

## BOOKS &amp; ARTS

## The making of geology

In the late eighteenth century, ideas about the age of rocks and fossils gave rise to a new science.

**Bursting the Limits of Time: The Reconstruction of Geohistory in the Age of Revolution**

by Martin J. S. Rudwick

University of Chicago Press: 2005. 840 pp. \$45

**Stephen Moorbath**

*Bursting the Limits of Time* is a massive work and is quite simply a masterpiece of science history. It charts in the most scholarly detail the beginnings of modern geology from the mid-1780s to the mid-1820s. Much of the activity during the earlier years took place in France and adjacent countries, and the book abounds in descriptions of the ideas and interpretations of savants, including Georges Cuvier, Jean-André de Luc, Horace-Bénédict de Saussure and Abraham Werner. These scientists were beginning to show how describing and classifying geological phenomena could lead to detailed geohistorical reconstruction.

Things were slower to get going in Britain, where the most familiar names are James Hutton, William Smith and William Buckland. The book doesn't go as far as Charles Lyell, Adam Sedgwick or Charles Darwin (who was a highly productive geologist before being side-tracked by evolutionary biology), but Martin Rudwick promises to deal with the next stage of geology in a follow-up volume.

In the late eighteenth century, geology — a term that had been creeping in since the 1770s — was a complex mixture of geothory, geohistory and geognosy (an early version of structural geology) in which much of the reasoning seems remote to modern eyes. One could even say that the sheer scale of all this theorizing was inversely proportional to the amount of data available. There were occasional flashes of insight, such as Georges Buffon's view of Earth as a cooling globe with a hot centre, or Hutton's interpretation of granite as once-molten fluid. But most of the intense geothoretical arguments of those days have long since been lost or won. Now we have our own divergent geothories, which weren't on the horizon 200 years ago. But right from the start, people realized that geology, like any other science, could advance only through informed and rational disagreement.

A wind of fresh foreign air blew through the drawing rooms of the French *savanterie* with the pioneering work of Smith, the so-called father of English geology. He correlated sedi-



**Rock star:** Georges Cuvier realized from fossils that the Earth was much older than humans.

mentary rocks by means of their characteristic fossil assemblages, recognized the relative time sequence of sedimentary strata, made the first meaningful geological maps of parts of England and Wales, and created the important subject of stratigraphical geology, also known as stratigraphical palaeontology.

Rudwick gives Smith his full credit but points out that Alexandre Brongniart and Cuvier were doing almost identical mapping in the Paris basin at the same time and, moreover, treated fossils not only as means to a stratigraphical end, but as palaeobiological ends in themselves. It was Cuvier, with his knowledge of comparative anatomy, who recognized that most fossil bones were different from modern ones and postulated that, in the absence of fossil human bones, a long pre-human history was followed by large-scale extinction. This had been hinted at previously, and the ensuing debate centred around whether or not the supposed catastrophic event could be correlated with the biblical flood. This was a particularly important point for Buckland, who was keen to combine the broadening geological horizon with his religious perspectives.

Many of the scientists discussed their geological ideas in terms of past catastrophes and extinctions, whereas others preferred to think of vast, uneventful stretches of time, as expressed in the implicitly eternalistic words of Hutton: "The result of our present enquiry is that we find no vestige of a beginning, no

prospect of an end." In 1809, Lamarck published his gradualist 'transformation' version of evolution, quite different from that proposed by Darwin 40 years later.

As promised by its title, Rudwick's book deals expertly with the topic of geological time, which developed when no absolute measure of time was available. From studies of rocks and fossils, most scientists felt that at least the pre-human timescale was vastly longer than the 6,000 years prescribed by the Bible. In those days, theology was still regarded as related to science and was thus subject to corroboration or conflict. Scientists and theologians were in close debate over these issues, without major argument. For some today, science and religion continue to coexist peacefully, but in the early days one can see little precedent for the hardline, anti-scientific attitudes practised today by fundamental biblical creationists.

Rudwick's text is beautifully written and grips the attention throughout. Nonetheless, it tends to be rather repetitive, because the author describes every nuance of each idea, however implausible, as well as the personal and scientific relationships between the protagonists. Some 200 years from now, our own scientific findings may well take just as much explaining. But a much shorter text could have covered the same subject matter, even over a broader time range, and thus reached a wider audience. All ten chapters are beautifully illustrated, with 179 contemporary black-and-white prints interwoven with the text. There are copious footnotes on every second page, as well as complete sources and references.

The book should be obligatory for every geology and history-of-science library, and is a highly recommended companion for every civilized geologist who can carry an extra 2.4 kg in his rucksack.

Cuvier ultimately emerges as the pivotal figure in the history traced in this book, but numerous others of scarcely less importance produced the foundations of the new geology. Rudwick has amply fulfilled his stated aim of describing the injection of history into a science that had been primarily descriptive or causal. Indeed, thanks to Rudwick and his kind, we may rest assured that the future of the history of science is in safe hands. ■

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