In the shadow of extinction

Only six degrees separate our world from the cataclysmic end of an ancient era

It is old news, I admit. Two hundred and fifty-one million years old, to be precise. But the story of what happened then, which has now been told for the first time, demands our urgent attention. Its implications are more profound than anything taking place in Iraq, or Washington, or even (and I am sorry to burst your bubble) Wimbledon. Unless we understand what happened, and act upon that intelligence, prehistory may very soon repeat itself, not as tragedy, but as catastrophe.

The events that brought the Permian period (between 286m and 251m years ago) to an end could not be clearly determined until the mapping of the key geological sequences had been completed. Until recently, palaeontologists had assumed that the changes that took place then were gradual and piecemeal. But three years ago a precise date for the end of the period was established, which enabled geologists to draw direct comparisons between the rocks laid down at that time in different parts of the world.

Having done so, they made a shattering discovery. In China, South Africa, Australia, Greenland, Russia and Svalbard, the rocks record an almost identical sequence of events, taking place not gradually, but relatively instantaneously. They show that a cataclysm caused by natural processes almost brought life on earth to an end. They also suggest that a set of human activities that threatens to replicate those processes could exert the same effect, within the lifetimes of some of those who are on earth today.

As the professor of palaeontology Michael Benton records in his new book, When

Life Nearly Died, the marine sediments deposited at the end of the Permian period record two sudden changes. The first is that the red or green or grey rock laid down in the presence of oxygen is suddenly replaced by black muds of the kind deposited when oxygen is absent. At the same time, an instant shift in the ratio of the isotopes (alternative forms) of carbon within the rocks suggests a spectacular change in the concentration of atmospheric gases.

On land, another dramatic transition has been dated to precisely the same time. In Russia and South Africa, gently deposited mudstones and limestones suddenly give way to massive dumps of pebbles and boulders. But the geological changes are minor in comparison with what happened to the animals and plants.

The Permian was one of the most biologically diverse periods in the earth's history. Herbivorous reptiles the size of rhinos were hunted through forests of tree ferns and flowering trees by sabre-toothed predators. At sea, massive coral reefs accumulated, among which lived great sharks, fish of all kinds and hundreds of species of shell creatures.

Then suddenly there is almost nothing. The fossil record very nearly stops dead. The reefs die instantly, and do not reappear on earth for 10 million years. All the large and medium-sized sharks disappear, most of the shell species, and even the great majority of the toughest and most numerous organisms in the sea, the plankton. Among many classes of marine animals, the only survivors were those adapted to the near-absence of oxygen.

On land, the shift was even more severe. Plant life was almost eliminated from the earth's surface. The four-footed animals, the category to which humans belong, were nearly exterminated: so far only two fossil reptile species have been found anywhere on earth that survived the end of the Permian. The world's surface came to be dominated by just one of these, an animal a bit like a pig. It became ubiquitous because nothing else was left to compete with it or to prey upon it.

Altogether, Benton shows, some 90% of the earth's species appear to have been wiped out: this represents by far the gravest of the mass extinctions. The world's "productivity" (the total mass of biological matter) collapsed.

Ecosystems recovered very slowly. No coral reefs have been found anywhere on earth in the rocks laid down over the following 10 million years. One hundred and fifty million years elapsed before the world once again became as biodiverse as in the Permian.

So what happened? Some scientists have argued that the mass extinction was caused by a meteorite. But the evidence they put forward has been undermined by further studies. There is a more persuasive case for a different explanation. For many years,

geologists have been aware that at some point during or after the Permian there was a series of gigantic volcanic eruptions in Siberia. The lava was dated properly for the first time in the early 1990s. We now know that the principal explosions took place 251 million years ago, precisely at the point at which life was almost extinguished.

The volcanoes produced two gases: sulphur dioxide and carbon dioxide. The sulphur and other effusions caused acid rain, but would have bled from the atmosphere quite quickly. The carbon dioxide, on the other hand, would have persisted. By enhancing the greenhouse effect, it appears to have warmed the world sufficiently to have destabilised the superconcentrated frozen gas called methane hydrate, locked in sediments around the polar seas. The release of methane into the atmosphere explains the sudden shift in carbon isotopes.

Methane is an even more powerful greenhouse gas than carbon dioxide. The result of its release was runaway global warming: a rise in temperature led to changes that raised the temperature further, and so on. The warming appears, alongside the acid rain, to have killed the plants. Starvation then killed the animals.

Global warming also seems to explain the geological changes. If the temperature of the surface waters near the poles increases, the circulation of marine currents slows down, which means that the ocean floor is deprived of oxygen. As the plants on land died, their roots would cease to hold together the soil and loose rock, with the result that erosion rates would have greatly increased.

So how much warming took place? A sharp change in the ratio of the isotopes of oxygen permits us to reply with some precision: 6C. Benton does not make the obvious point, but another author, the climate change specialist Mark Lynas, does. Six degrees is the upper estimate produced by the UN's scientific body, the intergovernmental panel on climate change (IPCC), for global warming by 2100. A conference of some of the world's leading atmospheric scientists in Berlin last month concluded that the IPCC's model may have underestimated the problem: the upper limit, they now suggest, should range between 7 and 10 degrees. Neither model takes into account the possibility of a partial melting of the methane hydrate still present in vast quantities around the fringes of the polar seas.

Suddenly, the events of a quarter of a billion years ago begin to look very topical indeed. One of the possible endings of the human story has already been told. Our principal political effort must now be to ensure that it does not become set in stone.

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George Monbiot's book, The Age of Consent: A Manifesto for a New World Order, is published by Flamingo.