

# Darwin's geological time dilemma

**To the Editor** — The Editorial 'Darwin's Geology' and the Commentary 'Man, myth, geologist' in *Nature Geoscience*<sup>1,2</sup> discuss Charles Darwin's achievements as a geologist. It is also worth pointing out that Darwin's theory of descent with modification called for an age of the Earth far greater than thought at the time.

Charles Lyell's monograph, *Principles of Geology*<sup>3</sup>, introduced the uniformitarian view of geology, which is based on the idea of gradual changes throughout the Earth's history, rather than catastrophic events. Darwin found evidence to support this view in his travels, but, perhaps more importantly, this view also affected his thoughts on the variation of plants and animals, influencing his assessment of the transmutation of species. Indeed, in chapter IV of his *On the Origin of Species*<sup>4</sup>, Darwin wrote, with reference to Lyell's "noble views"; that "... as modern geology has almost banished such views as the excavation of a great valley by a single diluvial wave, so will natural selection ... banish the belief of the continued creation of new organic beings, or of any great and sudden modification in their structure."

With the establishment of geological (and biological) uniformitarianism, the concept of a Young Earth, as described in the Bible, was seriously challenged. It is remarkable that Darwin, initially a theologian by training, invoked "yet quite unknown (vast) periods of time"<sup>4</sup>, rather than the age of 6,000 years estimated from the Bible. In 1868, William Thompson, a physicist, estimated that the Earth was no more than 100 million years old<sup>5</sup>, an age widely accepted by Darwin's fellow geologists. However, Darwin disagreed with this age, as his theory required a long period before the Cambrian formation<sup>4,5</sup>.

By about 1860, a relative geological timescale was established based on the vertical succession of fossils, reflecting the sequence of organismic evolution<sup>6</sup>. However, it was only with the discovery of radioactivity in 1896 that absolute dating became possible<sup>7</sup>.

Charles Darwin's time dilemma was resolved in 1929, when a custom-made mass spectrometer provided the means to measure isotopes of lead and uranium. On the basis of these and other quantitative data, Ernest Rutherford estimated that the

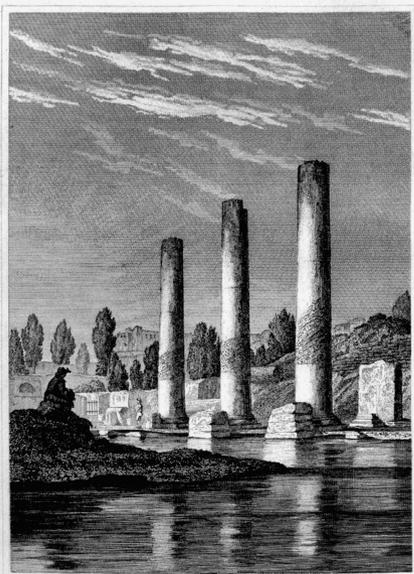
Earth was 3,400 million years old<sup>7</sup>. Further refinement of mass spectrometers, the "time machines of the geochronologists"<sup>7,8</sup>, established the Earth's age at  $4,527 \pm 0.01$  million years<sup>9</sup>. Thus, the origin of the first mass spectrometers<sup>7,8</sup> finally resolved a key question raised by Darwin in his book *On the Origin of Species*, some seven decades later. □

## References

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— Bradley, 51.

*Present view of the Temple of Serapis at Saqqara.*

London, Published by John Murray, Albemarle St. June, 1854.

## PRINCIPLES OF GEOLOGY,

BEING

AN ATTEMPT TO EXPLAIN THE FORMER CHANGES  
OF THE EARTH'S SURFACE,

BY REFERENCE TO CAUSES NOW IN OPERATION.

BY

CHARLES LYELL, Esq., F.R.S.

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