

tion of the yardstick, increasing with a power $D = 1.52$ as the mesh becomes finer and finer. The coast of Norway is a fractal, and D is its fractal dimension.

Benoit Mandelbrot (IBM Thomas J. Watson Research Center), the inventor of the word "fractal," has pointed out in several books and articles that nature is full of such self-similar objects with noninteger dimension. Feder is a physicist at the University of Oslo, and his own research, carried out in collaboration with Torstein Jøssang, has been mostly on aggregation of protein clusters and on flow in fractured media.

Feder's book reviews experiments and observations of fractals in fields ranging from astrophysics and fluid dynamics to random walks and aggregation. The string-like arrangement of clusters of galaxies in the universe has a fractal dimension slightly larger than unity. In a chapter on "viscous fingering" Feder shows amazing patterns obtained from very simple experiments, such as the displacement of epoxy by air in a medium consisting of a monolayer of glass spheres between two glass plates. The experimental results can, to some extent, be described mathematically in terms of "inversion percolation," also reviewed in the book.

The fractals in Feder's book are seen through a physicist's rather than a mathematician's eyes. The focus is clearly on explicit descriptions of specific fractal structures in nature rather than on general mathematical statements and analysis or on numerical simulations and computer graphics of abstract mathematical fractals. In this way the emphasis clearly differs from that of Mandelbrot's books *Fractals: Form, Chance, and Dimension* (Freeman, San Francisco, 1977) and *The Fractal Structure of Nature* (Freeman, San Francisco, 1982) and Heinz-Otto Peitgen and Peter Richter's *The Beauty of Fractals* (Springer-Verlag, New York, 1986). All the examples are documented with raw, unmanipulated data so that readers can see for themselves precisely how the fractal analysis works. Feder's book is easy to read, but nonetheless it includes the most recent research in the field. For instance, the book reviews in great detail the multifractal analysis of convection in Rayleigh-Bénard experiments carried out by Mogens Jensen, Leo Kadanoff, Albert Libchaber and Itamar Procaccia, all at the University of Chicago.

I found the chapter on fractal records in time particularly interesting. It is an empirical fact that many

physical observables fluctuate much more in time than one would expect from the simple square root time dependence expected for stochastic processes. These fluctuations are characterized by the "Hurst exponent," which is usually greater than $1/2$. Following the general philosophy of the book, this rather complicated phenomenon is illustrated by a specific analysis of the history of wave height at "Tromsøflaket" at the Norwegian coast, using original data measured by the Norwegian Institute of Technology.

Despite the ubiquitousness of fractals, their origin is not at all understood. There is almost no theory of the dynamical processes leading to their formation. It seems strange to me that Feder, a physicist, never stops for a second to wonder *why* fractals appear everywhere. The origin of fractals is one of the great mysteries of physics and promises to be an exciting research area for the future.

The strategy of teaching through examples works extremely well. This is an excellent textbook for a physics course on fractals, guiding the reader to even the most up-to-date research on fractals while avoiding complex mathematical details. The abundance of fractals assures that the field is here to stay, and I recommend the book to anyone wishing to learn what they are all about. It is the best book I know of on fractals in physics.

PER BAK

Brookhaven National Laboratory

Harmony and Unity: The Life of Niels Bohr

Niels Blaedel

Science Tech, Madison, Wis.,
1988 [1985]. 323 pp.

\$35.00 hc ISBN 0-910239-14-2

The author of this biography, which was written for the centenary of Bohr's birth, is a Danish science writer. The book is intended primarily for nonphysicists; nevertheless it offers extensive (albeit nontechnical) accounts of all aspects of Bohr's scientific work. The consistent emphasis, however, is on Bohr as a person—his character, interests and *Weltanschauung*. Niels Blaedel was able to draw on matchless resources, both human and material: Bohr's family (especially his widow, Margrethe Bohr, who shared both her memories and her correspondence), Bohr's former friends and colleagues, and a rich supply of documentary and photographic material from Danish collec-

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tions, as well as from the AIP Niels Bohr Library in New York. The result is a lavishly illustrated and affectionate account of Bohr from his earliest years until his death.

Much of the more personal material will be familiar to anyone who has read previously published studies of Bohr—in particular the collection *Niels Bohr: His Life and Work as Seen by His Friends and Colleagues* (North-Holland, Amsterdam, 1967) edited by Stefan Rozental. Nevertheless, there is merit in having a portrait that is the work of a single author, and the present work is unquestionably more authoritative and balanced than the quite good biography written more than 20 years ago by Ruth Moore.

In one particular area Blaedel's book includes much interesting detail not to be found in earlier accounts of Bohr: the background to Bohr's disastrous interactions with Winston Churchill during World War II. Another chapter that does not cover familiar ground concerns Bohr's lifelong interest in poetry and the ideas of the great poets, especially Goethe and Schiller. Clearly there was a strongly romantic side to Bohr's nature, and it appears in some of his writings, especially in letters to his wife.

This book spares no effort to celebrate the greatness of Niels Bohr, both as a scientist and as a human being, but I suspect that the magic of his influence cannot be adequately conveyed to anyone who did not actually work with him. Clearly it was something that transcended the demands he placed on his young associates, who suffered through draft after draft of the papers he hammered out with them, using them as both sounding boards and amanuenses. (And his propensity for changing articles over and over again, even after they had reached proof stage, must have driven editors and printers to distraction!) Yet, as the book makes clear, he commanded loyalty and affection from essentially all of that band of brilliant younger colleagues who, under his fatherly influence, were the chief creators of quantum mechanics. The crucial element may well have been his ability to reconcile seeming contradictions through the doctrine of complementarity, which pervaded his philosophy of both physics and human affairs.

I do have minor criticisms. Bohr appears a little too much as an embodiment of all the virtues. For example, one would hardly guess from this account that his performance as a lecturer and public speaker was what Abraham Pais once described as "di-

vinely bad," and it would not have detracted in the least from his greatness to acknowledge that fact. The English rendering of the text is in general good, though I was briefly thrown by the phrase "lattice spectrograph," until I realized that "lattice" was to be read as "grating." The fact that neither the translator nor the author is a physicist is also evident at various other places in the text. However, as a general picture of Bohr and his work this book can be warmly recommended. (Outside North America the book is available from Springer-Verlag, Heidelberg, FRG; ISBN 3-540-19334-0.)

ANTHONY P. FRENCH
Massachusetts Institute of Technology

BOOK NOTE

Symposium on the Foundations of Modern Physics 1987: The Copenhagen Interpretation 60 Years after the Como Lecture

Edited by Pekka Lahti and Peter Mittelstaedt

World Scientific, Singapore
(Teaneck, N. J.), 1987. 523 pp.
\$75.00 hc ISBN 9971-50-382-4;
\$37.00 pb ISBN 9971-50-460-X

As stated in this book's foreword, the aim of the 1987 Symposium on the Foundations of Modern Physics was "to review the main aspects of the Copenhagen interpretation of quantum mechanics, to discuss the relevance of this interpretation for our present understanding of quantum mechanics, to present some systematic interpretations of the theory, and to discuss the role of the observer in quantum physics." The book consists of the invited and contributed lectures presented at the symposium, held in Finland in August 1987. A reprint of Niels Bohr's Como lecture "The Quantum Postulate and the Recent Development of Atomic Theory," published in *Nature* in 1928, is included. There are contributions by David Bohm, Bernard d'Espagnat and C. F. von Weizsäcker, among others.

—PER H. ANDERSEN

NEW BOOKS

Atomic Physics

Advances in Atomic and Molecular Physics, Vol. 25. D. Bates, B. Bederson, eds. Academic, San Diego, Calif., 1988.

559 pp. \$99.50 hc ISBN 0-12-003825-0. *Compilation*

Aspects of Many-Body Effects in Molecules and Extended Systems. Lecture Notes in Chemistry 50. Proc. Wksp., Calcutta, February 1988. D. Mukherjee, ed. Springer-Verlag, New York, 1989. 565 pp. \$73.00 pb ISBN 0-387-50765-5

Fundamental Processes of Atomic Dynamics. NATO ASI Series B: Physics 181. Proc. Inst., Maratea, Italy, September 1987. J. S. Briggs, H. Kleinpoppen, H. O. Lutz, eds. Plenum, New York, 1988. 693 pp. \$120.00 hc ISBN 0-306-42988-8

Mathematical Models of Chemical Reactions: Theory and Applications of Deterministic and Stochastic Models. P. Erdi, J. Tóth. Princeton U. P., Princeton, N. J., 1989. 259 pp. \$59.50 hc ISBN 0-691-08532-3. *Monograph*

Methods in Computational Chemistry, Vol. 2: Relativistic Effects in Atoms and Molecules. S. Wilson, ed. Plenum, New York, 1988. 291 pp. \$55.00 hc ISBN 0-306-42946-2. *Monograph compilation*

Methods of Molecular Quantum Mechanics. Second edition. R. McWeeny. Academic, London, 1989. 573 pp. £65.00 hc ISBN 0-12-486551-8. *Monograph text*

Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory. Revised edition. A. Szabo, N. S. Ostlund. McGraw-Hill, New York, 1989. 466 pp. \$39.95 hc ISBN 0-07-062739-8. *Text*

Simple Molecular Systems at Very High Density. NATO ASI Series B: Physics 186. Proc. Wksp., Les Houches, France, March 1988. A. Polian, P. Loubeyre, N. Boccarda, eds. Plenum, New York, 1989. 512 pp. \$105.00 hc ISBN 0-306-43028-2

The Structure of Small Molecules and Ions. Proc. Wksp., Neve Ilan, Israel, December 1987. R. Naaman, Z. Vager. Plenum, New York, 1988. 351 pp. \$75.00 hc ISBN 0-306-43016-9

Topological Methods in Chemistry. R. E. Merrifield, H. E. Simmons. Wiley, New York, 1989. 233 pp. \$35.00 hc ISBN 0-471-83817-9. *Text*

Condensed Matter Physics

Amorphous Silicon and Related Materials, Vols. A and B. Advances in Disordered Semiconductors 1. H. Fritzsche, ed. World Scientific, Singapore (Teaneck, N. J.), 1989. 1123 pp. \$159.00 (set) hc ISBN 9971-50-615-7. *Compilation*

Beyond the Crystalline State: An Emerging Perspective. Springer Series in Solid-State Sciences 84. G. Venkataraman, D. Sahoo, V. Balakrishnan. Springer-Verlag, New York, 1989. 207 pp. \$69.00 hc ISBN 0-387-19110-0. *Monograph text*

Current Issues in Condensed Matter Structure. Current Issues in Solid State Science. A. M. Stoneham, ed. Adam Hilger, Bristol, UK (AIP, New York), 1987. 222 pp. £14.50 (\$39.00) pb ISBN 0-85274-450-1. *Reprint compilation from J. of Physics C: Solid State Physics*