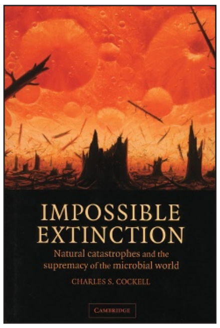
The ultimate survivors



Impossible Extinction: Natural Catastrophes and the Supremacy of the Microbial World

by Charles S Cockell

Cambridge University Press, $28.00
192 pp. hardcover
ISBN 0521817366, 2003

Reviewed by John Postgate

The Earth and the millions of the creatures that inhabit it have a profound impact on each other. The Earth's history has determined the character and distribution of living things for approximately 4 billion years, and living things have equally altered the Earth's geochemistry and geology.

Astronomical events—the familiar periodicities brought about by the Earth's rotation, the Moon's orbit and our orbit around the sun, and less predictable events such as cosmic radiation, the arrival of meteorites and other spatial detritus—have all influenced life on this planet. But these astronomical influences are certainly not interactive—life can in no way influence them—and terrestrial life is wholly at their mercy.

Or is it? Charles Cockell has taken a fascinating look at the question and has chosen to present his ideas within the framework of a less familiar orbit. As the Earth rotates around the sun once a year, so the solar system rotates around the center of our galaxy, the Milky Way, once every 225 million terrestrial years. Shortly before the start of the current galactic cycle about 250 million years ago, a biological catastrophe called the end-Permian extinction wiped out nearly 75% of animal and plant species from the Earth.

Cockell considers the extent to which celestial events might have caused—or at least triggered—major extinctions that may have occurred during the Earth's subsequent trip round the galaxy. He also explores what terrestrial catastrophes might initiate or augment mass extinctions and asks whether, and how, terrestrial-type life might become extinguished altogether.

Cockell first outlines contemporary views on the origins of our galaxy, the solar system and the Earth, with its liquid water and pristine quota of organic chemicals. Skating over life's actual origin(s), he explains how unicellular microbes alone populated the planet for nearly 3 billion years and then, by generating an oxygen-containing atmosphere, kick-started the emergence of complex multicellular creatures. He then gives a brisk overview of the amazing stress resistance exhibited by contemporary microbes, predominantly bacteria.

Cockell points out that some bacterial species flourish in water superheated to 113 °C, in saline water supercooled below 0 °C, or in saturated salt solutions; others inhabit acidic, alkaline and oxygen-free environments. Some species can lie dormant for centuries, even millennia, surviving desiccation or boiling; some can live on poisonous substances or minerals; some survive the intense ionizing radiation of a nuclear reactor; some live happily under enormous pressure in the abyssal depths of the oceanic trenches; some live far from day-to-day stresses, kilometers deep in the Earth's crust, rejoicing in the warmth from the Earth's mantle. Many species are present-day representatives of those that were abundant during the Earth's early eons (though I doubt they are direct descendants thereof).

Hard evidence of the causes of biological extinctions is actually limited, so there are many subjunctives in Cockell's discussion. For example, the end-Permian extinction, the most severe of all, was a two-stage catastrophe that probably involved a precipitous fall in atmospheric oxygen, associated with a period of global warming and a burst of volcanic activity, during which the Siberian Traps originated.

An extraterrestrial trigger such as a comet impact is conceivable but unlikely. Other possibilities include a disease pandemic and excessive salinity of terrestrial waters. Cockell omits a recent scenario of a drastic, planet-warming 'burp' of methane, released from oceanic methane-ice by global warming.

A less drastic disaster, the end-Triassic extinction, occurred some 200 million years ago and probably also involved volcanic activity and low oxygen. The celebrated Cretaceous-Tertiary extinction of 65 million years ago, however, which all but eliminated the dinosaurs, almost certainly involved a meteorite that hit—and created—the present Gulf of Mexico. Its impact complemented a burst of volcanic activity that gave rise to the Deccan Traps.

Other comet or asteroid impacts, as well as volcanic explosions, have caused local devastation but hardly extinctions; on the other hand, Cockell rightly reminds us that the human population explosion has now initiated a new worldwide era of mass species extinctions.

Cockell touches on the likelihood of life elsewhere in the solar system, but his major thesis is that the major extinctions of which we know would have left our microbial world essentially unscathed—indeed, many species benefited from them—and that microbes would survive even conjectural hazards such as a nearby star becoming a supernova. Microbes might, by being carried into space, even escape the consumption of the Earth when our own sun explodes into a red giant—an event expected some 5 billion years from now.

Terrestrial life is very much more resilient than is its currently dominant species. This is a stimulating think-piece—not too long, generally well informed and written in a reader-friendly style. It will appeal to general readers as well as to scientists who like to reflect outside their own specializations.

The author is emeritus professor of Microbiology at the University of Sussex, Brighton, UK.
Email: johnp@biols.susx.ac.uk