New 508-million-year-old bristle worm species from British Columbia's Burgess Shale wiggles into evolutionary history

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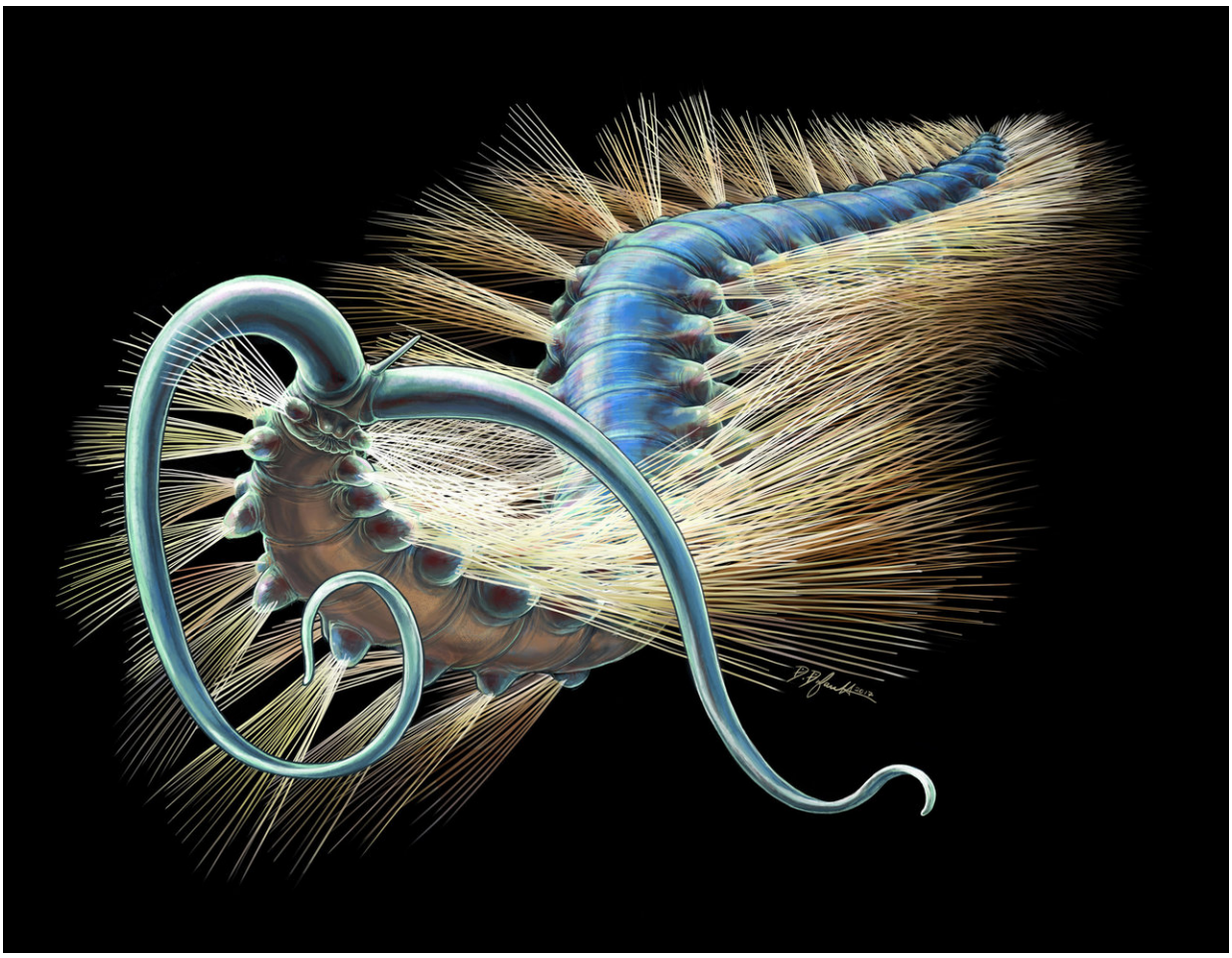

Life reconstruction of Kootenayscolex barbarensis. Credit: Danielle Dufault, 2018 © Royal Ontario Museum

Researchers at the Royal Ontario Museum and the University of Toronto have described an exceptionally well-preserved new fossil species of bristle worm called *Kootenayscolex barbarensis*. Discovered from the 508-million-year-old Marble Canyon fossil site in the Burgess Shale in Kootenay National Park, British Columbia, the new species helps rewrite our understanding of the origin of the head in annelids, a highly diverse group of animals which includes today's leeches and earthworms. This research was published today in the journal *Current Biology* in the article A New Burgess Shale Polychaete and the Origin of the Annelid Head Revisited.

"Annelids are a hugely diverse group of animals in both their anatomies and lifestyles," said Karma Nanglu, a University of Toronto PhD candidate, and a researcher at the Royal Ontario Museum, as well as the study's lead author. "While this diversity makes them ecologically important and an evolutionarily interesting group to study, it also makes it difficult to piece together what the ancestral annelid may have looked like."

Annelids are found in nearly all marine environments from hydrothermal vents to coral reefs to the open ocean, and also include more evolutionary derived species living on land today. Although quite abundant in modern environments, their early evolutionary history, in particular the origin of their heads, is confounded by a relatively poor fossil record, with few species described from well-preserved body fossils near the evolutionary origins of the group.

Co-author Dr. Jean-Bernard Caron, Senior Curator of Invertebrate Palaeontology at the Royal Ontario Museum, Associate Professor in the departments of Ecology & Evolutionary Biology and Earth Sciences at U of T, and Nanglu's PhD supervisor, said: "While isolated pieces of annelid jaws and some annelid tubes are well known in the fossil record, preservation of their soft tissues is exceedingly rare. You need to look to

truly exceptional fossil deposits like those found in the 508-million-year-old Burgess Shale locality in British Columbia to find well preserved body fossils. Even then, they're quite uncommon and many of the currently described species there are still poorly understood."

Kootenayscolex barbarensis is part of a group of animals called annelids (or the 'ringed worms'). It had a pair of long sensory structures called palps on its head, with a small medial antenna between them (right). Its body was covered in fleshy appendages called parapodia which bear bristles called chaetae. These structures are used for movement. Credit: Jean-Bernard Caron © Royal Ontario Museum

One key feature of the new Burgess Shale worm *Kootenayscolex barbarensis* is the presence of hair-sized bristles called chaetae on the

head which led Nanglu and Caron to propose a new hypothesis regarding the early evolution of the head in annelids. "Like other bristle worms, *Kootenayscolex* possesses paired bundles of hair-sized bristles spread along the body; this is in fact one of the diagnostic features of this group of animals," Nanglu added. "However, unlike any living forms, these bristles were also partially covering the head, more specifically surrounding the mouth. This new fossil species seems to suggest that the annelid head evolved from posterior body segments which had pair bundles of bristles, a hypothesis supported by the developmental biology of many modern annelid species."

The Cambrian Period (541-485 million years ago) represents the first time that most animal groups appear in the fossil record, however, many species often possessed morphologies that were very unlike their modern relatives. "Coupling new fossil discoveries, such as *Kootenayscolex*, with a deeper understanding of developmental processes presents a powerful tool for investigating these unique morphologies and, ultimately, the origin of modern animal diversity," added Dr. Caron.

The description of *Kootenayscolex* is one of many new discoveries from the Burgess Shale site called Marble Canyon (Kootenay National Park) which are changing the way we think about the evolution of a wide array of animal groups. Dr. Caron led the ROM research team that uncovered this new locality in 2012, 40 km southeast of the original Burgess Shale site (Yoho National Park) in the Canadian Rockies. This new bristle worm is not only the most abundant species of annelid throughout the entire fossil record with more than 500 specimens recovered, but also the best preserved so far. "Some specimens preserved remnants of internal tissues, including possible nervous tissues, which is the first time we see evidence of such delicate features in a fossil annelid. This exceptional preservation opens a new chapter in the study of these ancient worms" added Caron.

"508 million years ago, the Marble Canyon would have been teeming with annelids," said Nanglu. "The fine anatomical details preserved in *Kootenayscolex* allow us to infer not only its evolutionary position, but also its lifestyle. Sediment preserved inside their guts suggest that, much as their relatives do in modern ecosystems, these worms served an important role in the food chain by recycling organic material from the sediment back to other animals that preyed on them."

The new annelid's species name, *barbarensis*, was chosen to honour Barbara Polk Milstein, who is a Royal Ontario Museum volunteer and longtime supporter of Burgess Shale research. *Kootenayscolex barbarensis* is brought to life by ROM visual artist and scientific illustrator Danielle Dufault.

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