Pigafetta's paradox

John Brady

The Timing of Biological Clocks. By Arthur T. Winfree. *W. H. Freeman:1987. Pp.199. £15.95.**

THIS is a colourful book — in both senses of the word — embellished on every page with all the hues of the rainbow. But why such lavish illustration to analyse that insubstantial, grey element, time? The answer is that Winfree uses the spectrum as an analogy, so that each wavelength represents a different phase of the underlying oscillation that drives every biological rhythm, or at least describes its form.

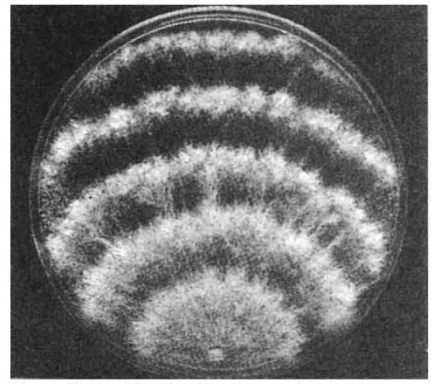
The result is visually stunning. But whether or not it will help readers in understanding the subject matter will depend on their previous level of knowledge. And that raises the question of whom the book is intended for. The publisher is surely not aiming at the biological-clock *cognoscenti*, most of whom have followed Winfree's work over the past two decades (or have at least tried to). The informed man in the street, then? Hardly. He is likely to be lost before the end of Chapter 1, trying to fathom how the world's time-zones end in a 'singularity' at the South pole, yet walking round the pole has no effect on one's calendar, or why Pigafetta, Magellan's log-keeper, lost a day during his voyage round the world. I imagine that the book will appeal most to the mathematically sophisticated: readers of the *Journal of Theoretical Biology*, for example, or physical scientists with an interest in biology.

I once heard C. S. Pittendrigh — Winfree's doctoral supervisor at Princeton, and one of the three Grand Viziers of chronobiology — describe Winfree's work as 'baroque'. Presumably, he meant in the sense of 'exuberant and extravagant architecture'. The word came back to me repeatedly as I read the book, and grasped for the significance of converting a two-dimensional phase-response curve (which I understand) into a three-dimensional torus (which I don't), or when grappling with *four*-dimensional graphs of yeast metabolism (x, y, colour and numbered contour).

Certainly, what Winfree has done over the past 20 years has been to inject into the analysis of biological time-keeping a whole new approach to the subject. He has taken the single, linear dimension we were used to, and returned it to us stretched and folded into exuberant multi-dimensional arrays. While this has opened our eyes to the complexities of time, it is not clear how many of us have really benefited from the experience. There is also an element of the alternative, 'whimsical' sense of baroque in Winfree's delight in quoting from James Thurber and Lewis Carroll, which suggests, perhaps, an almost mischievous pleasure in juggling with time. Otherwise, any whimsy is more fairly identified as only the impression to be gained by the less-sophisticated reader; Winfree's analyses, though elegantly presented, are intricate, and the faint-hearted may choose the line of least resistance and pass by without comprehending.

Time is, indeed, a difficult subject. For scientists in general it commonly appears as the abscissa on their graphs, showing the progress or rates of reactions. For the chronobiologist, however, it often appears on both axes — especially as phase-response curves. Here it may no longer be linear, showing the amount by which the timing of some physiological process changes in response to a change in the timing of the environment. Time in two dimensions is hard to grasp, and the book is very much concerned with explaining the implications of such phase responses.

Winfree restricts his analysis to rhythms, and especially to the ubiquitous, 24-hour 'circadian' variety: seasonal day-length responses, hour-glass-type interval timing and time-sense of the kind necessary for navigation by long-distance migrants are not touched upon. The biological clocks of the title are therefore distinctly exclusive. Nevertheless, Winfree stands unique in the science of biological time-keeping by visiting all fields, from population dynamics, through cells, to biochemistry. And he offers a grand synthesis that no one else could have attempted, although it must be said that his analysis is primarily concerned with the phenomenology of biological rhythms rather than their mechanisms.



From *The Timing of Biological Clocks*

Circadian advance — growth rings of Neurospora crassa, *22 hours apart.*

For the biomathematician, this may be sufficient satisfaction in itself; for the physiologist, however, the former is justified only so far as it illuminates the latter. Winfree has provided some brilliant insights into how biochemical and cell systems may interact temporally, but it is not yet clear how far this approach will really accelerate our capture of a circadian clock; personally, I enjoyed his fascinating *Geometry of Biological Time* more. □

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* In the United States published as a volume in the Scientific American Library.

Behind the curtain

Richard Mabey

The Natural History of the USSR. By Algirdas Knystautas. *Century Hutchinson: 1987. Pp.224. £14.95.*

WHEN socialism was young, and still full of vision, nature was seen as part and parcel of the world that had to be liberated from capitalist oppression. Or, more precisely, helped towards its own liberation, to become Subject, not Object. The young Marx talked of the "resurrection" of nature. Bertolt Brecht waxed lyrical about the "otherness" of trees, the value of their having "something about them which cannot be put to use".

Then — for the Soviet Union at least — came war, Stalin, economic collapse and the kind of desperate, rushed ransackings of the natural world that climaxed at Chernobyl. Many in the West have assumed that more ghastly environmental catastrophes lie hidden in the recesses of that vast country, and that exploitation of nature is unavoidable in a self-styled materialist society.

The remarkable thing about Algirdas Knystautas's book is that it not only lifts the curtain and challenges many of these assumptions, but succeeds in recapturing something of the founding father's dream of a kindredness with nature. It is not a theoretical book, still less a political one. Yet even the statistics — those much parodied Soviet litanies — have the unfamiliarity and excitement of a survey of another planet. The Soviet Union has 3 million rivers, 2.8 million lakes, 100,000 species of plant and 800 species of bird. Many of these live in the 8 million square kilometres of forest that is popularly imagined to blanket most of the country. But the Soviet Union accounts for almost one-sixth of the Earth's land surfaces, and its habitats range from the south-western deserts, with their wild asses, gerbils and giant fennels, to the mysterious lush woodlands of Ussuriland in the Far East, where half of the country's bird species have been recorded. The Soviet Union is nothing less than the main reservoir of the ecosystems of the Northern Hemisphere, and it is no wonder that young, ecologically aware scientists should begin to demonstrate their concern about it.

Yet Knystautas is something of a