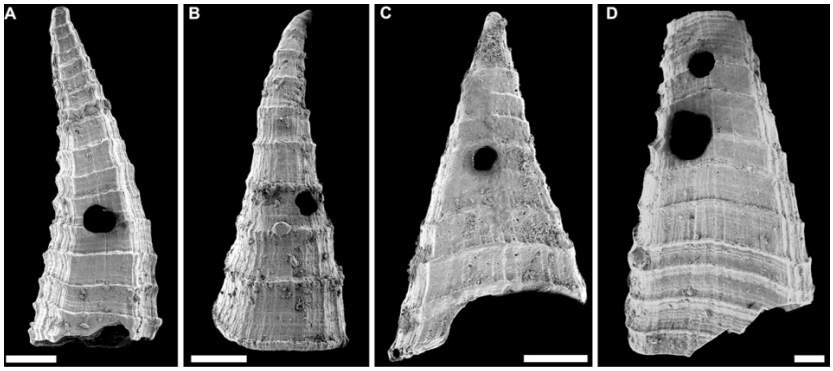
American Museum of Natural History

Media Inquiries:
Kendra Snyder
Department of Communications
212-496-3419
communications@amnh.org
amnh.org

Embargoed until 11 am U.S. Eastern Time on Friday, January 3, 2024

Study Reveals Oldest-Known Evolutionary "Arms Race"

Hundreds of punctured shells from the Cambrian illuminate unique predator-prey interactions in the ocean 517 million years ago



A new study led by researchers at the American Museum of Natural History presents the oldest known example in the fossil record of an evolutionary arms race. These 517-million-year-old predator-prey interactions occurred in the ocean covering what is now South Australia between a small, shelled animal distantly related to brachiopods and an unknown marine animal capable of piercing its shell. Described today in the journal *Current Biology*, the study provides the first demonstrable record of an evolutionary arms race in the Cambrian.

"Predator-prey interactions are often touted as a major driver of the Cambrian explosion, especially with regard to the rapid increase in diversity and abundance of biomineralizing organisms at this time. Yet, there has been a paucity of empirical evidence showing that prey directly responded to predation, and vice versa," said Russell Bicknell, a postdoctoral researcher in the Museum's Division of Paleontology and lead author of the study.

An evolutionary arms race is a process where predators and prey continuously adapt and evolve in response to each other. This dynamic is often described as an arms race because one species' improved abilities lead to the other species improving its abilities in response.

Bicknell and colleagues from the University of New England and Macquarie University—both in Australia—studied a large sample of fossilized shells of an early Cambrian tommotiid species, *Lapworthella fasciculata*, from South Australia. More than 200 of these extremely small specimens, ranging in size from slightly larger than a grain of sand to just smaller than an apple seed, have holes that were likely made by a hole-punching predator—most likely a kind of soft-bodied mollusk or worm. The researchers analyzed these specimens in relation to their geologic ages, finding an

increase in shell wall thickness that coincides with an increase in the number of perforated shells in a short amount of time. This suggests that a microevolutionary arms race was in place, with *L. fasciculata* finding a way to fortify its shell against predation and the predator, in turn, investing in the ability to puncture its prey despite its ever-bulkier armor.

“This critically important evolutionary record demonstrates, for the first time, that predation played a pivotal role in the proliferation of early animal ecosystems and shows the rapid speed at which such phenotypic modifications arose during the Cambrian Explosion event,” Bicknell says.

This research was funded in part by the University of New England, the American Museum of Natural History, and the Australian Research Council (grant #s DP200102005 and DE190101423).

Study DOI: 10.1016/j.cub.2024.12.007

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Image:
Examples of Lapworthella fasciculata *shells (under scanning electron microscope) from the Mernmerna Formation, Flinders Ranges, South Australia showing holes made by a perforating predator. Scale bars represent 200 micrometers.*
R. Bicknell, et al (2025) Current Biology