LECTURE

Ordovician Soom Shale fossils, and early diversification of marine life

Summary of lecture presented to the Society on Saturday 11th November 2000 by Prof. Richard Aldridge, of Leicester University

Preservation of the soft tissues of animals in the fossil record is very rare, and new finds inevitably attract wide attention. The recent discovery of exceptionally preserved fossils in the late Ordovician Soom Shale of South Africa has special significance, as it provides the only known Ordovician deposit with fossil preservation equivalent to the celebrated Cambrian occurrences in the Burgess Shale of Canada, at Chengjiang in China and in the Scandinavian Orsten nodules.

The Soom Shale Member is a 10-15 m thick argillaceous unit within the 3000 m of arenites that make up the Cambrian-Silurian Table Mountain Group of the south-western Cape Province. It is of latest Ordovician (Ashgill) age, and comprises organic-rich, thinly laminated siltstones and mudstones laid down in a quiet-water marine basin, perhaps close to a retreating ice front. Sedimentological, geochemical and fossil evidence indicate that the bottom waters were dominantly anoxic and at times euxinic, with brief periods of oxygenation. The fauna of the Soom Shale is characterised by nektonic and nektobenthic species, including large conodonts, fish, orthoconic cephalopods and various arthropods; the cephalopods are commonly encrusted by lingulate brachiopods and cornulitids. Chitinozoans are abundant, and many bedding planes are covered with swirls of algae. The non-biomineralised tissues of several organisms are preserved in 3-D, including musculature and eye capsules of conodonts, musculature and respiratory structures (including book-gills) of eurypterids, pedicles of brachiopods and radulae of cephalopods. A particular feature of the biota is the presence of a number of bizarre, entirely soft-bodied animals that currently defy classification. The occurrence of coprolites containing crushed brachiopod shells or fragmentary conodont elements testifies to the presence of large predators or scavengers.

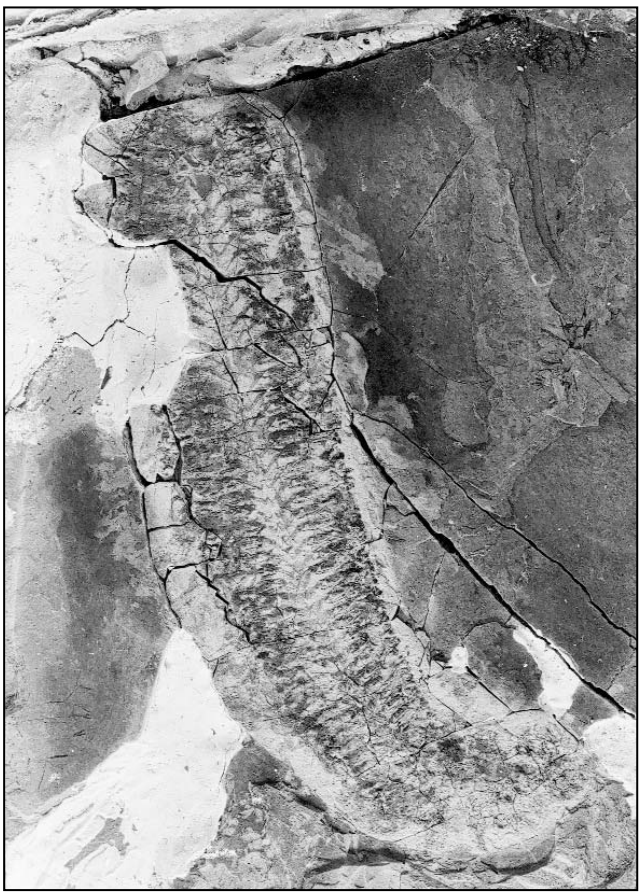

Figure 1. Enigmatic bilateral soft-bodied animal from the Soom Shale at Keurbos, near Clanwilliam, South Africa; x 0.3, presumed anterior at top. Body consists of more than 40 samarate (W-shaped) segments and is fringed on each side by a set of lobate appendages.

The anoxic and euxinic conditions in which the Soom Shale was deposited destroyed the skeletons (of $CaCO_3$ and $CaPO_4$) of all the fossils, but aided the preservation of soft tissues by inhibiting scavengers and burrowers and by promoting the depostion of authigenic clay minerals. These, now converted to illite, replaced soft tissues of animals as they decayed and also replaced the skeletal hard tissues as they dissolved away. Excellent replication of the soft tissues, as shown by the conodonts, eurypterids and several enigmatic organisms, shows that mineralisation occurred very soon after the death of the animals.

The occurrence in the Soom Shale of several organisms that resemble taxa otherwise only known from exceptionally-preserved Cambrian biotas suggests that some unusual body-plans may have had greater longevity than previously realised. It is also possible that some undescribed body-plans may represent experiments that were entirely Ordovician. These discoveries will help us to test models for early Palaeozoic evolutionary patterns that are currently influenced by data only from the Cambrian Lagerstatten.

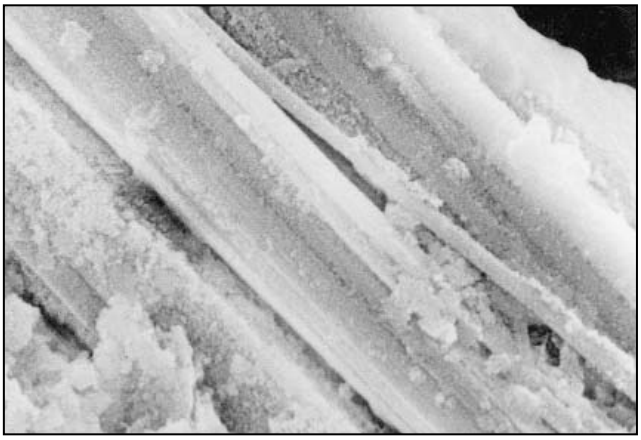

Figure 2. Muscle tissue from the body of a conodont animal in Soom Shale at Sandfontein, near Citrusdal. The muscle fibres and their myofibrils are replaced by illitic clay minerals; the fibres are about 5 mm across.