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MONOGRAPHIAE BIOLOGICAE 64

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individually purposeful vehicles are not necessary for selection, why are there so many of them? And why do multicellular organisms adopt a 'bottlenecked' life cycle?

The crucial distinction for Dawkins is not between sexual and asexual reproduction, but between those organisms that periodically go through cellular bottlenecks and those that do not. In the second case, no difference exists between growth and reproduction. Mutated cells find themselves clumped with distantly related cells that retain the original genetic make-up. But organisms that go through single-celled bottlenecks can go back to the drawing board. Instead of attempting to reorganize an entire organism, all that has to be modified is a single genome. Sequestering certain cells into germ lines facilitates the evolution of complex organisms. This mode of organization seems so advantageous, one wonders why it is not universal. Clonal organisms must be doing something right because they are still with us.

Although Dawkins grants that bare genes are invisible to natural selection, he

argues that natural selection acts on genes through differences in their phenotypic effects, and these effects need not stop at the boundaries of our bodies. They extend to all the effects that a gene has on the world, including responses in the behaviour of other organisms. Thus, both Dawkins's book and the responses to it count as part of his extended phenotype. In one place, he describes an adult dunnock feeding a cuckoo chick that it has been tricked into adopting. The dunnock is so much smaller than the cuckoo chick that it must perch on the back of this monstrous foster-child to feed it. Dawkins remarks that German ornithologists refer to such foster-parents as 'addicts' and their cuckoo nestlings as their 'vice'. As I read this description, I pictured him perched atop his theory attempting to feed its gaping mouth. Scientists give every appearance of being addicts, and science is their vice. That is one reason why progress in science is so rapid. I for one have benefited a great deal from Dawkins's addiction. □

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Facts of life

W. F. Bynum

The Timetables of Science. A Chronology of the Most Important People and Events in the History of Science.

By Alexander Helleman and Bryan Bunch. *Simon & Schuster, New York/Sidgwick & Jackson, London: 1988/89. Pp. 656, \$29.95, £19.95.*

Asimov's Chronology of Science and Discovery. By Isaac Asimov. *Harper & Row, New York: 1989. Pp. 707. \$29.95, £22.95.*

WHAT are we to make of the almost simultaneous publication of two chronological guides to the history of science and technology, especially when a third — *Breakthroughs: A Chronology of Great Achievements in Science and Mathematics* by Claire L. Parkinson (Mansell, 1985) — has already been remaindered? One conclusion is simply that publishers think such books will sell (despite the remaindered example). More significantly, perhaps, is the fact that scientists do think about the history of their endeavours chronologically. As popularly conceived, scientific knowledge is cumulative, in ways that make it matter that Newton came after Galileo, or Dalton followed Lavoisier. Dates also count in priority disputes, to say nothing of the excuse anniversaries provide for holding jamborees. Who knows, anniversary studies may even be recognized soon as an important branch of the history of science.

Some of the attractions and pitfalls of this emerging discipline are amply illustrated by the two books under review. Asimov's is the easier to read, because he writes short, discursive essays, mostly of around 200 words, for most of the discoveries or inventions covered. There is something for every year since 1793 and for most years from about 1600. It all becomes rather formulaic: 1902 and 1970 were good years, with eleven entries each, whereas 1958 and 1928 were rather ordinary, with only five. Fleming's discovery of penicillin gets about as much space as Marguerite Perey's discovery of francium, Diderot's *Encyclopédie* about as much as the fifth satellite of Jupiter (Amalthea).

Asimov ends with the greenhouse effect, 4,001,988 years after his first entry, on bipedality, thereby giving a symmetry to the volume — if the first process had not occurred, neither would the last. In between there is much to admire but also everything to take on trust. As befits the author of 425 other books, Asimov has eschewed preface, acknowledgements, references or bibliography. The only personal touch is a dedication.

Helleman and Bunch (both of whom are science editors) don't tell us where they got their information from either, although in the preface they acknowledge help and provide the useful information that they "have relied upon the consensus of many historians of science whose works we consulted to help locate the events as closely as possible". They record about 10,000 separate items, ranging from a birth or a death to a publication, experiment or invention. Throughout, a 'general'

column locates the ordinary events of history (beginning of the English Civil War) or 'non-scientific' aspects of their story (publication of Freud's *Jokes and Their Relation to the Unconscious*, introduction of Oreos by the National Biscuit Company). Their timespan is shorter than Asimov's: they also end in 1988 but don't begin until 2,400,000 BC. The spare, atomistic approach to separate bits of information makes the book impossible simply to read. But a series of nine overviews (for example "Science after World War II") and more than 100 short essays provide some social and intellectual context for entries such as "A. Meissner invents a radio transmitter with vacuum tubes" (1913), "Permanent press clothing is introduced" (1964) or "Ernst Chladni invents the euphonium, a musical instrument in the tuba family" (1789).

The assiduous reader of Asimov would not have picked up any of these latter facts. For Asimov, the key dates for the radio are 1895 (radio antennae), 1901 (Marconi's sending of radio signals from England to Newfoundland), 1904 (J.A. Fleming's rectifier), 1906 (R.A. Fessenden's work on amplitude modulation), 1916 (E.H. Armstrong's superheterodyne receiver), 1939 (Armstrong's perfection of frequency modulation), 1948 (transistors) and 1954 (improvements in the transistor). For Hellemans and Bunch, there are at least 21 key moments, in addition to Meissner's work. For them, the radio antenna did not properly appear until 1905, Armstrong's superheterodyne receiver came in 1918 and Armstrong perfected frequency modulation radio in 1933. These authors agree with Asimov on the other dates, they also add a number of other moments in the history of radio.

Discrepancies also emerge in cross-checking through a year rather than a subject. Take 1922, for instance. Asimov writes of Leonard Woolley's excavation of Ur (dated to 1918 in Hellemans and Bunch, where his name is spelled Wooley); Howard Carter's discovery of Tutankhamen's tomb (confirmed by H and B); Herbert Evans's work on what became known as vitamin E (confirmed by H and B, although with the addition of K. J. Scott); Evans's research on growth hormone (not mentioned at all in H and B); Alexander Fleming's isolation of lysozyme (dated to 1921 in H and B); Oparin's work on the origin of life (under 1936 in H and B); experiments of J. Erlanger and H.S. Glasser on nerve conduction (recorded by H and B under 1944, when the Nobel prize was awarded); and A.A. Friedmann's work on the expanding Universe (confirmed by H and B).

Who would want to be an anniversarial scientist when there is so much uncertainty about the facts of history, to say nothing of their interpretation? Not I, which is why I have steadfastly refused to

adjudicate between Asimov and Hellemans and Bunch. It would, after all, simply be my reference books against theirs, and since they have declined to reveal theirs, it would be an unequal contest. I have reason to believe, however, that Leonard Woolley spelled his name thus. □

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Of thoughts past

Graham Ritchie

Ancient Britons and the Antiquarian Imagination: Ideas from the Renaissance to the Regency. By Stuart Piggott. *Thames & Hudson: 1989. Pp. 175. £14.95, \$19.95.*

As excavation techniques extend the range of what can be recovered, and theoretical considerations crowd into university curricula, archaeology increasingly turns to science. How important it is, therefore, that in the history of ideas about early British antiquity we should be aware of the attitudes of early scholars and have an appreciation of the framework within which their thinking took place. Stuart Piggott's perceptive exploration of antiquarian ideas draws together many

their own views of the world. It is a measure of Piggott's success that within this rigorous approach the reader is so pleasurably taken on a voyage of exploration through the worlds of the computation of Biblical chronologies, ancient giants and what happened after the Flood.

The Indians and Eskimos — even a Brazilian king — who were transported from the New World to be paraded before the European public in the course of the sixteenth century had a considerable effect on antiquarian approaches and on the way in which early Britons were depicted. It is startling to realize that at least a thousand Red Indians were brought back to Europe by early voyagers and that Frobisher brought Eskimos back from his expeditions to South Baffin Island in 1576–77. Early antiquaries drew comparisons between aspects of American Indian and Eskimo characteristics and those of the ancient Britons. Ethnographical illustration had a great deal of influence on the way that early man was depicted, and Piggott has assembled an unusual series of illustrations of Eskimos, Britons and, most enchanting, Picts and other North British tribesmen.

The fieldwork and recording of monuments by John Aubrey and Edward Lhuyd are set within the context of the day. Our current understanding of monuments such as Stonehenge, Avebury and the Rollright Stones begins with observations made three centuries ago. Thus William Stukeley is seen on the one hand "as a field

Hard facts? — Stonehenge, like Avebury and the Rollright Stones, inspired a "fantastic past for ancient Britain, dominated by fictitious Druids".

strands of research to create a fascinating picture of the intellectual worlds of well-known figures such as Aubrey and Stukeley, and at the same time introduces many lesser known writers from the late sixteenth to the early nineteenth centuries.

The past must be understood within the intellectual constructs of the time, and thus we are not introduced to approaches to prehistory — for the term prehistoric was first used by Daniel Wilson in 1851 — but to a world for which the chronology of early times was outlined in the Old Testament. The early antiquaries are to be seen as individuals undertaking research within

archaeologist of great distinction" and on the other as the man who misled generations "as the inventor and propagator of a fantastic past for ancient Britain, dominated by fictitious Druids" (p. 122). Stukeley's fieldwork at Avebury and Stonehenge is the earliest detailed recording of field monuments; between 1719 and 1724 he spent up to two months at a time surveying them using a theodolite, and making notes and drawings. In a way that we think of as 'modern', Stukeley's concern was to put on record monuments at risk from agricultural and building developments. ▶