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How to Build a Habitable Planet
God and the Astronomers

Lord Kelvin And The Age Of The Earth

JEFFERSON WILSON

The Age of the Earth National Academies Press
Questions of national identity have long dominated China’s political, social, and cultural horizons. So in the early 1900s, when diverse groups in China began to covet foreign science in the name of new technology and modernization, questions of nationhood came to the fore. In Unearthing the Nation, Grace Yen Shen uses the development of modern geology to explore this complex relationship between science and nationalism in Republican China. Shen shows that Chinese geologists—in battling growing Western and Japanese encroachment of Chinese sovereignty—faced two ongoing challenges: how to develop objective, internationally recognized scientific authority without effacing native identity, and how to serve China when China was still searching for a stable national form. Shen argues that Chinese geologists overcame these obstacles by experimenting with different ways to associate the subjects of their scientific study, the land and its features, with the object of their political and cultural loyalties. This, in turn, led them to link national survival with the establishment of scientific authority in Chinese society. The first major history of modern Chinese geology, Unearthing the Nation introduces the key figures in the rise of the field, as well as several key organizations, such as the Geological Society of China, and explains how they helped bring Chinese geology onto the world stage.
Uncertainty University of Chicago Press
In Mysteries of Terra Firma, James Lawrence Powell tells an engrossing three-part tale of how we came to understand the ground on which we walk, and how that ground holds the key to the greatest secrets of deep space and time. Naming his profound stories Time, Drift, and Chance, he tells of the three twentieth-century revolutions in thought that created the amazing science of Earth -- and of all planets to the edge of the universe. The riddle that drove the first revolution is obvious and yet in 1904 remained impenetrable: how old is Earth? An encounter between the imperious Lord Kelvin and a New Zealand farm-boy-turned-physicist, Ernest Rutherford, set the stage for the solution and launched a golden century of geology. As a result, scientists learned that if the 4.5 billion years of geologic time were compressed into a single twenty-four-hour period, Homo sapiens would have arrived only in the last second. The geological Revolution of Time reveals how long the ground on which we walk has existed, and how briefly we have trod that ground. In the early twentieth century, German meteorologist and polar explorer Alfred Wegener proposed a counterintuitive, heretical theory: that terra firma is not so firm; instead of being fixed in place, continents drift. In 1926, petroleum geologists convened in New York City to discuss Wegener's radical idea, where it was met with outrage and skepticism: "If we are to believe Wegener's hypothesis we must forget everything which has been learned in the last seventy years and start all over again," one attendee said. Forty years later, a new generation did exactly that. The Revolution of Drift, the second part of Powell's narrative, showed us how the ground on which we walk moves. Throughout geologic time, meteorites have incessantly bombarded everything in the solar system. Far from serene and predictable, the planets are ruled by random violence on an unimaginable scale. Once a mountain-sized meteorite flew through space, struck the Earth, killed the dinosaurs and two-thirds of all species, and spared the small hamster-sized creature that happened to be our ancestor. The chance of that happening again is essentially zero. So, the final revolution in Powell's history of a golden century of geology is the Revolution of Chance. Simply put, this revolution in thought has transformed our understanding of how lucky we really are. If we can learn so much from considering no more than the rocks beneath our feet, what will we learn when we begin walking on other planets? Mysteries of Terra Firma is both charming in its storytelling and staggering in its implications. Discovering the ground on which we stand is a fascinating journey into our past -- and our future.
The Earth on Show Anchor
An engaging introduction to marine chemistry and the ocean's geochemical interactions with the solid earth and atmosphere, for students of oceanography.
The Dating Game Simon and Schuster
How old is the Earth? At the end of the 19th century, geologists, biologists, physicists and astronomers were all looking for a clock that would provide an answer to this greatest time question of all. Here is the story of one man's vision in developing a geological time scale that would finally lead to an accurate date for the age of the Earth
An Essay on the Application of Mathematical Analysis to the Theories of Electricity and Magnetism University of Chicago Press
This study of Lord Kelvin, the most famous mathematical physicist of 19th-century Britain, delivers on a speculation long entertained by historians of science that Victorian physics expressed in its very content the industrial society that produced it.
The Life of Lord Kelvin Geological Society of America
This book spells out in detail how the age of the Earth has been determined over the centuries. First — the 'biblical' age: how was the date of Creation 4004 BC figured out? A date which is so important even today ... it is the basis of claims made by millions that the Earth is only about 6000 years old. Next — the response of geologists (and Darwin) for a very old Earth. Then, Kelvin's calculation of how long it would take for a hot Earth to cool down to its present state. And finally, today's answer ('billions'), based on the properties of radioactive materials. So, how old is Planet Earth?
Story-Lives of Great Musicians University of Chicago Press
“Anyone who is not shocked by quantum theory has not understood it.” Since Niels Bohr said this many years ago, quantum mechanics has only been getting more shocking. We now realize that it’s not really telling us that “weird” things happen out of sight, on the tiniest level, in the atomic world: rather, everything is quantum. But if quantum mechanics is correct, what seems obvious and right in our everyday world is built on foundations that don’t seem obvious or right at all—or even possible. An exhilarating tour of the contemporary quantum landscape, Beyond Weird is a book about what quantum physics really means—and what it doesn’t. Science writer Philip Ball offers

an up-to-date, accessible account of the quest to come to grips with the most fundamental theory of physical reality, and to explain how its counterintuitive principles underpin the world we experience. Over the past decade it has become clear that quantum physics is less a theory about particles and waves, uncertainty and fuzziness, than a theory about information and knowledge—about what can be known, and how we can know it. Discoveries and experiments over the past few decades have called into question the meanings and limits of space and time, cause and effect, and, ultimately, of knowledge itself. The quantum world Ball shows us isn't a different world. It is our world, and if anything deserves to be called "weird," it's us.

From Stars To Stalagmites: How Everything Connects Library of Alexandria

A classic introduction to the story of Earth's origin and evolution—revised and expanded for the twenty-first century Since its first publication more than twenty-five years ago, How to Build a Habitable Planet has established a legendary reputation as an accessible yet scientifically impeccable introduction to the origin and evolution of Earth, from the Big Bang through the rise of human civilization. This classic account of how our habitable planet was assembled from the stuff of stars introduced readers to planetary, Earth, and climate science by way of a fascinating narrative. Now this great book has been made even better. Harvard geochemist Charles Langmuir has worked closely with the original author, Wally Broecker, one of the world's leading Earth scientists, to revise and expand the book for a new generation of readers for whom active planetary stewardship is becoming imperative. Interweaving physics, astronomy, chemistry, geology, and biology, this sweeping account tells Earth's complete story, from the synthesis of chemical elements in stars, to the formation of the Solar System, to the evolution of a habitable climate on Earth, to the origin of life and humankind. The book also addresses the search for other habitable worlds in the Milky Way and contemplates whether Earth will remain habitable as our influence on global climate grows. It concludes by considering the ways in which humankind can sustain Earth's habitability and perhaps even participate in further planetary evolution. Like no other book, How to Build a Habitable Planet provides an understanding of Earth in its broadest context, as well as a greater appreciation of its possibly rare ability to sustain life over geologic time. Leading schools that have ordered, recommended for reading, or adopted this book for course use: Arizona State University Brooklyn College CUNY Columbia University Cornell University ETH Zurich Georgia Institute of Technology Harvard University Johns Hopkins University Luther College Northwestern University Ohio State University Oxford Brookes University Pan American University Rutgers University State University of New York at Binghamton Texas A&M University Trinity College Dublin University of Bristol University of California-Los Angeles University of Cambridge University Of Chicago University of Colorado at Boulder University of Glasgow University of Leicester University of Maine, Farmington University of Michigan University of North Carolina at Chapel Hill University of North Georgia University of Nottingham University of Oregon University of Oxford University of Portsmouth University of Southampton University of Ulster University of Victoria University of Wyoming Western Kentucky University Yale University

The Janus Point Penn State University Press

"Drawing on the lives of five great scientists -- Charles Darwin, William Thomson (Lord Kelvin), Linus Pauling, Fred Hoyle and Albert Einstein -- scientist/author Mario Livio shows how even the greatest scientists made major mistakes and how science built on these errors to achieve breakthroughs, especially into the evolution of life and the universe"--

Strata Basic Books

This book takes a long-term view of Earth's development as a habitable planet, incorporating physical, chemical and biological processes on the early Earth, through to human perturbations of the modern world and their implications for life in the future.

Lord Kelvin and the Age of the Earth CreateSpace

At the turn of the nineteenth century, geology—and its claims that the earth had a long and colorful prehuman history—was widely dismissedasdangerous nonsense. But just fifty years later, it was the most celebrated of Victorian sciences. Ralph O'Connor tracks the astonishing growth of geology's prestige in Britain, exploring how a new geohistory far more alluring than the standard six days of Creation was assembled and sold to the wider Bible-reading public. Shrewd science-writers, O'Connor shows, marketed spectacular visions of past worlds, piquing the public imagination with glimpses of man-eating mammoths, talking dinosaurs, and sea-dragons spawned by Satan himself. These authors—including men of science, women, clergymen, biblical literalists, hack writers, blackmailers, and prophets—borrowed freely from the Bible, modern poetry, and the urban entertainment industry, creating new forms of literature in order to transport their readers into a vanished and alien past. In exploring the use of poetry and spectacle in the promotion of popular science, O'Connor proves that geology's success owed much to the literary techniques of its authors. An innovative blend of the history of science, literary criticism, book history, and visual culture, The Earth on Show rethinks the relationship between science and literature in the nineteenth century.

Brilliant Blunders Cambridge University Press

In a universe filled by chaos and disorder, one physicist makes the radical argument that the growth of order drives the passage of time -- and shapes the destiny of the universe. Time is among the universe's greatest mysteries. Why, when most laws of physics allow for it to flow forward and backward, does it only go forward? Physicists have long appealed to the second law of thermodynamics, held to predict the increase of disorder in the universe, to explain this. In The Janus Point, physicist Julian Barbour argues that the second law has been misapplied and that the growth of order determines how we experience time. In his view, the big bang becomes the "Janus point," a moment of minimal order from which time could flow, and order increase, in two directions. The Janus Point has remarkable implications: while most physicists predict that the universe will become mired in disorder, Barbour sees the possibility that order -- the stuff of life -- can grow without bound. A major new work of physics, The Janus Point will transform our understanding of the nature of existence.

Energy and Empire Vintage

The quest to pinpoint the age of the Earth is nearly as old as humanity itself. For most of history, people trusted mythology or religion to provide the answer, even though nature abounds with clues to the past of the Earth and the stars. In A Natural History of Time, geophysicist Pascal Richet tells the fascinating story of how scientists and philosophers examined those clues and from them built a chronological scale that has made it possible to reconstruct the history of nature itself. Richet begins his story with mythological traditions, which were heavily influenced by the seasons and almost uniformly viewed time cyclically. The linear history promulgated by Judaism, with its story of creation, was an

exception, and it was that tradition that drove early Christian attempts to date the Earth. For instance, in 169 CE, the bishop of Antioch, for instance declared that the world had been in existence for “5,698 years and the odd months and days.” Until the mid-eighteenth century, such natural timescales derived from biblical chronologies prevailed, but, Richet demonstrates, with the Scientific Revolution geological and astronomical evidence for much longer timescales began to accumulate. Fossils and the developing science of geology provided compelling evidence for periods of millions and millions of years—a scale that even scientists had difficulty grasping. By the end of the twentieth century, new tools such as radiometric dating had demonstrated that the solar system is four and a half billion years old, and the universe itself about twice that, though controversial questions remain. The quest for time is a story of ingenuity and determination, and like a geologist, Pascal Richet carefully peels back the strata of that history, giving us a chance to marvel at each layer and truly appreciate how far our knowledge—and our planet—have come.

That's Maths University of Chicago Press

Feynman once selected, as the single most important statement in science, that everything is made of atoms. It follows that the properties of everything depend on how these atoms are joined together, giving rise to the vast field we know of today as chemistry. In this unique book specifically written to bridge the gap between chemistry and the layman, Braterman has put together a series of linked essays on chemistry related themes that are particularly engaging.The book begins with the age of the earth, and concludes with the life cycle of stars. In between, there are atoms old and new, the ozone hole mystery and how it was solved, synthetic fertilisers and explosives, reading the climate record, the extraction of metals, the wetness of water, and how the greenhouse effect on climate really works. A chapter in praise of uncertainty leads on to the “fuzziness” and sharing of electrons, and from there to molecular shape, grass-green and blood-red, the wetness of water, and molecular recognition as the basis of life.Organised in such a way as to illustrate and develop underlying principles and approaches, this book will appeal to anyone interested in chemistry, as well as its history and key personalities. Where many other titles have failed, this book succeeds brilliantly in capturing the spirit and essence of chemistry and delivering the science in easily digestible terms.

The Age of the Earth Cambridge University Press

“Tells the story . . . of how ‘natural philosophers’ developed the ideas of geology accepted today . . . Fascinating.” —San Francisco Book Review Earth has been witness to dinosaurs, global ice ages, continents colliding or splitting apart, and comets and asteroids crashing, as well as the birth of humans who are curious to understand it. But how was all this discovered? How was the evidence for it collected and interpreted? In this sweeping and accessible book, Martin J. S. Rudwick, the premier historian of the Earth sciences, tells the gripping human story of the gradual realization that the Earth’s history has not only been long but also astonishingly eventful. Rudwick begins in the seventeenth century with Archbishop James Ussher, who famously dated the creation of the cosmos to 4004 BC. His narrative later turns to the late eighteenth and early nineteenth centuries, when geological evidence was used—and is still being used—to reconstruct a history of the Earth that is as varied and unpredictable as human history. itself. Along the way, Rudwick rejects the popular view of this story as a conflict between science and religion and shows how the modern scientific account of the Earth’s deep history retains strong roots in Judeo-Christian ideas. Extensively illustrated, Earth’s Deep History is an engaging and impressive capstone to Rudwick’s distinguished career. “Deftly explains how ideas of natural history were embedded in cultural history.” —Nature “An engaging read for nonscientists and specialists alike.” —Library Journal “Wonderfully erudite and absorbing.” —Times Literary Supplement “Fascinating, well written, and novel . . . Essential.” —Choice “Thrilling.” —London Review of Books

A Natural History of Time CRC Press

William Thompson (1824-1907), later Lord Kelvin, was the foremost scientific figure of an age that saw the quest of classical physics concluded and marked the beginning of the modern era of atomic physics and relativity. Kelvin's role in the 19th-century scientific revolution can be compared with Newton's position in the 17th century and Einstein's in the 20th. Kelvin meets no simple definition of scientist-engineer. The reader of his biography will be introduced to an extraordinary figure of a past era who in no way fits the image of the modern specialist. It is just this characteristic of Kelvin's life that will take readers, scientists and nonscientists, into the wider universe of technological innovation derived from scientific theory. Kelvin's ideas are expressed in words, not in the language of mathematics. Kelvin directly influenced James Clerk Maxwell, whose work culminated in the electromagnetic theory of light, the theory that ushered in the modern period of electrical science and technology. Kelvin's work on the Atlantic cable shortened the space between Europe and America from weeks to seconds. His controversy with the Darwinians resulted in one of the few scientific debates that the Victorian public followed. Kelvin was the nonpareil scientist of the 19th century, and his biography encompasses the dynamic scientific changes of the Victorian age.

Physicists of Ireland Simon and Schuster

From atom bombs to rebounding slinkies, open your eyes to the mathematical magic in the everyday. Mathematics isn't just for academics and scientists, a fact meteorologist and blogger Peter Lynch has spent the past several years proving through his Irish Times newspaper column and blog, That's Maths.Here, he shows how maths is all around us, with chapters on the beautiful equations behind designing a good concert venue, predicting the stock market and modelling the atom bomb, as well as playful meditations on everything from coin-stacking to cartography. If you left school thinking maths was boring, think again!

The Mountain Mystery Stanford University Press

Lord Kelvin was one of the greatest physicists of the Victorian era. Widely known for the development of the Kelvin scale of temperature measurement, Kelvin's interests ranged across thermodynamics, the age of the Earth, the laying of the first transatlantic telegraph cable, not to mention inventions such as an improved maritime compass and a sounding device which allowed depths to be taken both quickly and while the ship was moving. He was an academic engaged in fundamental research, while also working with industry and technological advances. He corresponded and collaborated with other eminent men of science such as Stokes, Joule, Maxwell and Helmholtz, was raised to the peerage as a result of his contributions to science, and finally buried in Westminster Abbey next to Newton. This book contains a collection of chapters, authored by leading experts, covering the life and wide-ranging scientific contributions made by William Thomson, Lord Kelvin (1824-1907).

An Introduction to the Chemistry of the Sea Princeton University Press

LORD KELVIN. In 1840, a precocious 16-year-old by the name of William Thomson spent his summer vacation studying an extraordinarily sophisticated mathematical controversy. His brilliant analysis inspired lavish praise and made the boy an instant intellectual celebrity. As a young scholar William dazzled a Victorian society enthralled with the seductive authority and powerful beauty of scientific discovery. At a time when no one really understood heat, light, electricity, or magnetism, Thomson found key connections between them, laying the groundwork for two of the cornerstones of 19th century science-the theories of electromagnetism and thermodynamics. Charismatic, confident, and boyishly handsome, Thomson was not a scientist who labored quietly in a lab, plying his trade in monkish isolation. When scores of able tinkerers were flummoxed by their inability to adapt overland telegraphic cables to underwater, intercontinental use, Thomson took to the high seas with new equipment that was to change the face of modern communications. And as the world's navies were transitioning from wooden to iron ships, they looked to Thomson to devise a compass that would hold true even when surrounded by steel. Gaining fame and wealth through his inventive genius, Thomson was elevated to the peerage by Queen Victoria for his many achievements. He was the first scientist ever to be so honored. Indeed, his name survives in the designation of degrees Kelvin, the temperature scale that begins with absolute zero, the point at which atomic motion ceases and there is a complete absence of heat. Sir William Thomson, Lord Kelvin, was Great Britain's unrivaled scientific hero. But as the century drew to a close and Queen Victoria's reign ended, this legendary scientific mind began to weaken. He grudgingly gave way to others with a keener, more modern vision. But the great physicist did not go quietly. With a ready pulpit at his disposal, he publicly proclaimed his doubts over the existence of atoms. He refused to believe that radioactivity involved the transmutation of elements. And believing that the origin of life was a matter beyond the expertise of science and better left to theologians, he vehemently opposed the doctrines of evolution, repeatedly railing against Charles Darwin. Sadly, this pioneer of modern science spent his waning years arguing that the Earth and the Sun could not be more than 100 million years old. And although his early mathematical prowess had transformed our understanding of the forces of nature, he would never truly accept the revolutionary changes he had helped bring about, and it was others who took his ideas to their logical conclusion. In the end Thomson came to stand for all that was old and complacent in the world of 19th century science. Once a scientific force to be reckoned with, a leader to whom others eagerly looked for answers, his peers in the end left him behind-and then meted out the ultimate punishment for not being able to keep step with them. For while they were content to bury him in Westminster Abbey alongside Isaac Newton, they used his death as an opportunity to write him out of the scientific record, effectively denying him his place in history. Kelvin's name soon faded from the headlines, his seminal ideas forgotten, his crucial contributions overshadowed. Destined to become the definitive biography of one of the most important figures in modern science, Degrees Kelvin unravels the mystery of a life composed of equal parts triumph and tragedy, hubris and humility, yielding a surprising and compelling portrait of a complex and enigmatic man.

Unearthing the Nation University of Chicago Press

The gripping, entertaining, and vividly-told narrative of a radical discovery that sent shockwaves through the scientific community and forever changed the way we understand the world. Werner Heisenberg’s “uncertainty principle” challenged centuries of scientific understanding, placed him in direct opposition to Albert Einstein, and put Niels Bohr in the middle of one of the most heated debates in scientific history. Heisenberg’s theorem stated that there were physical limits to what we could know about sub-atomic particles; this “uncertainty” would have shocking implications. In a riveting and lively account, David Lindley captures this critical episode and explains one of the most important scientific discoveries in history, which has since transcended the boundaries of science and influenced everything from literary theory to television.

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