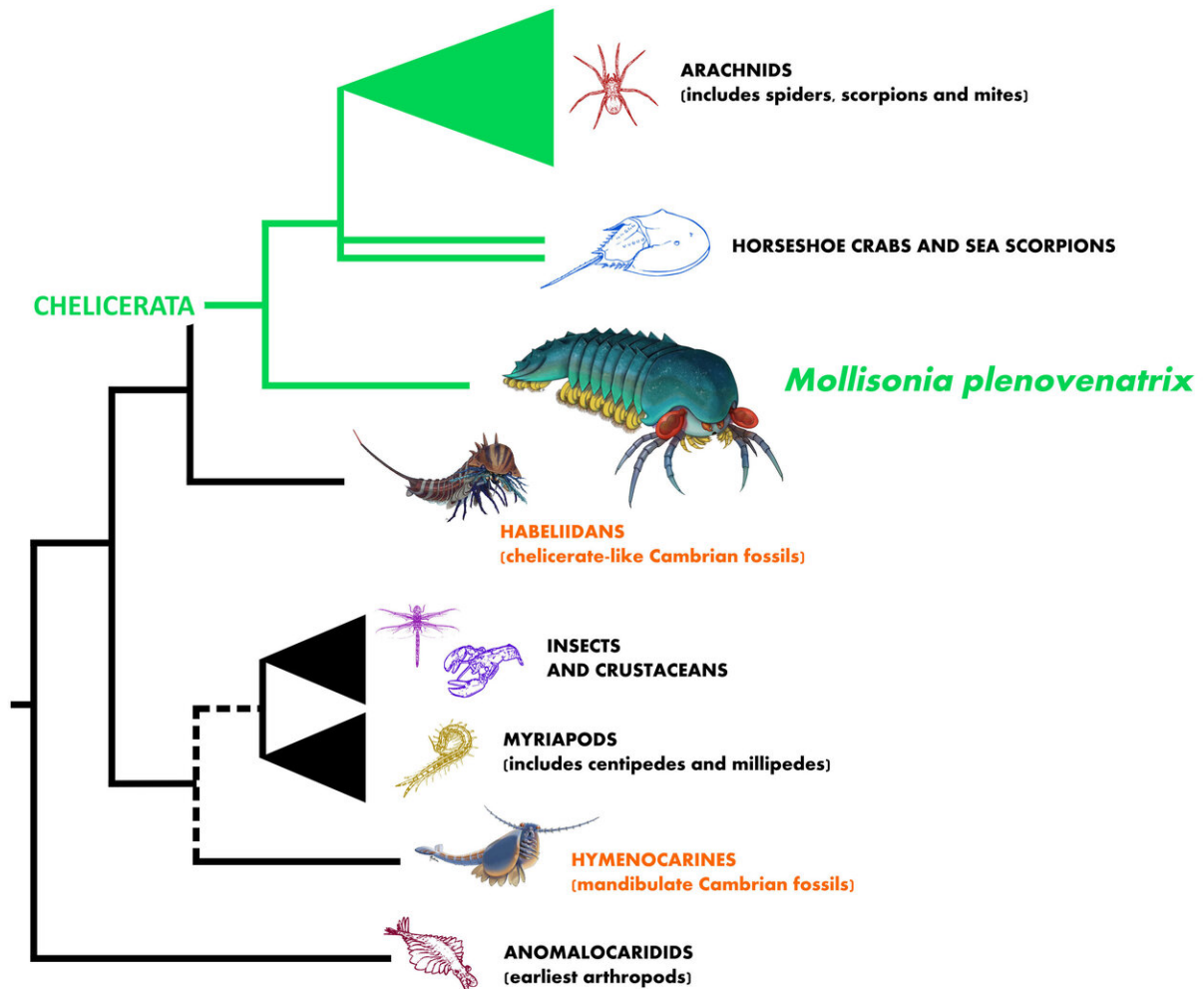
"Chelicerates have what we call either book gills or book lungs," explains Aria. "They are respiratory organs made of many collated thin sheets, like a book. This greatly increases [surface area](#) and therefore gas exchange efficiency. *Mollisonia* had appendages made up with the equivalent of only three of these sheets, which probably evolved from simpler limbs."

The authors believe that *Mollisonia* preferentially hunted close to the sea floor, thanks to its well-developed walking legs, a type of ecology called benthic predation. Because *Mollisonia* is so modern-looking, chelicerates seem therefore to have prospered quickly, filling in an ecological niche that was otherwise left poorly attended to by other arthropods at that time. The authors conclude that the origin of the chelicerates must lie even deeper within the Cambrian, when the heart of the "explosion"

really took place.

"Evidence is converging towards picturing the Cambrian explosion as even swifter than what we thought," says Aria. "Finding a [fossil site](#) like the Burgess Shale at the very beginning of the Cambrian would be like looking into the eye of the cyclone."

The importance of the Burgess Shale and similar deposits, such as the Chengjiang biota in China, lies in their exceptional preservation of the earliest marine animal communities at a time of uniquely rapid diversification of body forms called the "Cambrian explosion." Fossil animals from these sites are notable for preserving an extensive array of morphological features, such as limbs and eyes, but also guts and, much more rarely, nervous system tissues.



Evolutionary tree illustrating the relationship of *Mollisonia* to other arthropods. This study places it as basal within chelicerates, a group including arachnids (scorpions, spiders, mites, and their relatives), horseshoe crabs and sea scorpions. Certain Cambrian fossils (orange) have played an important role recently in understanding the origin of modern arthropod groups, mandibulates and chelicerates. Credit: Cédric Aria© Royal Ontario Museum

Mollisonia was first described more than a century ago by the discoverer of the Burgess Shale, Charles Doolittle Walcott. However, so far, only rare exoskeletons of this animal were known. "It is the first time that

evidence of the limbs and other soft-tissues of this type of animal are described, which were key to revealing its affinity," says co-author Jean-Bernard Caron, Richard M. Ivey Curator of Invertebrate Palaeontology at the Royal Ontario Museum (Canada). The exceptionally well-preserved fossils come from a new Burgess Shale sites near Marble Canyon, in Kootenay National Park, British Columbia.

"Marble Canyon is the biggest spotlight of my career so far. This area keeps giving us wonderful treasures year after year," says Caron, who has been leading the Royal Ontario Museum's Burgess Shale expeditions for the past 10 years. "I would not have imagined that we could, in a way, rediscover the Burgess Shale like this, a hundred years later, with all the new species we are finding."

The specimens of *Mollisonia plenovenatrix* described in this new research are better preserved than the ones found at the original Walcott quarry that is located about 40 kilometers northwest of the Marble Canyon quarry. Many other fossils found at Marble Canyon and surrounding areas have already played a critical role in our understanding of the early evolution of many animal groups. These notably include the vertebrates, our own lineage, thanks to numerous and exceptionally well-preserved specimens of the primitive fish *Metaspriggina walcotti*. Many new species await to be described; the latest one, a "flying saucer-like" new predatory arthropod with huge rake-like claws called *Cambroraster falcatus*, was just recently published on July 31, 2019.

The Burgess Shale fossil sites are located within Yoho and Kootenay national parks and are managed by Parks Canada. Parks Canada is proud to work with leading scientific researchers to expand knowledge and understanding of this key period of earth history and to share these sites with the world through award-winning guided hikes. The Burgess Shale was designated a UNESCO World Heritage Site in 1980 due to its outstanding universal value and is now part of the larger Canadian Rocky

Mountain Parks World Heritage Site.

Mollisonia will be among the many exceptional fossils from the Burgess Shale planned to be on display in the ROM's future new gallery, The Willner Madge Gallery, Dawn of Life, scheduled to open in 2021.

More information: A middle Cambrian arthropod with chelicerae and proto-book gills, *Nature* (2019). DOI: [10.1038/s41586-019-1525-4](https://doi.org/10.1038/s41586-019-1525-4) , [nature.com/articles/s41586-019-1525-4](https://www.nature.com/articles/s41586-019-1525-4)

Provided by Royal Ontario Museum

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