Why is anything ever simple?

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The Collapse of Chaos: Discovering Simplicity in a Complex World. By Jack Cohen and Ian Stewart. *Viking: 1994. Pp. 496. £18, $23.95.*

SOMEONE once described Los Angeles as 38 suburbs in search of a city. I can't think of a better metaphor to describe how I felt as I began my trek through this book. For the first 200 pages or so, I tried valiantly not to be distracted by the fineries of viruses, information theory, reductionism, algorithmic complexity, the genetic code, the Game of Life, Langton's ant, Lorenz's butterfly, dialogues with alien scientists and the dozens of other intellectual goodies put on the table before me. Not once tempted by these blandishments, I steadfastly persevered in search of the city surrounded by these suburbs of the intellect. And, as they say, all things come to those who wait — provided that they're willing to wait long enough — and on page 222 I finally found the Holy Grail. The authors' mission, it turns out, is to convince the world that scientists have been focusing on the complexities of a system when what really needs explaining is its simplicities. In short, if there's all that complexity out there, why is anything ever simple? *Voilà*. From there on it was as if I were in a hot-air balloon soaring over the landscape of complex systems, being continually regaled by tales of the world below by guides intimately familiar with every nook and cranny of the territory.

The "collapse of chaos" in the title refers to the way in which complex behaviour emerging from simple rules at one level can itself give way to simple behaviour at another hierarchical level. Although one might quibble with the conflation of chaos and complexity, this process of the emergence of simple properties and patterns from complex behaviour is the key in the rapidly unfolding science of complex systems, so the authors have certainly chosen well to have it constitute the centrepiece of the second half of the book.

The authors draw a useful distinction between reductionism as a way of getting at the scheme of things and emergent behaviour, regarding the first as focusing on the inside of systems, their content, so to speak, and the latter emphasizing that which lies outside the system, its context. These are essentially dual aspects of any system, which strongly suggests that both are needed to understand fully the whys and wherefores of any complex process. Yet conventional science focuses almost exclusively on the system's context, which seems to be a bit like trying to play basketball with one arm tied behind your back. It can be done, but you'll certainly do better with both arms engaged in the action. In fact, the book argues that it's flatly impossible to understand emergent phenomena if you don't look at both sides of this duality and consider the system's interactions with its environment.

To characterize emergent behaviour, the authors revive two archaic words, "simplexity" and "complicity", which to many readers (including this reviewer) may at first glance appear to be all-too-cute neologisms. But there turns out to be considerable merit to this semantic trick. Simplexity is related to the word 'simplex', meaning simple, and refers to 'regular' emergence, the kind whereby a system of rules gives rise to simple features. A good example is the appearance of the celebrated Feigenbaum constant in all period-doubling routes to chaotic behaviour. Complicity, on the other hand, is a kind of 'super' emergence, in which completely different rules converge to produce similar features. The authors cite consciousness and evolution as prime examples of this kind of emergence. So simplexity explores a fixed space of the possible, whereas complicity enlarges the space. Regardless of the appellations, these are definitely useful distinctions to draw about the behaviour of complex systems, and it is to the authors' credit that they present them in such an easy-to-digest fashion for the general reader, not to mention the scientific public.

Despite the intimidating theme, which may suggest to many a fairly dull tramp along several well-worn paths in the philosophy of science, I think most readers will be pleasantly surprised to find in this work a host of new and thought-provoking ideas about the workings of complex systems. The authors have taken considerable pains to describe their ideas in familiar terms, with many examples — mostly from biology — and have admirably made the point that something fundamental is missing in the traditional reductionist view of science.

Simplexity and complicity may or may not make their way into the scientist's lexicon, but the ideas they encapsulate about system complexity and simplicity will almost surely form the backbone of twenty-first-century science. And this book is as good an introduction to that science of the future as any you're likely to find. □

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More than 70 scholars worldwide contribute to **The Cambridge Encyclopedia of Human Evolution** edited by Steve Jones, Robert Martin and David Pilbeam (Cambridge University Press, £24.95). "A feast of information. . . If (whether student or professional) you're interested in human evolution, you'll want to have this volume handy" (Ian Tattersall, *Nature* **361**, 314; 1993).

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Princeton University Press has reissued two books in its Science Library series intended to bring the writings of leading scientists to a broad professional and general audience. They are: **The Enjoyment of Math** by Hans Rademacher and Otto Toeplitz, first published in 1957, a selection of mathematical problems and their solutions; and **The Supernova Story** by Laurence A. Marschall, which was described as "a superb piece of writing [which] reads almost as easily as a good novel" (H. Shipman, *Nature* **336**, 291; 1988). Each is priced at $12.95, £10.95.

Stress Test (Rutgers University Press, $10.95) is a collection of cartoons on medicine by the irrepressible Sidney Harris. An example of his humour appears below.

"YOU CAN TELL DR. RIDLEY THAT I KNOW KLEINZOFF'S SYNDROME WHEN I SEE IT, AND YOU DON'T HAVE KLEINZOFF'S SYNDROME."