Palaeontology

Biased record of early life

from Malcolm Walter

If an expedition to Earth from some other planet were to be mounted, and if the budget restrictions were such that only two samples could be collected to determine the history of life on Earth, it is probable that the palaeontological advisors to the expedition would urge the collection of a black chert to represent the first few billion years of biological history. Suppose, then, that the collectors travelled first to an island in Hudson Bay, where they gathered a sample of the 1.8×10^9 year old black chert¹, and then to Shark Bay in Australia or some similar arid shore², where they gathered a sample of extant life from the intertidal zone. When the two samples were analysed on return from Earth, it would be concluded that there had been no evolutionary progress for at least 1.8×10^9 years, and that the Earth was still in 'the age of cyanobacteria'.

Palaeontologists are aware of biases resulting from selective preservation. Disproportionate attention to cherts is not a result of naivete on the part of the palaeontologists who work on Proterozoic sequences, but is a consequence of the very success of the studies concentrated on cherts³. Ever since the seminal discoveries in the 2×10^9 year old gunflint chert of Ontario⁴, black cherts have been known as a good preservative for microbial cells, and consequently many studies, including that of Zhang Yun⁵ on page 547 of this issue, have focused on them. As a result, our view of the Proterozoic history of life is probably grossly distorted. Zhang Yun adds to the small but steadily growing list of described microfossil assemblages which represent much of our information about life in Early Proterozoic times ($1.65\text{--}2.50 \times 10^9$ years ago). Although there are techniques, such as the study of stromatolites and isotope geochemistry, that give us different sources of information about ancient life¹, microfossils are preserved cells and the most direct evidence we have. Of the various sources of information available to palaeontologists, microfossils have received by far the most attention. They are preserved in very finely crystalline silica, chert, and as a result of circumstances not yet well understood, most Proterozoic microfossiliferous cherts appear to have formed in the marine intertidal environment.

The attention to a limited set of palaeoenvironments has consequences in biostratigraphy as well as palaeobiology. Any attempt to use chert microfossils in biostratigraphy is greatly limited even before it begins, unless we can find cherts that preserve samples of microbial life from more than just the intertidal zone. Like a few other assemblages, Zhang Yun's could

represent a microbiota that was unique to the Early Proterozoic. The first reaction to this new report is to view it as an encouragement to biostratigraphers, but caution is needed. As in the case of most of the other examples, including the original one from the famous Gunflint Iron Formation, the Chinese example comes from rocks whose depositional environment has not been determined by modern sedimentological techniques. The fact that its microbiota are distinctive may therefore signify nothing more than that it comes from a distinctive palaeo-environment (Zhang Yun suggests the shallow sea in a region of volcanic activity) that has, so far, only been sampled in the Lower Proterozoic — a familiar problem to palaeontologists.

Proterozoic microfossils are also found in shales, where they are called acritarchs, but there they are studied by different techniques and usually by different scientists from those who work on cherts^{6,7}. Many of the shales were deposited in off-

shore marine environments and, as a result, contain a sampling of the marine plankton of the time. They can be expected to have been more diverse than the intertidal microbiota, not having been limited by the environmental extremes that characterize the intertidal zone. Shales should therefore provide a fuller record of evolution through the Proterozoic, and the material should provide the basis for a successful Proterozoic biostratigraphy. A combination of the palaeobiological approach that has been applied to cherts and the empirical biostratigraphical approach of the acritarch workers will give us a true picture of life in the Proterozoic, and provide the basis for sound biostratigraphy. Such work has begun⁸. □

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Oncogenetics

Progress in malignancy

from Miranda Robertson

Two rare tumours of childhood are proving to be a remarkable source of insight into the genetic steps by which cells may progress in malignancy. The tumours, retinoblastoma and neuroblastoma, have two significant features in common. First, they are both derived from embryonic precursors of nerve cells, which normally lose the ability to divide once they have differentiated; and second, both may be associated with chromosomal deletions. These two facts have been incorporated in the following hypothetical schema. The chromosomal deletion contains a gene that is normally responsible for turning off the embryonic phenotype, including the ability to divide; in its absence, embryonic genes remain active and the proliferative capacity of the cell is retained. It has been suggested that some of the cellular proto-oncogenes may be genes that are normally active only during embryogenesis; and with this in mind, Lee *et al.* have looked for an active oncogene in cells from ten fresh retinoblastomas. They find that the *N-myc* gene is transcriptionally active in all of them and amplified in two¹. At the same time, Schwab *et al.*, who originally discovered the *N-myc* gene², report that in retinoblastomas *N-myc* amplification is associated with late stages of tumour progression³, and thus may have prognostic implications.

N-myc is an oncogene by an unusually complex chain of inference. It was first detected by Schwab *et al.* in the amplified DNA of a number of neuroblastoma cell lines through its limited homology to the *c-myc* cellular proto-oncogene. Thus its identification as an oncogene rests on its relationship to a known oncogene and its presence in DNA that is amplified in tumour cells. Its activation in a second neuroectodermal tumour — retinoblastoma — strengthens the evidence implicating it in neural tumorigenesis.

The first step in the development of neuroblastoma and retinoblastoma must occur before the differentiation of the central nervous system is complete, and indeed may be inherited. The hereditary cases are often associated with chromosomal abnormalities involving the deletion of material from chromosome 1 in the case of neuroblastoma⁴, and from chromosome 13 in the case of retinoblastoma⁵. This is believed to predispose individuals to develop the tumours, but does not make it inevitable, presumably because a normal allele of the deleted gene remains on the intact chromosome. In the case of retinoblastoma, there is now very good evidence that the second step in tumorigenesis is the inactivation of the normal allele⁶. (The mechanisms by which this may occur in retinoblastoma and other childhood