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# Creationism and the Age of the Earth

For most of the 20th century religion and science in this country have coexisted with relatively little controversy. Scientists did not accept literally the version of beginnings set forth in Genesis, but many were touched with awe when they regarded the order and complexity of nature. They respected the ethical values fostered by organized religion. Some scientists were agnostics but few were atheists. This peaceable relationship has been strained by the people who allege that there is a body of knowledge which they call creation "science" that merits equal treatment with the teaching of evolution in primary and secondary schools.

The creationists also state that the age of the earth is between 6,000 and 10,000 years. In taking this stance they are in conflict with data from astronomy, astrophysics, nuclear physics, geology, geochemistry, and geophysics. In these disciplines an enormous mass of observational and experimental data has been accumulated bearing on the age of the earth and of the universe. Many independent approaches whose results buttress each other are in agreement that the age of the earth is much greater than 10,000 years. Substantial evidence indicates that the age of the solar system is about 4.5 billion years.

In the dating of ancient materials the best values are obtained by radiometric methods. At least five independent radioisotope clocks have been employed. Perhaps the best of these is one that depends on decay of  $^{238}\text{U}$  and  $^{235}\text{U}$  to the end products  $^{206}\text{Pb}$  and  $^{207}\text{Pb}$ . By use of this method the ages of rocks 2600 million years old have been determined with a probable error as small as 1 million years. When granitic magma solidifies, zircon crystals ( $\text{ZrSiO}_4$ ) are often formed. The atomic radii of uranium and zirconium are nearly equal, and uranium is usually present in the zircon crystal as a proxy for zirconium in the structure. The radiometric clock starts when the crystal forms. With the passage of time  $^{238}\text{U}$  decays to  $^{206}\text{Pb}$  and  $^{235}\text{U}$  decays to  $^{207}\text{Pb}$ . Under favorable conditions both isotopes remain locked in the crystal. Laboratory processing isolates the lead for mass spectrometric determination. In many thousands of instances rocks have been dated by three or more independent clocks and the ages determined have been in good agreement.

Astronomy and astrophysics have provided a set of distance and time scales that lead to an age for the universe of 10 billion to 20 billion years. This great age is consistent with the times which nuclear physicists calculate are required for stars to evolve—for example, from bodies like the sun to white dwarfs.

Data from geology, geochemistry, and geophysics all testify that the age of the earth is much greater than 10,000 years. For example, geologists have encountered a large number of formations in which the total number of annually deposited layers far exceeds 10,000. Geochemists have studied the decomposition of organic matter to form petroleum. Laboratory studies show that the rate of decomposition is such as to require millions of years to release the hydrocarbons found. Laboratory studies of amino acids found in fossils are also in accord with ages far greater than 1 million years. Geophysicists note that the rate of motion of tectonic plates is such as to require many millions of years for such events as opening of the Atlantic Ocean and raising of high mountains.

The efforts of the tens of thousands of scientists who have produced data relevant to the age of the earth or the universe have been motivated by a search for truth. If the age of the earth were 10,000 years or less, that result would have been proclaimed by many and accepted by all.

In contrast, those who propound creationism have started with a literal interpretation of the Bible. They have no substantial body of experimental data to back their prejudices. Truth is not on their side. In the end their activities must bring only harm to their cause.—PHILIP H. ABELSON

For further reading on creationism see *Science*, 6 November 1981, p. 635; 4 December, p. 1101; 11 December, p. 1224; and 1 January 1982, p. 33; and *Science* 81, December, p. 53.