

Life then went from rough to rougher. No one knows whether the plane crash in June 1992 was sabotage, but Leakey lost both his legs (managing to insult Moi, who had hurried to his bedside, by telling him he didn't need his prayers). He was forced to resign from KWS in March 1994, started his own political party in opposition to Moi and became a member of parliament in 1997 (and campaigned for the disabled). But in 1998 he was reinstated — by Moi — to direct KWS afresh. Conciliation, it seems, is a vital part of African politics. Now he has left KWS a second time to become permanent secretary to the president and head of Kenya's Public Service.

All in all, this is a rattling good yarn. But it is much more than that. At stake is the concept of nationhood, a bureaucratic artifice superimposed on tribes that are ancient, evolved and real. The battle of tribal and political leaders echoes that of Europe's medieval barons, albeit fought out under modern political floodlights. Greater than that is the perennial struggle of humans to form a coherent society, and although most are honest and socially minded, the influence of those bent only on self-interest is inevitably disproportionate. In the background is humanity's attempt to find a *modus vivendi* with a fellow creature that needs to be managed, but is sensitive beyond present measure and must not be 'controlled' as if it were some pest.

How will Leakey himself be remembered? He says he did not expect to survive beyond 40 but as he now seems indestructible, it is clearly too early to say. Colonial and post-colonial Africa has been shaped by larger-than-life personalities, some mercifully great, such as Nelson Mandela and Desmond Tutu, but also by too many chancers, such as Cecil Rhodes. Leakey has his detractors, but if we acknowledge that all humans are flawed, then he surely belongs among the greats. Kenya's elephants would sign up to that. ■

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Introduction to the Science and Technologies of Genes and Genetics From the 19th Century to the 22nd (Jonathan Cape).

Wormholes through physics

Nine Crazy Ideas in Science: A Few Might Even Be True

by Robert Ehrlich

Princeton University Press: 2001. 254 pp. \$24.95, £16.50

Time Travel in Einstein's Universe: The Physical Possibilities of Travel Through Time

by J. Richard Gott

Houghton Mifflin: 2001. 291 pp. \$25, £18.99

Paul Davies

Niels Bohr once remarked, when confronted with an unorthodox theory, that the problem was not whether it was crazy, but whether it was crazy *enough* to be true. Modern science, especially physics, is replete with outlandish ideas that defy common sense and intuition. It is almost impossible for the non-scientist to discriminate between the legitimately weird and the outright crackpot. If black holes, antimatter and virtual quantum particles are taken seriously, why is faster-than-light travel or extra-sensory perception pooh-poohed by scientists?

Physicist Robert Ehrlich has assembled a fascinating collection of apparently crazy ideas, and subjected them to careful analysis, assigning each a 'cuckoo' index of implausibility. Some of them, like the claim that small doses of nuclear radiation might actually be beneficial, he finds fairly convincing. To others he gives a decisive thumbs down, such as the much-publicized theory that AIDS isn't caused by HIV, or that having more guns in circulation leads to less crime. Ehrlich points out how statistics can be misleadingly presented in these cases, and how the distinction between effects that are causally related and those that are merely correlated often gets blurred.

Readers will make their own judgements about the various claims. Personally, I would not give the existence of tachyons — hypothetical particles that exceed the speed of light — quite the zero cuckoos that Ehrlich assigns. I do, however, share his enthusiasm for the offbeat theory of Thomas Gold that reserves of oil, coal and gas are not all produced by biological processes (the conventional story) but can be generated by primordial methane percolating up from deep in the Earth's crust and subjected to the activities of subterranean microbes. Gold has received a lot of flak for flying in the face of geological orthodoxy, and although I feel that the case he makes is far from decisive, I believe he

deserves far more credit for his ideas. In particular, his early championing of the theory that there exists a deep, hot biosphere turned out to be startlingly accurate, and is now generally accepted.

One crazy idea to which Ehrlich assigns medium plausibility is time travel. It is a recurring theme of science fiction, but can it really be done? Travel into the future is unproblematic, and known to be possible; it is a standard prediction of Einstein's theory of relativity and has been confirmed experimentally many times. But going back in time is another matter entirely. If that were possible, then all sorts of causal paradoxes loom, such as the famous example of the time traveller deliberately killing his grandfather as a baby, thus negating his own existence.

In spite of its bizarre overtones, the possibility of visiting the past has attracted the attention of many serious researchers in recent years. Most of the work relates to the proposal that a wormhole in space could be used as a time machine. A wormhole is like a black hole, but with an exit as well as an entrance. If one existed, it could provide a short-cut between distant points in space. Whereas falling into a black hole would be a one-way journey to nowhere, entering a wormhole might enable you to come out moments later in another part of the Universe. The theory of relativity predicts that a wormhole can be adapted so that an astronaut traversing one would come out *before* he went in. Wormholes remain highly speculative, but no knock-down argument yet exists that proves them to be physically impossible.

In *Time Travel in Einstein's Universe*, Richard Gott has come up with an alternative method of visiting the past, using hypothetical entities called cosmic strings. These would be exceedingly narrow tubes of trapped energy left over from the Big Bang, containing enough mass to seriously warp space and time. Gott envisages a pair of parallel cosmic strings flying past each other at high speed, and argues that an astronaut following a path looping around the strings could be transported back in time.

Gott's proposal is hardly practicable, being even less plausible than engineering a wormhole. Still, the merit in studying time travel lies not so much with the practicalities, but more with the way in which the topic illuminates the deep foundations of physics. Obviously, science must give a rational and self-consistent account of reality, so genuine paradox is not permitted.

Gott tries heroically to make the subject accessible to the non-specialist reader, although some of the discussion gets pretty technical, and occasionally mysterious. Perhaps his most striking claim is that the entire Universe could be a time machine that reaches back to the Big Bang and engineers its own creation. Some readers may well regard this



idea as a *reductio ad absurdum* of the whole subject, but for those who enjoy a speculative romp across some of the most fascinating topics in modern physics, Gott's book will prove a delightful challenge. ■

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Cut-and-paste knowledge

Encyclopaedic Visions: Scientific Dictionaries and Enlightenment Culture

by Richard Yeo

Cambridge University Press: 2001. 358 pp. £40, \$59.95

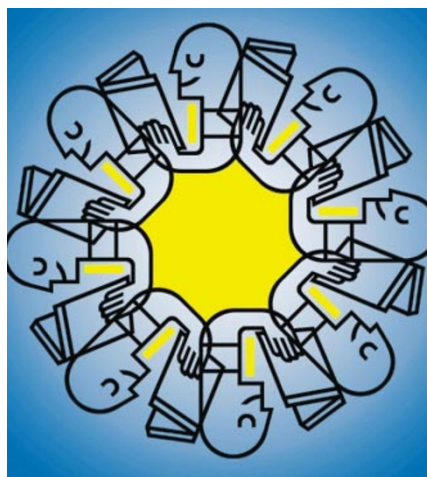
W. F. Bynum

One of my son's babysitters was an elderly woman who also looked after children of other Cambridge research students. When she closed her cottage to move in with her own son, she rewarded all her bookish friends with a remembrance: each received a single volume from her set of the *Everyman Encyclopaedia*. I never knew if the fact that I got the first volume was a particular sign of affection, or something rather more random.

Odd volumes of encyclopaedias may contain a lot of useful information, but they are best in complete sets. 'Twas ever thus, as *Encyclopaedic Visions*, Richard Yeo's sensitive and engaging study of Enlightenment encyclopaedias, makes clear. After all, the cycle embedded in the word 'encyclopaedia' carries with it the implication that all human knowledge is connected in some organic way. Most medieval and early modern works within the genre carried a statement or diagram, or both, attesting to such unity.

In spite of this rich historical tradition, modern encyclopaedias emerged only during the Enlightenment. At first glance, the Enlightenment reference book might be thought to be the *Encyclopédie* of Denis Diderot and Jean D'Alembert. Much has been written about the creation, publishing history and influence of this monumental work, whose aggressively secular nature brought both of its editors (and some of its contributors) into confrontation with the authorities in *ancien régime* France.

As Yeo reminds us, however, the *Encyclopédie* began its life as a planned translation of a work produced single-handedly by an English hack, Ephraim Chambers. So successful was Chambers' *Cyclopaedia*, first published in two volumes in 1728, that it turned its obscure author into a successful man of letters and earned him election to the Fellowship of the Royal Society (the eighteenth-



century Royal Society was happy enough to elect science popularizers to its midst).

Chambers' *Cyclopaedia* is central to Yeo's analysis, and science was at the heart of Chambers' work, as well as that of his successors and imitators. The objectivity of scientific knowledge gave it a special place in Enlightenment culture, raising it above the divisiveness of politics or religion. Science was thus fundamental to the ethos of self-improvement that featured in the rhetoric with which encyclopaedias were announced, advertised and justified. The scientific and technical contributions of Chambers, John Harris, Abraham Rees and the other encyclopaedists of the period were often highly original and much remarked upon.

But if the encyclopaedias were surrounded by an aura of utility and progress, they were, especially in Britain, products of commercialism and profit. In continental Europe, several learned societies undertook the systematic task of producing versions of the encyclopaedic ideal. Most of these projects either foundered or took decades to be realized. The British seemed to vacillate between pride at their own individual enterprise and initiative and envy of the more systematic way in which learned activity was organized on the Continent. Thus, the first edition of the *Encyclopaedia Britannica* (three volumes, 1768–71) was written single-handedly by the Edinburgh printer William Smellie (by his own admission with a paste-pot and a pair of scissors). Its title page, however, announced that it had been produced by "A Society of Gentlemen".

Smellie's mode of composition was hardly surprising: no one, even in the Athens of the North, could be expert in all branches of human knowledge. The key to producing a good encyclopaedia was knowing which authorities to summarize. This raised the tricky issue of copyright, even at a time when the legal protection of intellectual property was weak and pirated editions were regularly produced. The first edition of the *Encyclopaedia Britannica* actually produced a lawsuit, partly because of Smellie's liberal use

of the scissors and paste-pot, but mostly because London publishers and booksellers were nervous that this new encyclopaedia on the block originated in Scotland.

The *Encyclopaedia Britannica* not only survived these early rumblings, it actually thrived, and by the time of its third edition (1788–97) it had swelled to 18 volumes and acquired many of the trappings of modernity. Although still responsive to market forces, this *EB* was the work of identified experts. Although it aimed at comprehensive coverage of all branches of human knowledge, its scientific content was still central, science being recognized as the most active and rapidly changing field of knowledge, and therefore the one that dictated the necessity for frequent updating.

Yeo's monograph is solidly historical, but it reminds us that many of the issues of encyclopaedic form and content grappled with during the Enlightenment are still with us. Should encyclopaedias be principally repositories of authoritative knowledge where the learned can refresh their knowledge, or instruments to educate the novice? If science is about the objective understanding of nature, should it be subject to copyright? These and many other themes that Yeo scrutinizes are still current in our age of electronic publishing and the Human Genome Project. ■

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The price of success

Science, Money, and Politics: Political Triumph and Ethical Erosion

by Daniel S. Greenberg

University of Chicago Press: 2001. 528 pp. \$35, £22.50

David Dickson

Two characteristics instantly strike any observer of the scientific enterprise in the United States. The first is its vitality and productivity. The second is a level of financial support that, even in difficult economic times, has remained the envy of virtually all other industrialized nations.

A third characteristic, perhaps less immediately obvious but no less striking, is the longevity of its support structures. In other countries, research councils and funding agencies find their names and responsibilities altered as politicians seek to modify their roles in the face of changed economic circumstances. In contrast, the organizational landscape of US science has remained virtually unchanged for the past half-century.

For anyone interested in understanding