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.

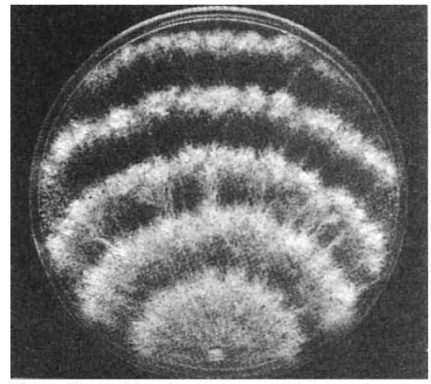
The result is visually stunning. But whether or not it will help readers in understanding the subject matter will depend on their previous level of knowledge. And that raises the question of whom the book is intended for. The publisher is surely not aiming at the biological-clock *cognoscenti*, most 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

natural phenomenon himself. If it were not for the new mood of "reconstruction" he might be thought a mythical creature from a Soviet bestiary: a 30-year-old freelance, who writes elegant and witty English and takes his own accomplished photographs.

It is his pictures (and those by other Russian photographers) that take the book way beyond a bland catalogue. They are reflective, affectionate, respectful, often quite simply *awed*. Vast and entirely useless taiga swamps and unclaimed tundra roll into the distance. A Russian desman, a bizarre aquatic mole, squints into the camera. Exquisite wild onions and tulips are shown in their best finery. And up on shingly river banks in the mountains of Tien Shan stalks the extraordinary and never properly photographed ibisbill, half wader, half ice-pick. Knystautas's infectious excitement at new discoveries, new seasons, new feelings, fills his writing too. His enthralled account of finding a blue whistling thrush in the wild mountainscapes of Central Asia — a bird whose "trills are so piercing that they can be heard... even above the noise of the waterfall" — would have done credit to the best of the Romantics. This is a bird valued entirely for itself.

The same concerns are evident in the long chapter on conservation. Soviet programmes do, of course, have a strong utilitarian base. The laws on pollution control and species protection, and the stratified system of reserves and parks based on them, have identical aims to those in the West: "for the maintenance of genetic resources... protecting unique landscapes or habitats... the study of the processes in a completely natural community". I suppose that at an ungenerous pinch the conservation of woodlands near hospitals could be seen as utilitarian. But beyond this there is a more tender note, a delight in the variety of the natural world, and a concern about its fragility. And, yes, a real willingness on the part of the author to criticize his own country for disasters such as the pollution of Lake Baikal.

Knystautas is a maverick, but no dissident. His book was launched at the Soviet Embassy. Yet statements such as "human activity is now so intense that there is a real danger of disturbing the stability of the entire system, on which every one of us, rich and poor, depends" would have been unthinkable a few years ago. Of the many changes happening in the Soviet Union, this new perception is one of the most encouraging — for all Subjects of the Earth. □

Richard Mabey, 10 Cedar Road, Berkhamsted, Hertfordshire HP4 2LA, UK, served on the Nature Conservancy Council from 1982 to 1986. His most recent book, Gilbert White: A Biography of the Author of The Natural History of Selborne, *was the winner of the 1986 Whitbread biography award.*

Wild writings

David E. Allen

Penguin Nature Library.*
The Exploration of the Colorado River and Its Canyons. By John Wesley Powell. Introduced by Wallace Stegner. *Pp. 407.*
My First Summer in the Sierra. By John Muir. Introduced by Gretel Ehrlich. *Pp. 264.*
Cape Cod. By Henry David Thoreau. Introduced by Paul Theroux. *Pp. 319.*
Nature's Diary. By Mikhail Prishvin. Introduced by John Updike. *Pp. 188.*

"NATURE writing . . . is a very special . . . genre", claims Edward Hoagland, the general editor, in his foreword to these first four titles in the Penguin Nature Library. As broadly defined by him, it consists of writings which combine rhapsody with science — normally, he might have added, science that is conducted out of doors and for preference in wild and remote areas. An offshoot of romanticism, it rose to popularity in the second half of the last century and reached its high point in the inter-war years. Since then exponents have been rare, deterred, it seems, by the general switch in taste to greater matter-of-factness and by acute distrust of subjectivity instilled by a more intensive professionalism. It has always been a treacherous genre, exposed on the one hand to the Scylla of anthropomorphism and on the other to the Charybdis of the banal, and its reputation has been badly tainted by the many who have tried their hand at it without exercising the requisite control. Yet even so, as these four volumes illustrate, it *has* had its masters; and it was high time that a new generation of readers was introduced to what the best practitioners could achieve.

Except for the fact that they were all men who took delight in wilderness, the four authors who have been selected offer an appetizing set of contrasts. Thoreau and Prishvin have a focus that is primarily zoological, Muir was mainly a botanist and Powell an ethnographer and geologist. Thoreau writes of the sea-shore, Prishvin of forest and swamp, Muir of lush mountain scenery, Powell of arid river valleys. Prishvin's book is the journal of a year, Powell's (in the main) and Muir's are diaries of testing four-month trips, while Thoreau's is a collection of essays extending over a mere three weeks' comparatively gentle sauntering. All were engaged in exploring country that was new to them, but whereas the last three, all Americans, were on the move while they did so, Prishvin, a Russian — and the only trained scientist of the four — was anchored to a single location.

Powell's book is the closest to a traditional explorer's narrative and there is an element of suspense in his account which is lacking in the others. It deals for the most part with an expedition that he organized and led in 1869 down the chain of canyons through which the Green and upper Colorado Rivers run for over a thousand miles. Described by Wallace Stegner in his introduction as "the last great exploration within the continental United States", it opened up an area as big as Texas which had been penetrated thitherto only by Indians and a handful of Spanish adventurers and priests.

Ten men in four boats (purpose-built in Chicago) set forth in May, taking rations that they thought would last them as long as ten months; but mile after mile of falls and rapids gradually took their toll, and by August food was running short, all the instruments were ruined and three of the party were driven to breaking away — never to be seen again. Powell and his surviving companions eventually struggled home, but only after forfeiting most of the data that they had compiled. In essence the report which he subsequently produced for the Smithsonian, the book is marred by an over-lengthy scene-setting which takes up as much as four chapters. In compensation, however, it is handsomely decked out with the many original wood engravings which *Scribner's Magazine* so generously paid for, and there is abundant testimony both in these and in the text of the author's deep and abiding interest in the Indians and their customs.

John Muir's special passion was trees (he is the Muir commemorated in the famous redwood reserve north of San Francisco). By an odd coincidence the "forever memorable High Sierra excursion" of which he writes was undertaken in the very same summer as Powell's incomparably more arduous expedition. Muir had been hired to supervise the driving of a flock of sheep from the hot Californian plain up into summer pasture far above, a task which left him with ample leisure and allowed him to indulge to the full his favourite occupation of sketching. The word-pictures which he reconstructed so much later from his notes still retain the youthful excitement that must originally have gone into their making; and if "marvellous", "magnificent" and "grand" recur overmuch, there is a rapturousness in the descriptions (as Gretel Ehrlich notes) which confers on them a special quality.

As the introducer of *Cape Cod*, Paul Theroux was an especially happy choice, for not only was he raised in Massachusetts and has first-hand acquaintance with the area concerned, but he writes as a veteran contributor to travel literature himself.

*All four titles are available in the United States, price $6.95 each. Only *Nature's Diary* and *Cape Cod* will be published in Britain (on 28 May, price £4.95).