



'An inward view of Stonehenge from the North', drawing by Dr William Stukeley, 1722. CC BY-SA 3.0

UNFREEZING TIME

Patricia Fara

How old is Stonehenge? Even the latest scientific technology yields no precise answer. Best estimates are that construction started over 5000 years ago, and that the site had been important for another 5000 before that. Such vast time spans would have been unthinkable five hundred years ago, when many people believed that the entire universe was only 6000 years old. But by the middle of the eighteenth century, long before Victorian scientists stretched out the age of the earth, traditional biblical chronology was already being challenged.

Britain's greatest Stonehenge expert was a clergyman called William Stukeley (1687–1765), who visited the site frequently during the early 1720s, making far more detailed measurements and drawings than any of his predecessors. But he delayed publishing his major book on the stones until 1740, by which time he had embarked on an ambitious (but never completed) seven-volume work to be called *Patriarchal Christianity: or, a Chronological History of the Origin and Progress of the true Religion, and of Idolatry*. By then more committed to speculative theology than

to scientific archaeology, Stukeley had rejected earlier theories that Stonehenge was built by the Romans or the Danes. Instead, he was determined to push its origins still further back to the age of the Druids.

To support his arguments, Stukeley hatched an ingenious way to use the monument as a giant clock. He turned for advice to his older colleague the Astronomer Royal, Edmond Halley, the subject of the portrait reproduced here. Halley (1656–1742) is most famous for a different type of cosmic chronometer – the comet now named after him that appears in the sky around every 76 years. In 1682, Isaac Newton carefully plotted its path through the heavens, but it was Halley who established the mysterious light's significance by scouring historical records to insist that this was not a one-off event, but a recurrent phenomenon.

Although embroidered in the Bayeux Tapestry as a six-month warning that William the Conqueror would invade, Halley's comet is not in reality a very reliable timekeeper: its period of orbit around the sun varies by up to five years, depending on the gravitational effects of the planets. But it did turn up pretty much on



Portrait of Edmond Halley by Michael Dahl, ca. 1736. © The Royal Society. 126.7 x 102.0 cms. I am grateful to the Royal Society for permission to reproduce this image.

cue in 1758 as predicted by Halley, thus finally convincing sceptical French philosophers to adopt Newton's theory of gravity.

By then, Halley was already dead, but as

well as studying the heavens, he had also been fascinated by the earth's invisible interior. When he posed for his last portrait at the age of eighty, he chose to hold a diagram that had

been produced over forty years earlier, but was scarcely referred to during the intervening decades. Because he is wearing dark clothes and a grey wig, the lighting emphasises the paper in his hand, which sketches out his plan of a subterranean world. The shaded rings indicate hollow – but not empty – spaces between solid concentric magnetic shells.

In his younger years, Halley repeatedly tried to explain why the patterns of terrestrial magnetism fluctuate, depending not only on the time of day but also on the place and the year. This was an important practical problem for sailors, who needed to know how much their compass needles deviated from the direction of geographic north. For his second attempt, he created a model that although simpler than the one illustrated here, remained influential right through the nineteenth century. Halley suggested that the earth has an outer magnetic crust separated by a fluid buffer from an inner rotating magnetic sphere. This structure would, he claimed, effectively give the earth four magnetic poles, constantly moving with respect to one another. By comparing this theoretical arrangement with available data, Halley concluded that it takes 700 years for a magnetic cycle to be completed.

Such physical estimates potentially provided valuable evidence for corroborating timescales of ancient history, such as the date of Noah's flood or the voyage of the Argonauts. Stukeley seized on Halley's figure to prove what he wanted to demonstrate – that the Druids constructed Stonehenge in around 460 BCE. By making detailed diagrams and measurements of the fallen stones, he ascertained that they belonged to an ancient temple whose alignment now fell at a small angle to the sun's direction at the summer solstice. Next, he took a creative leap. Assuming (with no justification) that the Druids had used compasses to orient their altar correctly, he argued that because a different magnetic state of the earth had prevailed while they were active, a compass needle would not have pointed in exactly the same direction as in the 1720s, when he was

investigating the site. By correlating his physical observations with information from literary and historical texts, Stukeley worked out how many periods of 700 years had elapsed, declaring triumphantly that his calculations corresponded closely with those of Newton and other experts on ancient chronology.

Halley himself was more concerned with the age of the universe than of Stonehenge. In the more complex version of his system shown here, an outer shell 500 miles thick surrounds three inner globes whose diameters are proportional to those of Venus, Mars and finally Mercury, a solid central magnetic ball 2,000 miles in diameter. Accused of being an atheist, 'a skeptick and a banterer of religion,' Halley desperately wanted to prove his Christian credentials while he was applying for an Oxford professorship. To support the orthodox view that the universe has a definite end, he postulated the existence of an invisible aether that was gradually slowing down all the heavenly bodies. To make the calculations work, the earth needed to be lighter, a difficulty he resolved by introducing hollow rings. But he added a sophistication that stretched belief still further. Arguing that God does nothing in vain, Halley speculated that these subterranean spaces might be illuminated and inhabited by living creatures, as if the Divine Designer had planned multi-storey buildings enabling more people to be squeezed into a city.

Despite Halley's efforts, the Oxford professorship went to another candidate. But as this portrait proves, at the end of his life he was still seeking to demonstrate that God's clockwork universe is slowly winding down.

Dr Patricia Fara is an historian of science and has been President of the AHS since 2016. This is number eight in a series of short articles in which she discusses a number of images, each illustrating a different way of incorporating time and its passing within a picture without showing a clock.