

worked out in detail and a good selection of exercises at the end. The illustrations are well done and there are several excellent tables, such as Table 6-1 which illustrates six different oscillators and tells how each oscillation is started, then presents the analogous equations for the natural frequencies, compliant elements, and inertial elements. Typos and misspellings are few and far between. More annoying to this reviewer are such stylistic omissions as commas denoting "thousands" and "millions" when not using power-of-ten notation, and periods after the initials in scientists' names.

In summary, Shive and Weber have written a book which fills a void in intermediate physics. Such a book will be a most useful addition to college and university libraries. Since it is best considered as collateral reading material, I

doubt that many students will pay the high price charged by the publishers for their own copy. But inexperienced physics teachers would find it a good investment to purchase this book. And those who enjoy the analogy point of view should consider buying this book for pleasure reading, for it does provide just that.

Elizabeth Ivey has been teaching at Smith College for 14 years and is presently serving as the Associate Dean of the Faculty. Her research is in the areas of environmental noise propagation and the attenuation of ground vibrations. She is co-author (with Clive Dym) of a book, Principles of Mathematical Modeling, which uses analogies in the presentation of material in several of its chapters.

Betrayers of the Truth. William Broad and Nicholas Wade. 256 pp. Simon and Schuster, New York, 1982. Price: \$14.95. (Reviewed by H. L. Armstrong.)

While this is not a work on physics, it is about science—or about some of the less savory aspects of science—and the physicist, like any other scientist, may profit by the warnings to be found herein. In fact, the subtitle, *Fraud and Deceit in the Halls of Science*, indicates what this book is about. It consists primarily of case studies of various examples of fraud, and other unethical behavior, in science. It may be stated at once that physics comes off fairly well; indeed, as the book itself says, the very structure of such sciences as mathematics and physics provides a certain protection against fraud. There was, however, the case of the N rays, which is discussed at some length. It appears that fraud has been more common in the biological sciences, and especially in those connected with medicine, maybe because there the rewards may be greater.

Outright fraud, of course, is only one extreme of unethical behavior. It has usually consisted of falsification of experimental results. But there are lesser degrees; for instance, the fudging of experimental results to make them look a little better. Then there are such unethical practices as plagiarism, and the taking of credit which rightly belongs to another. Then, there are different motives leading to scientific fraud. At one extreme, perhaps, is the practical joke which gets out of hand; some think that is the true explanation of the Piltdown affair. At the other extreme may be fraud purely and simply for personal gain. Examples of all of these things are discussed or mentioned in this work.

The scientific method is a thing about which much is said

and written nowadays. Chapter 7, "The Myth of Logic," has much to say on this point, and it tends to agree with the conclusion which has been expressed by others, that there is, in fact, no special scientific method. Certainly the picture so often presented in the elementary textbooks, of a steady progress from error to truth, is a distortion of what really happens. Since the scientific method, whatever it be, is supposed to be a way of arriving at truth, it should embody ways of avoiding or detecting error, let alone fraud. Three such safeguards are commonly cited; viz., the peer-review process, the refereeing of items for publication, and the replication of experiments. It is suggested, however, that none of these safeguards is very reliable. As for the review process, it has to do more with the question of what kind of research is to be undertaken than with the reliability of results which are announced. The reviewing of items for publication suffers on the one hand from superficiality, and on the other hand from inconsistency in what is accepted and what is rejected. As for replication, many experiments are not replicated in exactly their original form because, it may be, no one has the time or the inclination to do so. Besides, if someone undertakes to replicate an experiment and fails, he is likely to conclude, and often rightly so, that the trouble is that he has not mastered the technique. The reader will find all these points illustrated by example. Here, then, is a work which everyone occupied, or interested, in science should read, both as a warning to take a second look at results which seem *too* good, and as an antidote to the *hubris* into which it is only too easy to fall.

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Space-Perception and the Philosophy of Science. Patrick A. Heelan. 383 pp. Univ. California Press, Berkeley, 1983. Price: \$28.50. (Reviewed by James L. Park.)

A prospective reader with at least amateur interests in geometry and in the epistemology of science might well be attracted by this title while browsing in a book store; cursory perusal of the volume would reveal some fascinating

illustrations in the first few chapters, many pages of seemingly readable philosophical analysis, and in an Appendix just a little mathematical formalism. An attractive package to be sure, but our reader is apt to emerge from the reading more frustrated than enlightened, for beneath its alluring surface this work is in fact a very complex piece of philosophy made almost incomprehensible by an exceptionally turgid style of presentation. Presumably there are profes-

sional philosophers who would not share such a negative verdict on the readability of Heelan's prose, but as a physicist with a lifelong interest in the philosophy of science, this reviewer was deeply disappointed by the extreme obfuscation of a potentially intriguing thesis.

The central theme of the book is a philosophy of science emphasizing a generalized notion of perception that transcends the simple idea of receiving raw sensory data; indeed even scientific abstractions such as atoms apparently are to be regarded as perceptible. Professor Heelan constantly advocates a "hermeneutical" approach to philosophical problems and to the theory of perception in particular. ("Hermeneutics" usually refers to theological studies concerning methods of interpretation of Biblical texts.) In Heelan's philosophy one speaks of perceiving nature through "readable technologies" just as one perceives meaning in literal texts through ordinary reading.

Readers unexcited by such philosophical subtlety may nevertheless enjoy a portion of the work dedicated to empirical arguments suggesting that our natural "visual space" might more reasonably be characterized as hyperbolic rather than Euclidean. Evidence is offered from everyday observation, from psychological studies of visual illusions, and from the history of art and architecture. The familiar Euclidean viewpoint seems normal to us today,

Heelan argues, due to several centuries of technological civilization the development of which essentially required Euclidean geometry as a practical necessity. The point, however, is not that one geometry of visual space is the correct one; on the contrary, even a single individual might perceive the world at different times in different geometrical modes. Here the author appeals explicitly to the celebrated dualistic concepts of quantum physics and suggests in a plausible analogy that perceived visual spaces of different geometries might constitute a new manifestation of Bohrian complementarity.

The structure of the book will strike many readers as peculiar, in that the final retrospective chapter seems like a much needed and long awaited introduction. Evidently, to leave this impression was the author's intent, in order to illustrate by the very construction of the volume the "spiral" character of inquiry along "hermeneutical circles." To this reviewer the circle finally became too tedious to appreciate, but perhaps others can savor its literary uniqueness.

James L. Park is a professor of physics at Washington State University. He is particularly interested in the mathematical and philosophical foundations of quantum mechanics and thermodynamics.

BOOKS RECEIVED

- Apple II Applications.** (Blacksburg Continuing Education Series.) Marvin L. De Jong. Group Technology, Ltd., Check, Virginia, 1983. Price: \$13.93 (paper). ISBN: 0-672-22035-0.
- Atomic and Molecular Physics of Controlled Thermonuclear Fusion.** (NATO Advanced Science Institutes Series, Vol. 101.) Edited by Charles J. Joachain and Douglass E. Post. 576 pp. Plenum, New York, 1983. Price: \$79.50. ISBN 0-306-41398-1.
- Austenitic Steels at Low Temperatures.** (Cryogenic Materials Series.) Edited by R. P. Reed and T. Horiuchi. 388 pp. Plenum, New York, 1983. Price: \$62.50. ISBN: 0-306-41371-X.
- Basic Robotic Concepts.** (The Blacksburg Continuing Education Series.) John M. Holland. 270 pp. Order from Group Technology, Ltd., Check, VA, 1983. Price: \$19.95 (paper). ISBN: 0-672-21952-2.
- Biophysics.** M. W. Volkenshtein. 640 pp. Imported Publications, Chicago, 1983. Price: \$12.95 (cloth). ISBN: 0-8285-2405-X.
- Circuits, Devices and Systems,** 3rd ed. Ralph J. Smith. 767 pp. Wiley, New York, 1976. Price: \$35.95. ISBN: 0471-80171-2.
- Comprehensive Treatise of Electrochemistry,** Vol. 7. Kinetics and Mechanisms of Electrode Processes. Edited by Brian E. Conway, J. O'M. Bockris, Ernest Yeager, S. U. M. Kahn, and Ralph E. White. 788 pp. Plenum, New York, 1983. Price: \$95.00. ISBN: 0-306-41152-0.
- Earthquakes, Tides, Unidentified Sounds and Related Phenomena.** Compiled by William R. Corliss. (A Catalog of Geophysical Anomalies.) 214 pp. The Sourcebook Project, Glen Arm, MD, 1983. Price: \$12.95. ISBN: 0-915554-10-0.
- Electronic Prototype Construction.** (Blacksburg Continuing Education Series.) Stephen D. Kasten. 398 pp. Order from Group Technology, Ltd., Check, VA, 1983. Price: \$17.95. ISBN: 0-672-21895-X.
- Electronics Circuits and Devices,** 2nd ed. Ralph J. Smith. 494 pp. Wiley, New York, 1980. Price: \$24.50. ISBN: 0471-05344-9. Also: Instructor's Manual.
- An Elementary Course on General Relativity.** Tullio Regge. (Lectures Given in Academic Training Programme of CERN 1982-83.) 25 pp. CERN 83-09, Geneva, 1983. Price not given.
- Fundamentals of Crystal Physics.** Yu. I. Sirotnin and M. P. Shaskolskaya. 654 pp. Imported Publications, Chicago, 1983. Price: \$13.95. ISBN: 0-8285-2464-5.

- Fundamentals of Theoretical Physics,** Vol. 1, Mechanics Electrodynamics; Vol. 2, Quantum Mechanics. I. V. Savel'ev. (Translated from the Russian by G. Leib.) 792 pp. Price: \$16.95 (both). ISBN: 0-8285-2335-5.
- Handbook of Elementary Physics.** N. I. Koshkin and M. G. Shirkevich. 320 pp. Imported Publications, Chicago, 1983. Price: \$8.95. ISBN: 0-8285-2309-6.
- Handbook of Unusual Natural Phenomena.** William R. Corliss. 542 pp. The Sourcebook Project, Glen Arm, MD, 1983. Price: \$15.95. ISBN: 0-915554-01-1.
- Introduction to Electromagnetic Fields.** Clayton R. Paul and Syed A. Nasar. 567 pp. McGraw-Hill, New York, 1983. Price: \$36.50. ISBN: 0-07-045884-7.
- An Introduction to Tensor Calculus, Relativity and Cosmology,** 3rd ed. D. F. Lawden. 205 pp. Wiley, New York, 1983. Price: \$16.95. ISBN: 0471-10096-X.
- Lectures on Geometric Methods in Mathematical Physics.** (CBMS-NSH Regional Conference Series in Applied Mathematics.) Jerrold E. Marsden. 97 pp. SIAM (Society for Industrial and Applied Mathematics), Philadelphia, 1983. Price not given. ISBN: 0-89871-170-3.
- The Left Hand of Creation: The Origin and Evolution of the Expanding Universe.** John D. Barrow and Joseph Silk. 256 pp. Basic, New York, 1983. Price: \$17.95. ISBN: 0-465-03895-6.
- Lightning, Auroras, Nocturnal Lights, and Related Luminous Phenomena: A Catalog of Geophysical Anomalies.** William R. Corliss. 242 pp. Price: \$11.95. ISBN: 0-915554-09-7.
- Linear and Nonlinear Differential Equations.** (Ellis Horwood Series, MATHEMATICS AND ITS APPLICATIONS.) I. D. Huntley and R. M. Johnson. 190 pp. Wiley, New York, 1983. Price: \$22.50. ISBN: 0470-27420-4.
- Maxwell on Saturn's Rings.** Edited by Stephen G. Brush, C. W. F. Everitt, and Elizabeth Garber. 199 pp. MIT Press, Cambridge, 1983. Price: \$25.00. ISBN: 0-262-13190-0.
- McGraw-Hill Dictionary of Scientific and Technical Terms,** 3rd ed. Sybil P. Parker, editor. (Definitions encompass 100 disciplines.) 1846 pp. McGraw-Hill, New York, 1983. ISBN: 0-07-045269-5.