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0521813328 - The Chronologers' Quest: Episodes in the Search for the Age of the Earth

Patrick Wyse Jackson

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## The Chronologers' Quest

### Episodes in the Search for the Age of the Earth

The debate over the age of the Earth has been going on for at least two thousand years, and has pitted astronomers against biologists, religious philosophers against geologists. *The Chronologers' Quest* tells the fascinating story of our attempts to determine a true age for our planet.

This book investigates the many methods used in the search: the biblical chronologies examined by James Ussher and John Lightfoot; the estimates of cooling times made by the Comte de Buffon and Lord Kelvin; and the more recent investigations of Arthur Holmes and Clair Patterson into radioactive dating of rocks and meteorites.

*The Chronologers' Quest* is a readable account of the measurement of geological time. Little scientific background is assumed, and the book will be of interest to lay readers and earth scientists alike.

PATRICK WYSE JACKSON is a lecturer in geology and curator of the Geological Museum in Trinity College Dublin, and is a member of the International Commission on the History of Geological Sciences.

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EON	ERA	PERIOD	EPOCH	AGE	
PHANEROZOIC	CENOZOIC	NEOGENE	HOLOCENE	0.012	
			PLEISTOCENE	1.8	
			PLIOCENE		
			MIOCENE	5.3	
		PALEOGENE	OLIGOCENE	23	
			EOCENE	34	
			PALEOCENE	56	
			-----		65
			MESOZOIC	CRETACEOUS	-----
	JURASSIC	-----		200	
	TRIASSIC	-----		251	
	PERMIAN	-----		299	
	PALAEOZOIC	CARBONIFEROUS	PENNSYLVANIAN	318	
			MISSISSIPPIAN	359	
		DEVONIAN	-----		416
		SILURIAN	-----		444
		ORDOVICIAN	-----		488
		CAMBRIAN	-----		542
		PROTEROZOIC			
ARCHEAN				4,550	
ORIGIN OF THE EARTH					

The Geological Column with the age in millions of years of the start of each major stratigraphical unit (simplified and modified from the International Stratigraphic Chart published in *Episodes* 27, part 2 (2004), 85).

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PATRICK WYSE JACKSON

*Trinity College Dublin*



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*To Vanessa in Dublin, and Marcus and Eric  
in Carlisle, Pennsylvania*

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## Preface

Geologists have been much censured  
for vainly endeavouring to assign measures of time  
to the seemingly vague and shadowy ages  
of the Trilobites and Belemnites.

John Phillips (1800–1874), *Life on the Earth, its Origin and Succession* (1860)

Some drill and bore  
The solid earth and from the strata there  
Extract a register, by which we learn  
That He who made it and reveal'd its date  
To Moses, was mistaken in its age.

William Cowper (1731–1800), *The Task* (1785)

I have two main reasons for writing this book, and both have their origins in family matters. A few years ago I spent a fortnight with my wife and two young daughters on holiday on the Dingle Peninsula, in southwest Ireland. This area of immense scenic beauty and cultural significance is also an area of 'classic' geology. As an undergraduate student I had followed in the footsteps of geologists such as George Victor Du Noyer, a noted antiquarian and watercolourist, and Joseph Beete Juke, his boss in the Geological Survey of Ireland, in mapping some Silurian and Devonian sediments that formed the backbone of the peninsula. I doubt I produced a fuller and more accurate map than did these early pioneers. I recalled with feeling, during the first three damp, rain-sodden days of our holiday, the remark of Sir Roderick Impey Murchison, one-time Director of the Geological Survey of Great Britain, who declared, having endured two weeks of such weather, that 'there was nothing of interest in Irish geology'.

However, the changing weather conditions, allied with the splendid sunsets that we witnessed during the first week of our holiday, clearly left its mark on my elder daughter. She saw beautiful salmon-pink clouds streaking across the Kerry sky, which reflected

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the favourite culinary dish of my wife. She heard about the unusual 'green flash' that occasionally accompanied the very last vestiges of the orange sphere as it disappeared beneath the distant horizon – but was not fortunate enough to see it. This daily cycle of dawn, morning, afternoon and sunset got her thinking, and out of the blue as we crossed the mountainous road of the Connor Pass, a little voice from the back of the car asked, 'Mummy, how long ago did the world begin?' Quickly, realising my interest in the subject, my wife deflected the question to me.

'How long ago did the world begin?', I thought, pausing to reflect on the complexity and indeed simplicity of such a question from a person who had only celebrated her fifth birthday a month earlier. If I had attempted to fob her off with a response such as 'Oh, a long time ago' or 'Well, sometime before Granny was born', I knew that this would have been most unsatisfactory from the perspectives of both Susanna and myself. 'The world is over four thousand million years old,' I replied as I turned around. 'That's a lot of noughts, isn't it,' she thought out loud. And she was right, it is a lot. For a few moments she took this in, and appreciated that the world was very old indeed.

On my return to the city, I met up with my youngest brother Michael for our usual weekly lunchtime escape from respective offices and he handed me two items. One was a book and the other a large roll of paper. He was aware that I was beginning this book, and said, 'You're interested in James Ussher. Have a look at these.' The book was a small green octavo volume entitled *The Life and Times of Archbishop Ussher*, written by a Reverend J.A. Carr, Rector of Whitechurch, a small parish situated four miles south of Dublin that nestles on the northern slopes of the local granitic mountains. He had found it on a upper shelf in a bookcase in my mother's house, and I was delighted that he had, as I had been trying to track down a copy of Carr's book, perhaps the best and most accessible biographical treatment of the Archbishop published in the nineteenth century. The second item, the large roll of paper, proved to be of great personal interest, but unfortunately of less use to me here. I carefully unrolled

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the four-foot-long document on the table and saw it was a family tree. Right at the top was written 'Henry Jones = Margaret Ussher (sister of the Primate)'. I gazed at the multitude of names and dates, interconnected by a maze of straight and wavy lines, and passed my eyes over several generations. Another Henry Jones listed was Bishop of Meath between 1661 and 1682 and was responsible for rescuing the Book of Kells, the seventh century version of the Gospels, from a bog in County Meath. This, the finest of Irish illuminated manuscripts, is on show in the Library of Trinity College Dublin, where it is seen by nearly a million tourists each year. Another character by the splendid name of Rashleigh Belcher caught my eye. He was a medical doctor who practised in the market town of Bandon in County Cork. I finally made my way down to the bottom of the document and there in plain black ink was my name. Amazed, I turned to my brother and remarked, 'We're related by marriage to James Ussher!' and added with a laugh, 'Mum's family is quite interesting after all, but it's a pity that they didn't hang on to the Book of Kells!' Buoyed up by this unexpected piece of genealogical coincidence, I returned home, turned on the computer and began to type.

Like my daughter, so many others have pondered the age of living organisms and also of the Earth. Biologists can examine the ontogeny of an organism for an indication of its age. As growth proceeds, the individual or colonial organism undergoes change. We are all aware of the stark changes in humans that distinguish infants from pre-pubescent children, and adolescents from fully grown adults. With adulthood these changes become less perceptible, but occur nevertheless. Hair colour changes, hair loss in many males increases, ears in men often become larger, and so on. In humans, it is easy to determine the age of an individual simply by asking, although this may still draw a blank. It is perhaps somewhat indelicate to ask the elderly their age. If they refuse to answer, or worse still cannot remember, one can raid the desk bureau and pull out the folded and faded birth certificate that will supply the answer. Although similar certificates might supply the information on the age of thoroughbred horses

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or of Cruft's champions, such certificates do not exist for most of the living organisms on Earth, nor for the inanimate Earth itself. For these we have to rely on other chronological indicators.

The early twentieth-century English microvertebrate palaeontologist W. C. Swinton was interested in Eocene fish, and conducted a careful study of the bones found in their ears. These otoliths are the shape of dinner plates, but much smaller. What he found was that they appeared to be composed of skeleton deposited in concentrically arranged patterns. He showed that these rings could be used to accurately age a fish. Similarly, the horsemen of the Tashkent plains or the wet fields around Ballinasloe in the west of Ireland can tell the age of a prospective purchase by looking into the horse's mouth and examining the condition of its teeth. They can rapidly tell if a horse claimed to be a three-year-old is rather longer in the tooth than that, and consequently worth much less. The age of trees is widely determined by ring counting, and this science of dendrochronology has proved to be a valuable resource in the study of past climates and an indicator of possible future climate changes.

But the Earth has no ears containing otoliths, nor does it have teeth or annual rings. It presents a complex array of indicators which philosophers, scientists and men of the cloth over at least two millennia have examined to answer the question: how old is the Earth?

This book presents the fascinating story of our attempts to determine the age of the Earth on which we all live. Since earliest times we have attempted to understand the nature of the Earth and its formation. Estimates of its antiquity have varied considerably from low biblically derived timescales to recently derived higher ages based on meteorites. Many novel methods have been pressed into service. Researchers have examined the biblical chronologies, the cooling rate of the Earth, rates of erosion and the thickness of sedimentary rocks, the saltiness of the oceans, the radioactivity of the rocks, and the constituents of the Moon and meteorites. All have been important steps in the evolution of this theme, and have contributed to our present understanding of the Earth.

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The debate that has been going on for over two thousand years has pitted various protagonists against each other: biblical versus non-biblical chronologers; physicists versus geologists; and more recently scientists versus creationists. At the turn of this present century a consensus has been reached amongst the scientific community and the majority of the general public that the Earth is four and a half thousand million years old.

Can we style these geological and biblical investigators 'chronologers' as I have done in the title of this book? Yes, I believe that it is perfectly acceptable to do so. According to the *Oxford English Dictionary* a chronologer is one versed in chronology; 'One who studies chronology, one who investigates the date and order in time of events' – in this case, the date of the origin of the Earth.

This book examines a number of episodes in the debate, starting with the ideas of some ancient civilisations and finishing with the present state of our understanding of this concept. It does not set out to produce new research facts; rather it brings together the strands of diverse research in geology, astronomy and religious chronology and aims to make the whole story of the dating of the Earth available to a new body of readers not conversant with the scientific literature.

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them. I am happy to count both Charles and Gordon as friends, and appreciate all that they have done for me.

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I am grateful to Matt Lloyd, my commissioning editor at Cambridge University Press, for his encouragement, dedication and patience.

Finally I thank my family, Vanessa, Susanna and Katie, who at times didn't see much of me when I ascended the stairs to the study to write this book, and when they did see me had to put up with discussions about Ussher, Buffon, Kelvin *et al.* I hope they feel that it has been worth the wait.