The Burgess shale

Strange animals from the Cambrian seas

from Richard A. Fortey

THE fossil record is usually very imperfect. Only those animals and plants with preservable hard parts are candidates for fossilization, and of these only those which lived in favourable environments, such as the continental shelves, are likely to have a complete record. The result is that our picture of past life in the sea tends to be somewhat biased. Reconstructions of the sea bed in popular books or in museum displays often show the sea floor of the Palaeozoic swarming with brachiopods and trilobites, but leave out the worms and other soft-bodied animals that were likely to have been just as numerous.

The rare occurrences where the whole fauna has been preserved are of great importance in correcting this biased view. Soft-bodied animals are only capable of preservation under special circumstances — where the bodies could be buried rapidly without decay, for example. One of the earliest of these is the Middle Cambrian (530–550 Myr) Burgess Shale of British Columbia, a fauna originally discovered in 1909, but which has recently been intensively re-collected and studied by H.B. Whittington of Cambridge University and his co-workers.

The Burgess Shale animals originally lived on muddy sediments at the sloping foot of a submarine cliff. The sea bottom was not stable, and from time to time great slumps occurred, carrying sediments and animals alike down the slope, to come to rest in a small basin. The rapidity of this burial is shown in the fossils because they are preserved almost higgledy-piggledy — some buried head first, others on their sides — and even the same species can present very different appearances depending on its orientation.

More than fifty species of soft-bodied animals occur in the Burgess Shale. The majority are arthropods — presumably distant relatives of living crustacea and horseshoe crabs — but there are several kinds of annelid and priapulid worms, and there is also a solitary representative of our own Phylum Chordata. Other strange animals defy inclusion in any group of organisms living in the sea today. Together they prove how rich and varied was the fauna even at this early time. The arthropods in particular show an amazing array of adaptations and most of these, too, are difficult to relate to living species.

The latest of the bizarre animals to be described (D.L. Bruton & H.B. Whittington *Phil. Trans. R. Soc. B300*, 553; 1983) are two arthropods: *Emeraldella* and

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Leanchoilia, illustrated here. So exquisite is the preservation that A. Jensen of the Palaeontological Museum in Oslo has been able to build detailed models of the animals. No other fossils of like antiquity

have been reconstructed in such detail.

But even this complete knowledge does not help in resolving the relationships of these animals to the living fauna: Bruton and Whittington conclude that *Emeraldella* is related to one other animal — and that, too, known only from the Burgess Shale. *Leanchoilia*, with its extraordinary 'great appendage' on the head, may also have relatives in the Burgess fauna, but its living relatives are unknown. This is usually explained by describing the animals at this remote time as being at some kind of 'experimental' stage in their development, but whatever the explanation it is proof of the flexibility of the arthropod design, at a time when the insects, living exemplars of arthropodan ingenuity, were still more than 100 million years in the future.

All illustrations are taken from Bruton and Whittington (*Phil. Trans. R. Soc. B300*, 553; 1983). a, Dorsal view of model of *Emeraldella*. b, *Emeraldella* (approx. $\times 2$). c, *Leanchoilia*, head end (approx. $\times 1.5$). d, Left lateral view of model of *Leanchoilia* (approx. max. known size).