interviewed all the former NASA administrators as well as several dozen veterans who worked at the agency over the past 30 years. Their stories read like an oral history of the petty disputes, bureaucratic turf battles and other dirty linen that seemed especially to mark NASA's shuttle era.

One example should be sufficient. With all the problems of the shuttle on his mind, James M. Beggs, NASA administrator from 1981 to 1985, had to suffer repeated interference from the White House over such trifling matters as VIP guest lists for launchings and the "cola wars". In his interview with the Trentos, Beggs told of the "aggravation" caused by Michael Deaver, the lobbyist and close friend of the Reagans, who sought to have his client Coca-Cola favoured over Pepsi-Cola in a zero-*g* test of soft-drink cans (pp.256–257). One feels sympathy for Beggs, but is left wondering why NASA got itself into such a silly predicament in the first place.

The clear impression here is that NASA sold its soul in return for the shuttles. According to the Trentos, the agency set high standards for technical excellence and became the symbol of boldness and success because of its early leaders, people such as T. Keith Glennan, James E. Webb, Robert Seamans, Rocco Petrone and Robert R. Gilruth. Of Gilruth, former director of the Houston space centre, the authors write that he was the "living embodiment of what NASA was supposed to be — effective, curious, and humane" (p. 75).

The Trentos may have romanticized the early NASA to stress its more recent decline. They can find no heroes of the shuttle era. The cumulative effect of the stories told by these interviewees is one of indecision, compromise, political meddling and a tragic neglect of engineering standards. A deplorable trend noted by the authors is the frequency with which agency officials move to and from employment with industry contractors, raising questions of potential (perhaps real) conflicts of interest.

A reader can draw two lessons from these books. One lesson — and this strikes home to this reviewer — is that we must not be so dazzled by the spectacle of space flight as to accept at face value everything NASA, or any agency, tells us. Nearly everyone, from the White House to Congress to the news media, fell into this trap. Consequently, NASA could delude itself into believing it was well-nigh infallible.

The other lesson, which has yet to sink in, is that if spacefaring is a worthy endeavour it is worth doing well. □

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Pattern and rhythm

John J. Tyson

Molecules, Dynamics & Life: An Introduction to Self-Organization of Matter. By A. Babloyantz. *Wiley: 1986. Pp.345. £50.45, $55.*

SINCE the publication of a short report in *Nature* in 1953, the attention of biologists has been drawn increasingly to macromolecular structure and function — rightly so, considering the success of this approach and the mind-stretching opportunities opened up by genetic engineering. But the structure/function paradigm of modern molecular biology provides a basically static view of life. Daily cycles of sleep and wakefulness, precise temporal and spatial organization in developing embryos, steady waves of contraction that sweep across a beating heart, such commonplace rhythms and patterns of living organisms are largely missing from the conception of life as structure, code, assembly. Over the past 20 years a study of the dynamics of biological systems, of their spatio-temporal organization, has taken root and spread, particularly in continental Europe. In *Molecules, Dynamics & Life* Agnes Babloyantz tells the story of this promising approach to the science of life in terms intelligible to the nonspecialist: the chemist, engineer or biologist who has heard rumours of something unusual and would like to know more about it.

Her job is not an easy one because the study of biological dynamics naturally expresses itself in terms of nonlinear differential equations, bifurcation theory, strange attractors and other arcane furnishings of dynamical systems theory. To make matters worse, she first plunges into the recondite subject of nonequilibrium thermodynamics. However, Dr Babloyantz proves herself to be a pleasant, practical and reliable guide to new territory which is still largely uncharted and inhospitable to tourists. Her style falls halfway between that found in a popular account and that of a textbook. She tells her story in a chatty, down-to-earth way, while also giving serious scientific consideration to fundamental issues of the self-organization of matter.

The first fundamental issue is the thermodynamical problem of how spatial and temporal order can arise spontaneously in physicochemical systems obeying the second law of thermodynamics (which requires closed, isolated systems to proceed monotonously to an equilibrium state of maximum disorder). The simple answer to this question, which was already apparent in the last century, is that spontaneously organizing systems (such as living cells) are neither closed nor isolated. Following the Brussels school of nonequilibrium thermodynamics, Babloyantz fleshes out this idea, showing in a clear, logical fashion how open systems operating far from equilibrium can lose stability of the "thermodynamic" branch of steady states and evolve spontaneously to regimes of spatial and temporal organization.

As Babloyantz points out, however, nonequilibrium thermodynamics does not provide a practical way of studying dissipative structures appearing beyond the region of stability of the thermodynamic branch. The work-a-day tools for such studies are provided by chemical kinetics, the qualitative theory of differential equations and numerical analysis. So she explains how to use these tools and then employs them on a variety of sample problems: oscillations and pattern formation in the Belousov–Zhabotinskii reaction, the primordial evolution of biological macromolecules, glycolytic oscillations in yeast cell preparations, aggregation of slime mould amoebae, morphogenetic models of positional information in embryos and a neural network model for epileptic seizures.

Dr Babloyantz has produced an engaging and earnest introduction to the field of self-organization in chemical and biological systems. Because she assumes that her readers will have no prior knowledge of biology but some familiarity with differential calculus, and because she concentrates in Part I on thermodynamic issues, her introduction is most suitable for physical scientists. But biologists could also benefit from her guidance if they skip straight to Part II and are willing to smile indulgently at some simplistic explanations intended for a different reader. □

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New journals review

On 24 September *Nature* will publish the seventh annual review supplement devoted to science journals.

Criteria for inclusion of a journal in the 1987 issue are that:

(i) the first number appeared, or the journal was retitled, *between June 1985 and May 1986* (the second cut-off date allows at least three issues of a journal to have been published, the minimum number on which a reasonable judgement can be based);

(ii) it is published at least three times a year;

(iii) the main language used is English.

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