

The age of the Earth: the changing views of science

People have always known the Earth was quite old. Nearly every civilisation has its own creation story in which gods created the Earth and the Heavens, the seas and the animals and finally mankind. And for thousands of years everyone was happy to accept the stories. There was no science and therefore there was no scientific evidence for the age of the Earth.

In Medieval times European knowledge was based upon what the Bible said. The version of creation in the book of Genesis was accepted as a true version of the beginning of the Earth and therefore people believed the Earth was only a few thousand years old. However Bernard Palissy (1510 – 1578) from France had observed that erosion by rain and winds could not have caused the changes we see around us in such a short time. The Earth must be much older, he claimed. It was not a good idea to contradict the Church at the time and he was burned at the stake as a heretic.

In 1645 Bishop Usher from Ireland painstakingly studied the family lists in the Bible and stated that the Earth must have been created on October 26th 4004 BC. This detail, he felt, would stop the arguments once and for all.

But it didn't. By the late 1700s James Hutton noted that Hadrian's Wall had not been eroded very much, even though it had been there for over 1000 years. He had to agree with Palissy that the Earth was much older than the Bible claimed. Luckily for Hutton, burning at the stake was out of fashion and the Church was much more liberal at this time. People began to listen and offer their own versions of events.

For example some worked out the rate that sediment was deposited in rivers and measured the thickness of the sediment layer. The result came out to about 1.6 billion years. Unfortunately they forgot to account for erosion and they forgot that ancient sedimentary rocks have often been metamorphosed (become changed into metamorphic rocks through heating and increased pressure).

By 1897 science was really coming into its own. Lord Kelvin (of Kelvin temperature scale fame) decided that the Earth had once been molten and was cooling down gradually by conduction and radiation. He calculated that it must be between 24 million and 400 million years old. However he was not aware of the fact that there are radioactive materials which generate heat deep in the Earth. The Earth is not cooling as fast as Kelvin had assumed so it must be much older than he worked out.

John Joly from Ireland added to the debate in 1899 when he calculated that the Earth was 90 – 100 million years old. He based his ideas on the rate at which salt is delivered to the oceans. River water contains a small amount of salt but evaporation results in the seas being much saltier, he stated. However he didn't think about salt being removed from the sea and preserved in rocks when ancient seas evaporated.

Ernest Rutherford took time out from his work on atoms to get involved in the debate. Henri Becquerel had discovered radioactivity in 1896. In 1905 Rutherford used radioactive decay of minerals to arrive at a date of 500 million years for the age of the Earth. By 1907 Boltwood had increased this estimate to 1.64 billion years using the same technique.

As we have gained a better understanding of radioactive decay our knowledge of how to find the age of rocks has improved and we are now convinced that the oldest rocks on the Earth are almost 4 billion (four thousand million, 4 000 000 000) years old. Moon rocks are slightly older at 4.5 billion years. The data also indicates that the Earth first formed 4.6 billion years ago.

Questions:

- Q 1. What was the first instance when someone questioned the Bible's suggested age for the Earth? Who was the questioner and what evidence did he use?
- Q 2. This evidence was supported by Hutton. What was his observation and what conclusion did he draw?
- Q 3. Throughout the 19th Century scientists were using a range of ways to estimate the age of the Earth. Make a chart listing the various people, their chosen methods, the age they estimated and the problem with their chosen techniques.
- Q 4. Once radioactive decay had been discovered it was used to estimate the age of the Earth. Who first chose to use this technique? What result did he get?
- Q 5. We now agree that the Earth is much older than any estimates before. Why are we much more confident in our technique now?