far too often he insists that "what is not expressly permitted is forbidden; substances or processes must be demonstrated to be benign before they can be used". Zimmerman argues for precaution in the face of possible but unproven danger. Wildavsky argues that "the search for possibilities is endless" and that it diverts scarce resources from more beneficial purposes.

The largest issue addressed by Zimmerman is global warming. He observes that "the scientific community has reached a greater degree of agreement on the issue of global warming than on virtually any other environmental concern.... The scientists [of the Intergovernmental Panel on Climate Change (IPCC)]... conclude that immediate action must be taken." Unfortunately, the degree of agreement is not a satisfactory criterion for resolving scientific disagreements. Had the climatological consensus of the mid-1970s prevailed, and been attached to Zimmerman's version of the precautionary principle, governments around the world would have taken immediate action to warm up the world.

The IPCC example also conspicuously fails to support Zimmerman's attack on the believers in the literal truth of the Old Testament. The author of quotation (2) is Sir John Houghton, chairman of Britain's Royal Commission on Environmental Pollution and co-chairman of the Scientific Assessment Working Group of the IPCC. He was warning that God may persuade us to mend our ways with a disaster. He went on to say ("Me and My God", *Sunday Telegraph*, 10 September 1995) that "[i]f we want a good environmental policy in the future we'll have to have a disaster. It's like safety on public transport. The only way humans will react is if there's an accident." Sir John's view of divine cause and environmental effect would undoubtedly meet Zimmerman's criterion of "superstitious drivel". □

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Earth's timekeeper

Joel D. Blum

Radiogenic Isotope Geology. By Alan P. Dickin. *Cambridge University Press: 1995. Pp. 452. £65, $89.95.*

RADIOACTIVITY is the ultimate geological timepiece. To unravel the complex chronology of the Earth and meteorites (on timescales from years to billions of years), geologists use the products of nuclear transformations that occur in virtually all materials. Some radioactive nuclides with long half-lives have survived from their production in stars before the formation of our Solar System; some are extinct and detectable only by the presence of their daughter nuclides; others are produced in the Earth's atmosphere as it is bombarded by Galactic cosmic rays; and still others are produced as a by-product of nuclear technology.

The field of radiogenic isotope geology borrows from an eclectic mix of disciplines including geology, geochemistry, nuclear chemistry and applied physics. It has grown rapidly over the past 30 years, finding applications throughout the Earth sciences. Until recently, the most comprehensive textbook on the subject was G. Faure's *Principles of Isotope Geology* (Wiley, 1986), which covered both radiogenic and stable isotope geology. Alan Dickin's new book is a worthy successor, filling an important niche by providing an encyclopaedic, research-level review of the principles, methods and applications of radiogenic isotopes in geology.

Dickin clearly and concisely reviews an enormous breadth of literature, and includes 470 figures and nearly 1,200 references. He begins with an introduction to nucleosynthesis and nuclear decay and some common experimental techniques. He then moves on to the main topic of emphasis in the book, the application of radiogenic isotope parent–daughter systems to establishing the age and petrological history of terrestrial igneous, metamorphic and sedimentary rocks. This fits well with the historical approach he takes to explain developments in this field. He also does a commendable job in reviewing methods and applications of studies of rare-gas isotopes, uranium-series isotopes, fission tracks and cosmogenic nuclides, which have found broad applications in fields such as oceanography, atmospheric studies and surface geology. Finally, he discusses the link between isotope geology and astrophysics, reviewing the study of extinct nuclides found in meteorites and their role in establishing the early chronology of the Solar System. The book falls short of being comprehensive only in its limited focus on some of the newest applications of radiogenic isotopes to hydrogeology, ecology and environmental science.

This is a notable contribution to the scientific literature on radiogenic isotope geology. It provides a readable introduction to applications of radiogenic isotopes for scientists from other disciplines and an important reference for students and researchers working in isotope geology, as well as a glimpse into many of the future directions of the field. □

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Just airborne

C. J. Pennycuick

The Simple Science of Flight: From Insects to Jumbo Jets. By Henk Tennekes. *MIT Press: 1996. Pp. 137. $20, £13.95. UK publication, end of June.*

HENK Tennekes's theme is that flying animals and aircraft are based on the same physical principles, but, as he explains in the introduction, he regards animal flight as an amusing diversion from the serious work of aeronautical engineering. He extends Crawford H. Greenewalt's classical allometric graphs to show that planes too have weights, wing loadings and speeds that, given the useful properties of logarithmic graph paper, can be strewn about the same line as those of animals. He quotes Vance Tucker's early physiological measurements from the 1960s, and has mined a few more recent sources for weights and wing measurements, which he uses in his graphs and tables without attribution or comment.

The author's Dutch roots and his subsequent career in the United States are betrayed by the brutal mixture of SI, metric non-SI and even ancient British units, which are still used, bizarrely, by American engineers. This does not add to the clarity of his explanations and comparisons. The book is profusely illustrated, mostly by published photographs, which Tennekes or his publisher seems to have scanned into a computer and converted into line drawings. This is visually quite effective, and must save on copyright fees.

Journalists will enjoy rummaging for facts in this book, but those in search of an introduction to either aeronautics or animal flight will find its inadequacies frustrating. □

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