

The rest of volume 2 is devoted to various perturbation methods. Many different techniques of perturbation theory have been developed over the years by celestial mechanicians, more than in any other field of which I am aware. There are, unfortunately, no universal methods, although some are more generally useful than others. Hagihara has, of course, concentrated on the more important methods, such as Hansen's, Lagrange's, Delaunay's, von Zeipel's, Brouwer's, and Hill's methods, but he has said something, at least, about many other lesser-known methods. Some of the latter have very interesting features. He also reviews the important new Lie transform methods of Gen-ichiro Hori and André Deprit. He has spiced his discussions with numerous applications of these methods to actual problems, such as asteroids, planetary satellites, artificial satellites, and so on, most of them being concise discussions of various workers' research, taken directly from the literature.

One of the most valuable features of this book, as is true of the previous volume, is the list of references. An informal estimate yields something like 1500 books and articles cited. Most of the references are relatively recent, although Hagihara's long experience in the field has enabled him to list numerous older references of importance also.

I have few criticisms. My copy of Part 1 came with one defect, namely an extra signature containing pages 237-268. No typographical errors were detected, however. It is truly a shame that these volumes are so expensive. One feels that they should be on the shelf of everyone working seriously in celestial mechanics, but I suspect that, because of the price, many will pass this series up.

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Speaking of Science: Conversations with Outstanding Scientists

Robert A. Potter, ed.

Six cassettes. American Association for the Advancement of Science, Washington, 1972. \$39.95

What to do with the message when there's a change in the medium? When everybody is watching and listening, how shall we convey the stuff we used to read?

Considerable thought and effort are

going to tape recordings for the purpose. *PHYSICS TODAY* has had its letters suggesting that physicists follow the lead of the American Medical Association, which makes tapes that doctors can listen to as they drive from patient to patient or home to office. Physics texts, both advanced and simple, are among the books that are carefully taped and packaged at Recordings for the Blind. Now the American Association for the Advancement of Science has added an impressive set of six cassettes (about four hours' worth) called *Speaking of Science: Conversations with Outstanding Scientists* to the reels and cassettes on which it has already made available more than 100 AAAS symposiums of 1969-71.

The plan is effective. Edward Edelson and Mitchell Krauss, both broadcast journalists, conduct interviews with scientists and produce what sound like radio programs—even to the musical opening and ending. Carl Sagan speaks of space exploration, Theodosius Dobzhansky of evolution, George Rathjens of ways to peace, Mark Kac of advances in life sciences, Margaret Mead of telling the public, Jack Goldman of technology. And so on: Herbert Holloman, Athelstan Spilhaus, Arthur Kantrowitz, Herman Kahn, many others.

Some interviews are with one person at a time, and in some two or three converse as a panel. Usually the interviewers give the speakers free rein and let them tell it their way. Often, though, the interviewers lead with probing questions, and occasionally they attempt a change of course. Without much success Edelson tried to get Dobzhansky to define his concepts when he felt, as I did, that the content was becoming too abstruse.

On the whole, though, you will find the material clear and, above all, interesting. Each of the speakers looks at science, even his own speciality, in the large. What does it do for society? How does it affect the people who pursue it? What, if anything, can science as a way of life contribute to better the world we live in and its intellectual storehouse?

Margaret Mead, I found, is particularly stimulating. She calls for better programs to train science writers—such as the one at Columbia recently abandoned for want of support. The popular image of science, she says, should be changed; the scientist isn't really the man in a white coat, isolated from life around him, that the public sees. She pleads also for responsible technology: "Don't make anything until you can take it apart again." Emphatically she decries the writing of scientists and asks them to talk intelligibly in simple English. Amen. But

the sword has two edges. Obfuscating language, hard to understand, convinces the reader that the work is difficult, and that impression, many agree, is a lot of fun to create. It is even fun to create it with a donor when you convince him that anything so hard to do must be worthy of his full support. How do you remove such motivation? Perhaps by recognizing that after a couple of decades on the gravy train, we have fallen off. The donors now look for things that they can understand—dirty rivers and crowded cities.

The various disparate proposals and programs of making tapes—textbooks for the blind, papers for physicians and these conversations for fun and stimulation—invite a more concentrated effort to use the tape medium, which is now largely supported by rock bands and their listeners. Easily you can imagine a regular series of tapes to be heard as you travel on trains, planes and highways, played on the same instrument that you carry for on-the-road records and dictation. A good look at the market and some building on it might justify expenditure of some of the funds intended to improve science, scientists and communication among them.

Anyway, these six tapes are good. You will not be disappointed if you buy a set, put them on your cassette player and let them displace a couple of hours of the public broadcasting that has been called "a vast wasteland."

R. HOBART ELLIS JR

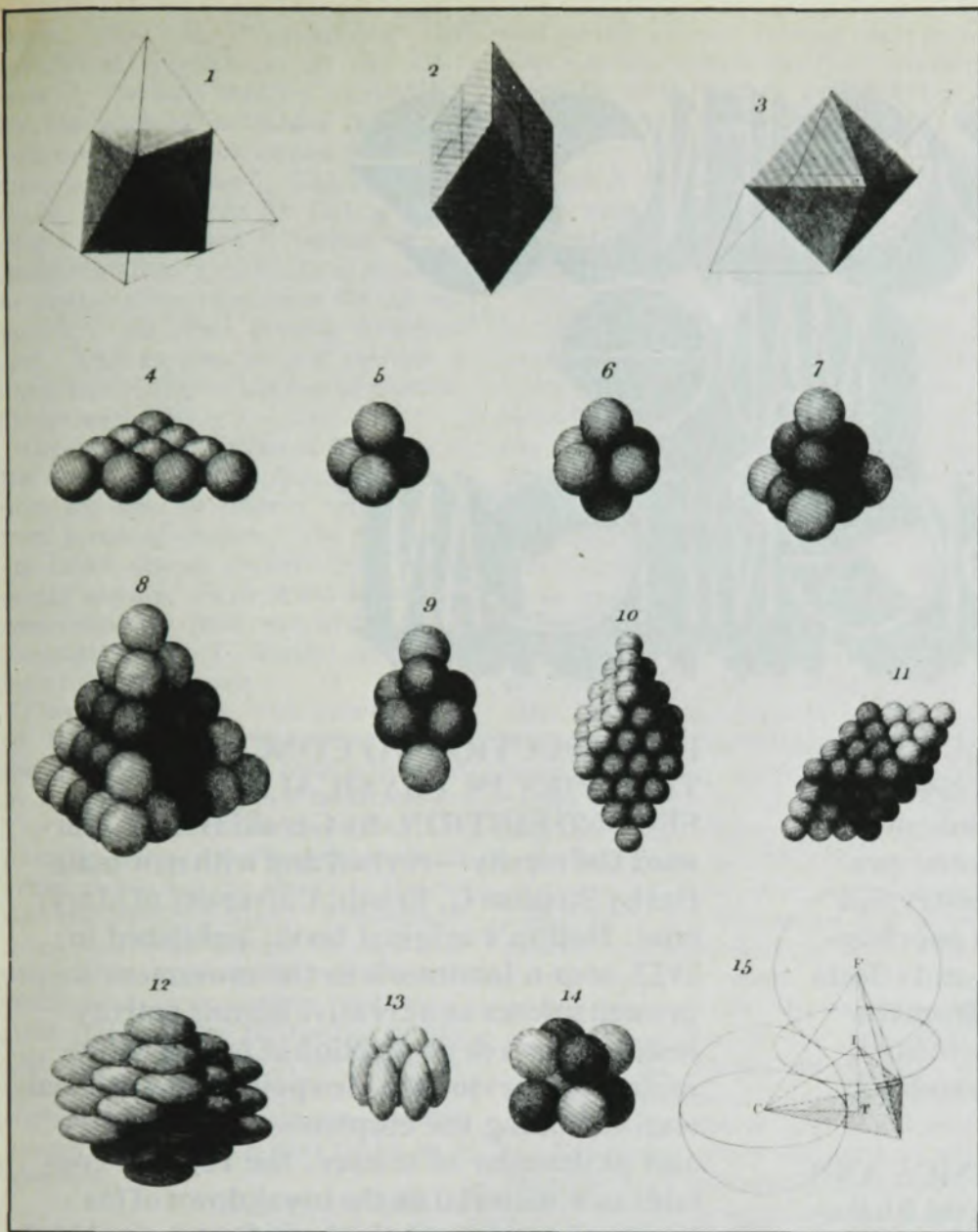
Hobart Ellis, who edited PHYSICS TODAY from 1965 to 1969, died last October; the review above is his last contribution to this magazine. An obituary appears on page 65.

The Science of Matter: A Historical Survey, Selected Readings

M. P. Crosland, ed.

Penguin, Middlesex, UK, 1971. \$4.95

The question "of what is the world made?" is certainly as old as reflective man; the answers given are nearly as varied as the men who have given them. "Of principles," say some, "of elements," say others; "of atoms" says still a third group; "of forces," claims another, or "of little bits of electricity." Each answer reflects the men who gave it, the tradition in which they worked, and their era. M. P. Crosland, reader in the History of Science at the University of Leeds, has assembled 163 selections to display some of these answers. The selections are ar-



Crystal structure. These figures, which illustrated a lecture given by William Wollaston in 1812, show how it was thought that the regular shapes of crystals could be formed by appropriate arrangements of elementary particles. Some of Wollaston's papers and those of others who have investigated the structure of matter are included in M. P. Crosland's book.

ranged chronologically, beginning with Aristotle on the Ionian principles (6th century B.C.) and ending with C. N. Yang on the conservation of parity (1958). Crosland's introduction emphasizes that the anthology represents—as any honest anthology should—a “personal” selection. Personal it may be, but the selections are not eccentric. In addition to a general introduction designed to explain why opinions on the nature of matter are worth study, Crosland gives each of the 33 sections in which the selections are grouped brief but insightful introductions. The volume gives, in the words of their originators, a sampling of many of the seminal scientific ideas: Lucretius, Paracelsus, René Descartes, Robert Boyle, Galileo, Sir Isaac Newton, Denis Diderot, Boscovich, Joseph Priestley, Antoine Lavoisier, John Dal-

ton, Sir Humphrey Davy, Joseph Proust, Michael Faraday, James Clerk Maxwell—to name a prominent few. For the 20th century about 70 pages of text appears to offer less than complete coverage. If one were to quarrel with Crosland's selections, the quarrel would possibly revolve around which papers should be included for the 20th century. Max Planck's papers are not represented although there are references to him and one of the introductory sections abstracts his work. All anthologies suffer from selections that are too short; “snippets” is the pejorative term. For an anthology of scientific writing the problem becomes acute, as Crosland admits, since economy requires that experimental evidence be omitted. Crosland attempts to remedy the deficiency by giving the precise reference to the work from

which the anthologized section was taken, collected in “Sources” at the end of the work. His name and subject indexes supply further guides for the reader.

Three classes of readers are served by an anthology: students surveying a field find brief samplings, useful introductions and guides; serious researchers find quick references helpful; casual browsers oftentimes find short selections from quality material both provocative and beguiling. Crosland's anthology should be attractive to all three groups.

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Statistical Methods in Experimental Physics

W. T. Eadie
American Elsevier, New York, 1972.
\$17.25

The experimental physicist frequently needs an understanding of some of the more advanced methods for the statistical analysis of his data. Many of us have learned our methods as the need arose and lack a knowledge of the theoretical basis for such methods. The authors have attempted to meet this need by writing a text designed to be more than a handbook of methods and formulae. They have included many of the theoretical concepts, while at the same time trying to keep the text short enough to tempt the experimentalist to use it. This was done by stating most results without proof and by omitting techniques judged of lesser importance to experimental physicists.

The text begins with the necessary coverage of the theory of probability. The emphasis here is on convergence and the Central Limit Theorem. This is the basis for later discussions of the differences between the asymptotic properties of distributions and the finite sample properties. Chapter 4 is a catalogue of the more common ideal distributions and an all too brief discussion of “real life” distributions. The distributions are illustrated by many good computer-generated plots. The usefulness of several of these plots is unfortunately diminished by the fact that there are no labels on some of the curves.

The remainder of the text treats the subject of statistics. The authors choose to emphasize the Anti-Bayesian (classical) approach, but frequently point out the differences with the Bayesian view. They approach the subjects of point and interval estimation from the viewpoint of information