An Introduction to Chaotic Dynamical Systems

Robert L. Devaney
320 pp. Benjamin–Cummings, Menlo Park, Calif., 1986.
ISBN 0-8053-1601-9. $29.95

The field of chaotic dynamical systems has had such a success, and such extensive coverage in PHYSICS TODAY, that it suffices to recall here its main features: Even very simple deterministic systems in the laboratory or in mathematics exhibit apparently unpredictable dynamics, rich fractal structures that cannot be analyzed by such traditional tools of physics as Fourier analysis and mode expansions.

This generated much skepticism and, later, much enthusiasm in the physics community, and, to a lesser extent, in the mathematics community—as indicated, for example, by the large and still growing number of books on the subject.

Robert L. Devaney's book has a clear aim: To describe in a mathematically correct fashion some major aspects of discrete (in time) dynamical systems, that is iterated maps. Except for the last chapter only rudimentary knowledge of mathematics is expected from the reader. Devaney has made a great effort to provide a careful exposition, omitting no definitions. It is my belief that a reader who wants to learn the mathematics of the subject cannot really avoid an apprenticeship: This book provides an excellent occasion to learn the definitions and the facts.

The book does not address any physics, nor does it treat the important subject of dynamical systems continuous in time and of the ergodic theory of dynamical systems. I regret this, and I hope Devaney will write another book, in the same style, dealing with these matters.

The references are held to a minimum on purpose. I do not believe that this is helpful for the student who seeks familiarity with the subject. But otherwise I can recommend the book warmly—even to physicists.

Now a comparison with other books. On the mathematical side, we have *Nonlinear Oscillation, Dynamical Systems, and Bifurcations of Vector Fields* by J. Guckenheimer and P. Holmes (Springer-Verlag, New York, 1983)—somewhat wider in scope and on average easier reading than Devaney's book; *Introduction to Ergodic Theory* by Y. G. Sinai (Princeton U. P., Princeton, N. J., 1978)—which provides only an exposition of ergodic theory for dynamical systems. On the physical side, we have *L'Ordre dans le Chaos* by P. Bergé, Y. Pomeau and D. Vidal (Hermann, Paris, 1984)—a very nice, elementary exposition for physicists [see review in PHYSICS TODAY, January 1986, page 85; it has now been translated by L. Tuckermann as *Order Within Chaos: Towards a Deterministic Approach to Turbulence* (Wiley, New York, 1986)]; and *Deterministic Chaos* by H. G. Schuster (VCH Publishers, New York, 1984)—an exposition in easy style, but somewhat more sloppy. *Advanced Synergetics: Instability Hierarchies of Self-Organizing Systems and Devices* by Hermann Haken (Springer-Verlag, New York, 1983) is broader in scope, but less systematic than the other books. Of course, there are several other books, but my omissions do not reflect personal taste.

Finally, I coauthored a book—*Iterated Maps of the Interval as Dynamical Systems* by P. Collet and J.-P. Eckmann (Birkhäuser, Boston, 1980)—as well as two logically related reviews *Rev. Mod. Phys.* **53**, 843 (1981) and with D. Ruelle *Rev. Mod. Phys.* **57**, 817 (1985).

JEAN-PIERRE ECKMANN
Université de Genève
Switzerland

Manhattan: The Army and the Atomic Bomb

Vincent C. Jones
660 pp. Center of Military History, United States Army (dist. by Supt. of Documents, Gov't Printing Office), Washington, D. C., 1985. $21.00

The Dragon's Tail: Radiation Safety in the Manhattan Project, 1942–1946

Barton C. Hacker
246 pp. U. of Calif. P., Berkeley, 1987.
ISBN 0-520-05852-6. $25.00

Anyone who is familiar with the vast popular and scholarly literature on the building of the first atomic bombs during World War II might wonder what possibly could be left to say about the Manhattan Project. Vincent C. Jones's *Manhattan* and Barton C. Hacker's *The Dragon's Tail* show that quite a lot has remained obscure; both books provide new information and fresh perspectives that enhance our knowledge of the bomb project during and immediately after the war.

As the subtitle of his book indicates, Jones, a historian with the US Army's Center of Military History, focuses on the role of the army in running the Manhattan Project. His protagonist is General Leslie R. Groves, the intense, hard-driving, ambitious officer responsible for solving a series of perplexing problems to make scientific theories about nuclear energy into the realities of atomic bombs. In his discussion of the efforts to separate U^{235} from U^{238}, to produce usable quantities of plutonium, and to design workable bombs, Jones covers much of the same ground as Richard G. Hewlett's and Oscar E. Anderson Jr's monumental *The New World, 1939–1946* (1962). But he adds significant new information on the army's execution of key administrative functions, such as securing materials, acquiring land, generating electric power, and constructing communities to house thousands of workers.

Jones faithfully recounts the controversial aspects of the army's performance, some of which enraged Manhattan Project scientists and provoked allegations of having slowed progress on the bomb. This was particularly true of the policies of compartmentalizing scientific information and enforcing strict security measures (ironically, though, not strict enough to expose Soviet spy Klaus Fuchs). He concludes that "the Army was the organization best suited, and perhaps the only one able, to undertake the responsibility for administering a program of the magnitude and difficulty of the Manhattan Project." *Manhattan* is too long and detailed to appeal to a casual reader, but anyone seeking a handy and reliable reference will find it invaluable.

Hacker examines a subject that has been at best slighted and at worst neglected in other studies of the Manhattan Project. He describes how project scientists guarded against ever-present but poorly understood radiation hazards while racing to produce the bomb. After surveying prewar radiation protection efforts and the development of the first "tolerance doses," he discusses the work of the health physicists of the Manhattan Project. He shows how they expanded knowledge of radiation hazards and improved instruments to measure them. Hacker, a historian at Oregon State University who wrote this book as part of a contract with the Department of Energy, demonstrates that radiation safety was an important concern of top-level officials in conducting the first atomic bomb test in 1945 and the Bikini test shots in 1946. But he also emphasizes that radiation protection of participants or the public was not their primary consideration. Health physicists knew, he writes, that "radiation safety was only one [concern], and not the most important. It might well suffer in conflict with other test goals."

Hacker delivers an excellent analysis of the early history of radiation safety. He provides a clear exposition of a complex topic that needed careful scholarly treatment. His book is un-