Fossil corset-animals (loriciferans) help solve Darwin's dilemma[1]

The living corset-animals (loriciferans) are a remarkable group of miniscule, seabed dwelling creatures, which were first found in the 1980s. Now, the discovery by palaeontologists Tom Harvey and Nick Butterfield of the loriciferans' deep ancestry in 490 million year old Cambrian strata is helping to rewrite the story of the Cambrian explosion of life and resolve what is known as Darwin's dilemma.

Named *Eolorica*, from the Greek for *eos* (dawn) and *lorica* (corset), the diminutive species *Eolorica deadwoodensis* was found in rocks of the Deadwood Formation of southern Saskatchewan, Canada. It is the only convincing fossil representative of the loriciferans. The curious name refers to the corset-shaped cone which houses and protects the body of the animal, which is barely visible at about 0.01 millimetre in size. The head and mouth structure, fringed with spiny bristles, is everted from the cone for feeding and respiration. They live their entire lives and breed within seabed sediment.

Loriciferans and the meiofauna

Few people outside the academic world of invertebrate biology will have heard of the loriciferans but they are an important part of the most abundant and diverse fauna on Earth – that of the marine meiofauna – the myriads of microscopic organisms that live between the grains of seabed sediments all around the globe. As members of this meiofauna, the loriciferans are some of the smallest and most remarkable multicelled (metazoan) animals known. Despite being so small their complex bodies are made of several thousand cells and biologists think that they must have evolved through a process of minituarisation from larger ancestors.

As a group of animals, the loriciferans are so well hidden that they were only found in 1983 and are one of the most recently discovered groups of metazoans. Since then loriciferans have been found throughout the marine realm from intertidal to deep ocean environments. In the latter, they include the only known metazoans, which spend their entire lives in oxygen-free (anoxic) environments.

Discovering the fossils

Nick Butterfield from the Department of Earth Sciences in the University of Cambridge and Tom Harvey of the University of Leicester have been investigating the fossil microbiota of the Cambrian age mudstones for some time. Their samples come from drill cores and despite the great age of the rocks and the rigours of physical and chemical preparation, organic remains from these ancient seabed muds are preserved in remarkable and sometimes exquisite detail.

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It was from amongst the organic residues that the researchers recovered over a hundred identical specimens of this strange cone-shaped fossil. They named them *Eolorica deadwoodensis* because of their remarkably close resemblance to the living lorciferans despite the 490 million years, which separate the fossil and living species. The specimens comprise the only convincing fossil record of the Phylum Loricifera, one of the 35 phyla of animals, which make up the animal kingdom. Normally, such minute soft bodied animals are not preserved in the fossil record except under certain special conditions, such as found in the Deadwood mudstones.

The Cambrian explosion

The presence such highly adapted meiofaunal micro-organisms, such as the loriciferans, in Cambrian age strata further amplifies our understanding of the 'Cambrian explosion' in diversity of marine life at the time. It further suggests that the loriciferans may have had an earlier evolutionary history extending back into Precambrian times. Darwin was greatly concerned that the fossil record, as it was known in the early decades of the 19th century, indicated a sudden appearance of different kinds of animals already differentiated into separate biological groups without evidence of a common ancestry the theory of evolution requires. Although a deep Precambrian ancestry for life has now been well established, palaeontologists are still struggling to track back the ancestry of many groups into the remote past. Investigations of the ancient meiofauna, such as Nick Butterfield and Tom Harvey, are conducting may well provide some of the answers.

Douglas Palmer

Fossil Loriciferan, ©Dr Tom Harvey, University of Leicester