LECTURE

Is the past the key to the future?

Summary of lecture presented to the Society on Saturday 10th February by Dr Chris Lavers, of Nottingham University.

The principle of uniformitarianism - that the present is the key to the past - has served earth scientists well for many years. The philosophy is quite odd, however, in the sense that it became entrenched at a time when geologists were beginning to suspect that the earth must be immensely old. It follows from this that the present must be no more than the finest shaving from the tip of geological time. Can we really understand and interpret 4.6 billion years of history using the present, any more than we can understand the Eiffel Tower by examining a sliver of paint from the top? Of course we must learn about the past by studying the present, but we may also learn about the present, and perhaps also the future, by studying the past.

For example, two of the most pressing environmental problems that we currently face are global warming and biological invasions (the latter sometimes referred to as 'global mixing'). How may we judge the likely impact of these processes on the biosphere? Computer modelling is one way but, different models yield different predictions, and the questionable reliability of such techniques, particularly in relation to climate, is widely acknowledged.

Another approach is to look to the past for guidance. In the case of global warming and mixing the best analogue is arguably the Permian-Triassic transition. The potential for global mixing at the end of the Permian was great because the earth's continental landmasses had all coalesced to form the supercontinent of Pangea. Recent research also suggests that a 6oC rise in temperature at equatorial latitudes occurred at this time, a figure at the upper end of the prediction for average global warming by 2100 by the Intergovernmental Panel on Climate Change. Warming at higher latitudes is thought to have been even greater, leading to the establishment of a relatively uniform warm to hot climate across Pangea. The change is thought to have been brought about by the release of carbon dioxide from the oxidation of coal-bearing deposits in the southern part of Pangea, and latterly from the eruption of the flood basalts of the Siberian Traps.

The Permian-Triassic transition was marked by the largest mass extinction in the history of life. The bulk of extinctions on land probably resulted from the homogenisation of habitats across Pangea as the pole-to-equator temperature gradient flattened. This gradient also drives the circulation of the oceans, and it seems likely that circulation slowed so much at the end of the Permian that the world's oceans became catastrophically depleted in oxygen and nutrients. The most extraordinary aspect of both terrestrial and oceanic ecosystems in the earliest Triassic was the ultra-low diversity and extreme cosmopolitanism among the survivors. Ninety per cent of all terrestrial tetrapod assemblages at this time, for example, consist of the remains of just one type of animal: the dicynodont Lystrosaurus.

Although global warming has been cited as the deadly *coup de grâce* for Palaeozoic life, it is inconceivable that global biodiversity would have fallen so low at the end of the Permian had continents and oceans been separated as they are now. Isolation acts to protect and generate biodiversity whatever the extraneous circumstances. We may not today be pushing the continental landmasses together in a physical sense today, but our transportation of species around the globe is having much the same effect. In fact the rate of global mixing is higher today than at any time in Earth's past.

To contend that we are currently heading for a Permian-like environmental catastrophe would be too extreme, but the parallels are clearly evident. The same processes, of global warming and global mixing, are certainly in operation, and are widely acknowledged to be key threats to the biosphere. As such, even if the late-Permian is rejected as an analogue for our current environmental predicament, it at least seems sensible to take this fascinating time in Earth's history as a warning.

Literature

Lavers, Chris, 2000. *Why Elephants Have Big Ears*. Gollancz: London.