International Journal Of General System

ISSN: 0308-1079 (Print) 1563-5104 (Online) Journal homepage: https://www.tandfonline.com/loi/ggen20

Book Reviews

To cite this article: (1989) Book Reviews, International Journal Of General System, 15:3, 269-271, DOI: 10.1080/03081078908935051

To link to this article: https://doi.org/10.1080/03081078908935051

Published online: 27 Apr 2007.

Malinovskii, A. A., "Elementy khudozhestvennoi obraznosti v svete pavlovskogo uchenia." *Sympozium po kompleksnomu izucheniu khudozhestvennogo tvorchestva. Tezisi i annotatsii*. Leningrad, 1963.
Malinovskii, A. A., "Obshchie voprosi stroienia sistem i ikh znachenie dlia biologii," *Problemi metodologii sistemnogo isledovania*, Moscow, 1970.
Malinovskii, A. A., "Znachenie kachestvennogo izuchenia upravliayushchikh sistem dlia teoreticheskikh voprosov biologii," *Primenenie matematicheskikh metodov v biologii*, Vol. III, Leningrad, 1964.
Malinovskii, A. A., "Nekotorie voprosi organizatsii biologicheskikh sistem." In: *Organizatsia i upravlenie*, Moscow, 1968, pp. 105–138.
Malinovskii, A. A., "Rol' geneticheskikh i phenogeneticheskikh iavlenii b evolutsii vida. I. Pleiotropija." *Izvestia AN SSSR*, Ser. Biol., No. 4, 1939, pp. 575–614.

THE COSMIC BLUEPRINT, by Paul Davies. Simon and Schuster, New York, 1988, 223 pp.

Paul Davies is a noted author of popular science books (*God and the New Physics*, *Superforce*). In *The Cosmic Blueprint* he provides an excellent overview of and introduction to the basic content and results of what has been called "self-organization theory" or "complex systems theory".[1] Although systems scientists will recognize complex systems theory as comprising a significant portion of their field, Davies is not working strictly within the systems science discipline. However, he references systems scientists as freely as traditional physical scientists. Certainly the historical and logical relations between complex systems theory and the study of systems in general is not lost on Davies.

Complex systems theory is more generally recognized as the confluence of a number of fields which have shown recent theoretical and practical advances, among them dynamic systems theory, bifurcation theory, catastrophe theory, algorithmic complexity theory, fractal geometry, cellular automata, neural networks, deterministic chaos, non-linear differential equations, far from equilibrium thermodynamics, and self-organizing systems theory.

The book takes a common language rather than a technical or mathematical approach. While the lack of formalism can be frustrating for the technically literate reader, ample references are provided. Davies does a good job in introducing fundamental concepts, like wholism and reductionism, duality and emergence, reversibility, the basic concepts of thermodynamics, scale dependencies, order and organization, phase changes and symmetry breaking, indeterminism and uncertainty, and ergodicity. Key issues are graphically illustrated and clearly explained in qualitative terms through the use of historically significant, classical examples, like Edward Lorenz's observations about weather forecasting, the logistic equation, forced pendulums, and the B–Z reaction. The work of most, if not all, of the prominent researchers in these fields is introduced, including Ilya Prigogine, Charles Bennett, Rene Thom, Robert Rosen, John Hopfield, Howard Pattee, David Bohm, Benoit Mandelbrot, Joseph Ford, Stuart Kauffman, Manfred Eigen, and Stephen Wolfram.

My major criticism of the book is its tendency to be satisfied with clearly metaphorical treatments of some especially difficult concepts, such as teleological phenomena. He freely refers to the "creative powers" and "creative abilities" of the universe as a whole, or of a river, or of matter with "a will of its own" (although in Davies' own quotation marks). It is, of course, very difficult to avoid vitalistic language when discussing these ideas, especially in popular writings; and Davies is clearly aware of the problem, and discusses it explicitly. Nevertheless the necessity of providing especially careful language is all the more important in a popular book that attempts to describe current scientific thought about how life and mind can arise as natural phenomena.

Also disturbing is Davies confusion of the necessary ignorance entailed by quantum theory with a position of anti-realism. It seems that he uncritically advances the claim that not only do we construct our knowledge, but further that we thereby construct *reality*. Clearly this is a claim that must be subjected to the highest form of scrutiny.

Along similar lines, Davies provides relatively uncritical analyses of the perhaps more dubious theories of such researchers as Roger Penrose, Fred Hoyle, and Ilya Prigogine. Although all of these tendencies risk serious confusion for the reader, Davies usually clearly labels the more controversial theories, and blatant misrepresentation is usually avoided.

Davies begins the book with a review of classical issues in philosophy of science, and how current thinking addresses them. The vanquishing of determinism and reduction are loudly proclaimed, leading to the problem of explaining the growth of complexity out of simplicity. Other chapters deal specifically with the subjects of irreversible thermodynamics, complexity theory, chaotic dynamics, fractal structures, dissipative structures and theories of self-organization, and the definition and origins of life. Final chapters address general theories of the growth of organization and complexity in evolving physical systems, the involvement of quantum theory, and the existence of mind.

I would now like to discuss some ideas of his own that Davies introduces. He describes four general conditions under which complexity can arise [p. 22]: (1) complexity often arises suddenly, not gradually; (2) complex systems are also usually large systems—that is possessing a relatively large number of components, dimensions, or degrees of freedom; (3) complex systems are almost always open systems; and (4) the interactions in complex systems are typically non-linear.

The above criteria also seem selected to dispute previous "classical" attitudes in science and their emphasis on simple, small, equilibrium, linear, closed systems. Yet we can clearly recognize all of the above conditions as **special cases** for the more general cases of erratically changing, larger, open, disequilibrium, non-linear systems. Indeed, the class of non-linear functions is of a qualitatively higher order than linear functions. In this way, as well, we recognize the main claim of those opposed to the "classical paradigm", that the above conditions cannot be special cases, mere peculiarities in a world accessible to simpler kinds of explanation, but indeed on the contrary that simple, classical system should be regarded as very special cases of the more general condition of intractability and uncertainty.

> There is a tendency to think of complexity in nature as a sort of annoying aberration which holds up the progress of science. Only very recently has an entirely new perspective emerged, according to which complexity and irregularity are seen as the norm and smooth curves the exception [p. 22].

One of systems science's fundamental concerns is the existence of natural laws describing systems of different types. Davies' treatment of the concept of natural laws, and especially the necessity of qualitative natural laws, is also very interesting:

> ...a law can only be tested by applying it to a collection of identical systems. As we come to consider systems of greater and greater complexity, the concept of a class of identical systems becomes progressively less relevant because an important quality of a very complex system is its uniqueness. It is doubtful, then, whether any mathematically exact statements can be made about classes of very complex systems. There can be no theoretical biology, for example, founded upon exact mathematical statements in the same ways as in theoretical physics [p. 144].

Certainly this is not a new idea,[2] yet it does not seem as if its significance has been widely recognized.

I would strongly recommend this book to anyone looking for an informative, intelligent, and well-referenced introduction to modern ideas of evolution and complexity. It stands with other recent books, such as James Gleick's *Chaos*[3] and Jeremy Campbell's *Grammatical Man*,[4] as vehicles for bringing critical modern ideas to the interested public.

REFERENCES

1. S. Wolfram, "Complex systems theory." In: *Emerging Syntheses in Science*, edited by David Pines, Addison–Wesley, New York, pp. 183–190, 1988.
2. W. M. Elsasser, "Individuality in biological theory." In: *Towards a Theoretical Biology*, v. 3, edited by C. H. Waddington, Edinburgh University Press, Edinburgh, 1975.
3. J. Gleick, *Chaos: The Making of a New Science.* Viking, New York, 1987.
4. J. Campbell, *Grammatical Man.* Simon and Schuster, New York, 1982.

CLIFF JOSLYN
Systems Science Department, SUNY-Binghamton
Binghamton, New York, USA