

further from home as our knowledge of the cosmos has become more positive. Even the bottom of the galaxy is now perhaps too close.

Dr Dick's interest is very much more in the philosophical rather than in the scientific stage of the debate about the plurality of worlds. Newton, to whom worlds of anti-matter — or at any rate "Worlds of several sorts in several parts of the Universe" — were by no means inconceivable, appears only 50 pages before the end of the 190-page text. I think this is a pity. The principle of universal similitude is much less interesting in the period where it was justified only by the experientially dubious argument that things are more probably like than unlike, than in the age of modern science when it has been justified by observational and theoretical successes. We have built up a fair body of knowledge of how this principle can be applied, and where it fails to work. Moreover, since Kant's time we have learnt a great deal about similitude in living things on Earth and have related this knowledge to a theory of their evolution in such a way as to transform the discussion of the possibility of living phenomena elsewhere. True, none of this has come near answering the question: "Are there other inhabited worlds?" but it has taught us at least where such worlds are not, and hardened the distinction between scientific imagination and scientific romance. The question: "Was Jesus Christ to be seen as the planet-hopping Savior in the new cosmology?" (Dr Dick's phrase), once so poignant to the theologians, would not disturb a modern astrophysicist but scientist and theologian might agree that the most profitable working hypothesis for the present is to assume the Earth's singularity. Earths outside our galaxy seem likely to remain as unknowable to us as God's alternative universes in mediaeval thought.

Dr Dick's painstaking account contains few surprises. No one has made assertion or denial of the plurality of worlds the pole of a philosophical or scientific system; rather, the idea has been exploited or refuted as an exemplary consequence of more fundamental ideas about space, time and being. Very often, as in that most famous book of all on the subject, Fontenelle's *Entretiens* (1686), plurality has been defended in a fanciful or fictional manner. Belief in the plurality of worlds has also long been an intellectual symbol, like the expropriation of the expropriators or free love, a sign that he who holds this belief is fettered by no conventional dogmas of religion or science. It never seems to have done anyone much harm to assert this belief, not even Giordano Bruno (and Galileo rejected it). Whether it has ever done anyone any good I shall not attempt to say. □

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There is a tide in the affairs of men . . .

Arthur T. Winfree

The Clocks That Time Us: Physiology of the Circadian Timing System. By Martin C. Moore-Ede, Frank M. Sulzman and Charles A. Fuller. Pp.448. ISBN 0-674-13580-6. (Harvard University Press: 1982.) \$25, £17.50.

IF YOU have cancer, don't accept another dose of cytotoxins or X-rays at a time scheduled for clinical convenience: the damage to your healthy tissue can be devastating at one time of day, yet go relatively unnoticed at another. If you read this en route across time zones, don't sleep off your jet-lag behind drawn curtains: exposure to people and sunlight will markedly shorten the time of discomfort. If you want a stimulating book to read, try this one.

Why this one? Wide-ranging books on circadian rhythms have appeared before: Bunning's classic *The Physiological Clock*, updated in 1973; Luce's popular *Biological Rhythms in Psychiatry and Medicine* in 1970; Ward's still-more-popular *Living Clocks* in 1971; Wever's 1979 classic-to-be *The Circadian System of Man*; my own *Geometry of Biological Time* in 1980; plus abundant, more specialized monographs and symposium proceedings. So who needs another?

You do if you found Winfree too mathematical, Wever too preoccupied with data and statistics, the journalists too excited for scientific reliability, and Bunning too preoccupied with invertebrates and plants. We mammals have clocks too, and clock physiology has immediate medical pertinence. A lot has been discovered by mammalian physiologists and medical doctors in the past decade, especially about sleep timing in human beings and the origin of sleep rhythms in the lower brain. *The Clocks That Time Us* is absolutely up-to-date in these respects, and does a superb job of presenting the major results in jargon-free English.

As with most scientists cum writers, the authors are liveliest on topics more distant from their scholarly speciality. The chapters on neuroanatomy and monkey physiology may become tiresome unless you are professionally involved. But if you are, you will appreciate the 150 or so figures, mostly depicting data, and some 900 reference citations, most of them less than a decade old. Regardless, you cannot help but appreciate the rich variety of illustrations drawn from *human* physiology, psychology and medicine.

Richard D. Alexander's *Darwinism and Human Affairs*, first published in 1980 and reviewed in *Nature* 287, 173 (1980), has now appeared in paperback. The book is published by the University of Washington Press and costs \$9.95.

Every author must compromise accuracy somewhat for a lively presentation and I might have chosen a different balance in some of the more theoretical sections. For example, the 30-page section about phase-resetting and entrainment, though well done, is drawn from outdated theory of the 1950s, and in any case is never referred to again. And a "mathematical model", vintage 1981, for the human temperature rhythm and sleep/wake alternations occupies most of a short chapter, but to my mind gives the misleading impression that we know a lot more than we do.

Though sceptically alert, even to the point of peppering pages with "howevers" in the physiology chapters, Moore-Ede *et al.* seem to me to accept many other, oftentimes rather sensational, data too nearly at face value. For example, were I assigned to edit the next edition, I would urge less emphasis on the likelihood that we harbour two or more separate sources of circadian timekeeping in our various organs, unless more persuasive experiments appear. Nonetheless, every suggestive observation in this book deserves the emphasis given if it provokes immediate testing: for example, that the only four successful "test-tube baby" implantations carried out at the time of writing were performed between 10pm and midnight, and the 75 failures were attempted at other times.

The long last chapter was the most exciting to me: "Medical Implications of Circadian Rhythmicity". The effectiveness (and toxicity) of drugs and anaesthetics show marked rhythms which should be charted to improve the safety of medical procedures; this has already been done and reduced to clinical practice in the case of cortisone therapy. We also learn about jet lag and the inconveniences of disparity between external time and internal body time. Unfortunately, no evidence is presented that internal desynchronization is, in itself, part of the problem. The prospect of a "jet-lag pill" is discussed, but no drug more reliable than caffeine is suggested. Whoever invents this one seems sure to get rich. Note is made that shift-workers suffer from desynchronization while responsible for critical decisions in hospitals, nuclear power plants and submarines; the Three Mile Island incident occurred at 4am. Psychiatric disorders, too, may sometimes stem from derangement of circadian coordination: success has been reported in some attempts to cure insomnia and recurrent depression by phase-resetting.

So do not buy this book lightly — you may end by habitually charting your body temperature and hours of sleep. □

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