

DISCOVERED: THE MAN WHO FOUND THE AGE OF THE EARTH!

Have you ever wondered how we know how old the dinosaurs are? Do you know how old the Earth is, or how we date it? Today we can date anything from mass extinctions to Martian meteorites, but how do we do it? Can *you* name the man who made it happen?

Arthur Holmes is one of the great unsung heroes of science, and this is the story of how he learnt to date the rocks and tell the age of the Earth, which eventually led to us being able to work out how old the dinosaurs are. Born in England in 1890, as a young boy Arthur Holmes was fascinated by the great scientific debate of the day – how old is the Earth?



Arthur Holmes as young man in 1910.

Early ideas about the age of the Earth

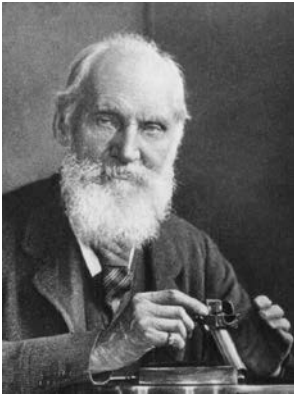
For centuries scientists had believed what they read in the Bible – that the world was created 4004 years before the birth of Christ (BC) – and as a consequence they thought that all rocks were deposited during the 40 days of Noah's flood. Eventually though, through continued observation of how rocks were laid down, geologists such as Charles Darwin (who was a geologist before he became a biologist), and his geological mentor Charles Lyell, realised that unimaginable amounts of time were required to deposit the rocks, and that geological time was practically infinite.



Archbishop Ussher who, in 1650, dated the Earth at 4004 BC.

Armagh Public Library

However, the physicists of the day disliked what they considered were the non-scientific methods that geologists used to measure the age of the Earth, and set out to estimate it for themselves. Lord Kelvin, the greatest physicist of his time, became the leading figure in the fight. By working out the rate at which the Earth had cooled from the time it had been in a molten state, he gradually reduced his first estimate of the age of the Earth from a geologically acceptable 400 million years, to a completely unreasonable 20 million. But who could argue with his figures? Certainly not many geologists.



Lord Kelvin in 1902.

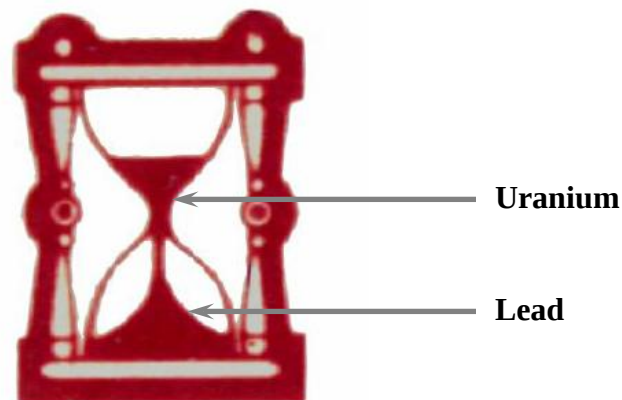
He dated the Earth at 20 million years.

Science Museum/Science and Society Picture Library

Radioactivity – the clock that tells geological time

As it happened, help was at hand. The discovery of radioactivity in 1896, by a Frenchman, Henri Becquerel, rapidly resulted in a whole new branch of science that 60 years later would solve the problem. Radioactivity is the natural ‘decay’ of one radioactive element, such as uranium, into a non-radioactive element, such as lead, and for this story it is also important to know that in the process of radioactive decay, heat is given off. As soon as this was realised, physicists could no longer calculate the age of the Earth from its rate of cooling as Lord Kelvin had done, because while it was cooling, radioactive elements within the Earth had been keeping it hot! Consequently, it must have cooled much more slowly than Lord Kelvin had thought, and it would therefore be much older than he realised. The geologists were triumphant!

By 1904 Ernest Rutherford, a New Zealander working in Canada, understood that radioactive decay had gone on throughout geological time at a very precise and constant rate. Picture an old-fashioned hour glass (egg timer). When you first turn it over, imagine that all the sand in the top half is uranium which, as it trickles through to the bottom, grain by grain, turns into lead. On the side of the lower half of the hour glass are marks that tick off the hours, so as the ‘lead’ reaches each mark, you know how many hours have passed. In the same way, uranium in rocks is constantly changing to lead at a very precise rate.



Therefore, by measuring the amount of uranium left in the rock, and the amount of lead that has accumulated, it should be possible to calculate the rock’s age, once the rate of decay is known. Radioactivity was to become the clock that would eventually tell geological time.

Arthur struggles to date the Earth

At about this time, Arthur Holmes won a scholarship to study physics at the Royal College of Science in London. Inspired by the age of the Earth debate, and fascinated by radioactivity, he decided to develop a geological time scale and find the age of the Earth for himself. But financial hardship soon diverted him

from his studies. From a modest family background, Arthur found College life in London both lonely and expensive. On a scholarship of only £60 a year (\$100), he was continually struggling to make ends meet, until in 1911, when offered a job prospecting for minerals in Mozambique, he could not afford to turn it down. Dating the age of the Earth would just have to wait.

Arthur recorded his adventures in Mozambique in letters sent he sent home. Remarkably, these wonderful letters and his diary for 1911, have survived. He tells us about his life in London before he leaves, and the girl who has stolen his affections. On the journey to Mozambique aboard a luxury steamer he gives us glimpses of the places they stop at on the way – as they were in 1911. In Mozambique we learn about the difficulties they faced with the local tribes while ‘on safari’ – human heads were posted outside some of the villages!

On the personal side we feel his acute disappointment as week after week the mail bag comes in with nothing for him, and we read how he conceals his deteriorating health from his parents. Everyone was sick with malaria and eventually Arthur collapsed with blackwater fever, a particularly dangerous form. On arrival in hospital he was not expected to live, and a report of his death was telegraphed back to England. But luckily for science, eleven days later, he was up and well!

In trying to understand the ancient rocks of Mozambique, Arthur realised that the first thing to do was to understand the order in which the rocks had been laid down. He realised more than ever the need for a time scale with which he could date the rocks and which would throw a fresh light ‘on the more fascinating problems of the Earth and its Past’. With this vision he determined to get back to the lab and start work. Back in London, Arthur worked hard, pushing back the boundaries of geological time, and soon obtained a staggering 1,600 million years (1.6 billion!) for the age of the Earth. Now geologists had an ‘embarrassment of Time’ and the majority could not accept these vast timescales. While Lord Kelvin had deprived them of time, Arthur Holmes gave them too much.

Despite his growing reputation as a scientist, Arthur was continually passed over at College for higher positions. Now with a young family to support, his finances (or lack of them) once again became a problem, but jobs were scarce just after the First World War. So in 1920 Arthur took a post as chief geologist with Yomah Oil to search for oil in Burma. Initially life in Burma was fun and exciting but another diary records his increasing frustration as the company failed to pay its bills and salaries. Despite heroic attempts to obtain money owed to him he got deeper and deeper into debt until finally there was nothing left to do but come home – but he had hung on too long. Just before the family left, his three year old son caught dysentery. There was little the doctors could do for one so young. Arthur and his wife left their son in Burma, with a bunch of flowers and a wooden cross on his grave.

Success at last!

Back in England, with no child, no money and nowhere to live, life looked very grim. Arthur took a job selling vacuum cleaners and then opened a shop. It was nearly 2 years before he could get back to dating the Earth, but when he did, a period of tremendous activity began. The age of the Earth was pushed back first to 2 billion and then 3 billion years old, whereupon it was older than the age of the Universe! This greatly worried the astronomers, but not the geologists who, this time, knew they were right!

In America during the Second World War, many scientists had worked on developing the atom bomb in which uranium was the main ingredient. As a result, major progress was made on new instruments (mass spectrometers) that were also used to measure the amount of lead and uranium in rocks. So by the end of the war, with some new data provided by a young American physicist called Alfred Nier, Arthur calculated the age of the Earth to be 3.35 billion years. It was slowly going up. Only another billion or so to go!



In 1946 Arthur Holmes dated the Earth to be 3.35 billion years

With the new instruments that were available, better and better and better dates were coming out and over the next decade more and more people started to work on the problem. But by now Arthur was an old man, and not very well. In the year that he retired (1956) another young American, Claire Patterson, got a much older date for the Earth. He made it 4.5 billion and in the 50 years since that time, that age has hardly changed. Not only that, but we now know that meteorites and the moon are also 4.5 billion years old – suggesting that they all formed together from the same material.



Claire Patterson who finally dated the Earth at 4.55 billion years.
California Institute of Technology

Dating dinosaurs

So how does all this help us find out how old the dinosaurs are? Well, this again brings us back to Arthur Holmes. As he kept finding older and older rocks, what he did was build a timescale, so that all the different geological periods were eventually given a date. Today, every rock we find can be fitted into that scale, if we know the geological period that it came from, and a date given to it. So we do not date the dinosaurs themselves, but the rocks in which they are found. With additional help from other fossils, such as ammonites, found in the same rocks as the dinosaurs, we can now date them very precisely.

Cherry Lewis

Cherry Lewis is the author of *THE DATING GAME – One Man's Search for the Age of the Earth* (Cambridge University Press), in which she tells the full story of Arthur Holmes' struggle to date the age of the Earth, despite financial hardship, scientific opposition and personal tragedy. Her engaging writing combines an account of the history of dating the Earth and how radioactivity is used to date rocks, with the biography of Arthur Holmes – the leading pioneer in this field. The Dating Game is available online from www.Amazon.com where you can read more about it.

Cherry has had a life-long passion for rocks and fossils. After Drama College and running her own clothes business for several years, she finally decided to indulge her passion and studied geology as a mature student. Her degree was succeeded by a PhD which led to a career in the oil industry. She is now a free-lance writer who delights in telling people about the wonders of geology, and science in general. She has 2 sons and lives in Cheshire, England.