is no statement of why there are *lines* in a spectrum; the same page that includes a discussion of spectral lines shows a prism dispersing light but in the absence of a slit. The figure illustrating the Doppler effect appears to show $\Delta\lambda$ independent of λ. The reason for the emission of radiation by an accelerated charge is not explained. No distinction is made between oceanic and solid-body tides. Diffusive separation in the thermosphere of the Earth is described as "diffuse separation." We discover that cooling rather than heating of rocks releases large amounts of gas. At a time when the human population of the Earth will shortly be 4 billion souls, we are told that "a total of about 4 billion living objects have inherited the Earth at one time or another"; Berman means species. The combinatorial possibilities of DNA nucleotides are absurdly underestimated.

There is a peculiar reliance on miles, feet, the Fahrenheit temperature scale, and numbers like "sextillion." It is erroneously implied that significant heat transport occurs by atmospheric circulation on Mercury and Venus. Molecular nitrogen is announced on Mars; Jupiter is said to have "ionization belts"; synchrotron emission is unveiled for Saturn; Pic du Midi is transported to the Alps; the word "ionizes" is explained as "electrically inflames"; and the Stefan-Boltzmann, Wien and Planck radiation laws are all handed down from Mount Sinai. Red-giant electrons are called degenerate without explanation or defense of the electron. Some Stratoscope 2 flights are said to be manned. Berman has not noticed the withdrawal of the claim some years ago of ultraviolet luminosity around the star Spica. There are a fair number of misspellings including proper names (Alpher, Mutch, Penzias and Ponnamperuma), but there are good summaries of the scales of matter, time and energy, the galactic distance scales and recent lunar investigations. A removable phosphorescent star chart for night viewing is included as well. If only *Exploring the Cosmos* were not so error-ridden, its verve, enthusiasm and visual appeal would make it a first-rate introductory descriptive astronomy text. Perhaps the second edition will have major errors corrected.

Introductory Astronomy and Astrophysics, written by two professional astronomers, is more demanding of its readers. From this text it is possible to glean a fair amount of the excitement about contemporary astronomy. Its handling of some frontier areas—for example, quasars—is brief, thorough and fair to most of the disputing parties. There are some good pedagogical touches, such as a log-log plot of Kepler's third law, showing that P^2 is indeed proportional to a^3, and, while there are far too many "false trivials," there are still occasional exemplary elementary derivations, including those of the pressure, temperature and luminosity of stars. The discussion is of the traditional astronomical subjects, but very well balanced.

Chapter 1 is a little off-putting. We are informed that complex interstellar molecules such as *water* have been found in interstellar space, and that Mars is more like the Moon than the Earth. Then on the literary side, we have a discussion of the blind man and the elephant, and a concluding sentence, "Having set the stage, let the play begin!"

Among the problems: An undiscussed connection between negative total energy and bound orbits; a statement with no further elaboration that the study of fossil corals tells us something about the tidal evolution of the Earth-Moon system; a fundamental confusion, in the escape of planetary atmospheres, between equilibrium and exosphere temperatures; the erroneous contention that the rotation periods of no moons but our own are known; a "false-trivial" statement on the first test of general relativity; a curve purporting to show that lunar craters are of impact origin that nowhere shows points for volcanic craters; the omission of the 10-micron and other infrared windows when discussing regions of low opacity in the Earth's atmosphere; a definition of the atmospheric scale height, which is off by a factor of $\frac{2}{3}$, and several inaccuracies regarding the other planets of our solar system. There are a large number of "false trivials" that could readily have been rectified in a few lines—as, for example, the period/density relationship of Cepheids.

In general the book is remarkably up to date, although there is, for example, no reference to Cygnus X-1. Illustrations, such as the comparison of the Southern Milky Way with NGC 891, and an extremely instructive illustration of the winding of galactic spiral arms, are generally well done. There are attractive lunar mercator projection end papers. The authors also clearly distinguish the latin singular from plural in the widely misused terms: mare, maria; nova, novae; and nebula, nebulae. With some culling of errors and removal of "false trivials," Smith and Jacobs could become the standard introductory astronomy text for science-oriented students in the coming years.

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X rays in Atomic and Nuclear Physics

N. A. Dyson
380 pp. Longman, London, 1973.
£8.00

In the 40-odd years since the publication of Arthur Compton's and Samuel Allison's classic work on x-ray physics (*X rays in Theory and Experiment*), workers in the field have produced an extensive and often very specialized literature. Norman Dyson's book on x rays is a good general introduction to the physics and uses of x rays in atomic and nuclear physics. The book's great virtue lies in its combination of comprehensiveness and conciseness; this is achieved by leaving out most of the applications of x rays to crystallography, solid-state physics and metallurgy, trace-element analysis and so on. (Current reviews of some of these topics may be found, for example, in *X ray Spectroscopy*, edited by Leonid Azaroff, just published.) Dyson deals primarily with the basic physical processes of x-ray production, at a level that should make it quite useful to advanced undergraduates in physics as well as a convenient reference for graduate students and researchers in any field that makes use of x rays.

The book begins with a very readable short historical introduction. While many of the phenomena and applications of x rays were known before World War II, in the last few years research physicists have again taken an intense interest in x-ray phenomena. Dyson concisely treats the current research areas of mu-mesic x rays, studies of electron momentum distributions in solids, x-ray emission induced by collisions of heavy ions with isolated atoms and with solid targets, x-ray emission from the sun and from hot laboratory plasmas for fusion research, synchrotron radiation and x-ray astronomy from sounding rockets and satellites. His own research has been in x-ray production and microscopy starting at the Cavendish Laboratory, Cambridge; more recently he has worked on studies of the Mössbauer effect and in medical and biological physics at the University of Birmingham.

His opening discussion of the intensity and angular distribution of both continuous and characteristic x rays is very extensive, perhaps to the point of tediousness for some readers. By contrast, he treats only briefly the subject of inner-shell ionization by proton and by heavy-ion impact, which often results in much larger cross sections than for electron impact at the same velocity. Dyson does point out, though, that there is vigorous work going on in this field right now. The chapters on x-ray absorption and scattering (including

Mössbauer scattering) and x rays in radioactive decay may seem superficial to the experts, but I believe they provide a good perspective for the beginner.

The most useful chapter of this experimentally oriented book may be the one that introduces basic laboratory techniques: x-ray tubes and sources (including accelerators), spectrometers, filters (including Ross's "balanced filters"), detectors, fluorescence yields and radiation dosimetry. There is a minor error in an otherwise excellent introduction to the proportional counter. Figure 4.14 shows the counter anode wire isolated from the high voltage lead by a misplaced blocking capacitor.

A selective chapter-by-chapter bibliography leads the reader quite painlessly into more specialized reviews and research papers from 1896 up to 1971. Five appendices give basic reference data in a convenient form.

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Nuclear Power Plant Design Analysis

A. Sesonske
486 pp. NTIS, US Dept. of Commerce, Springfield, Va., 1973. $10.60

Nuclear electric power is beginning to emerge as a significant and mature technological industry. The industry has had some severe growing pains, and there are more to come. Public attention is increasing rapidly, amid debates about safety and environmental effects. Meanwhile, the demand for graduate nuclear engineers is greater than ever.

Alexander Sesonske has written a nuclear-engineering textbook of unique breadth and scope, encompassing nuclear-power economics, reactor heat-transfer engineering, nuclear-analysis methods for reactor-core design, reactor safety and methods for system design (including the interplay of economics, materials limitations, safety considerations, and uncertainties).

This book evolved from material used in design-oriented nuclear-engineering courses at Purdue University. It is intended to fill the gap between the engineering-science type of textbook and the "real world" of the practicing engineer. It will be very useful in senior-level or graduate design courses in nuclear engineering. A graduate physicist or a practicing engineer without some background in nuclear reactors may find this book difficult to digest, at least without extensive supplementary reading.

Sesonske is already widely known for his other textbooks in nuclear engineering. In this book, he has tried to condense a five-volume set into one volume. The resulting loss of depth is partially compensated by abundant references, but in many places the book reads more like a handbook than a textbook. Undefined symbols appear in several equations, and there is some unexplained jargon (such as "spoiled core," "lethargy group," "age approach," "alpha search"). Another drawback, for which the author apologizes, is the incomplete updating; the most recent reference to the "loss-of-coolant accident" is dated 1968, and the discussion of the fuel configuration in high-temperature graphite reactors is obsolete. Projections of costs, made at the time the first three chapters were written, are incongruous today. Projections of power demand, and of its allocation among various types of energy sources, are also outdated.

The discussion of safety analysis, though somewhat dated, is generally good and well balanced. The author might have amplified his comments (page 300) about "mechanistic approaches and nonmechanistic assumptions which are not always consistent." There is much lively controversy today about the proper role of Maxwell demons in setting design constraints and safety limits.

This book, which could have been improved by more careful editing and updating, is nevertheless a major contribution to the literature of nuclear engineering. The collection of material from such a broad area and its integration into a unified approach for engineering design is extremely valuable.

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Applications of Laser Raman Spectroscopy

S. K. Freeman
336 pp. Wiley, New York, 1974. $17.50

A more meaningful title of this book for readers of PHYSICS TODAY would have been "Applications of Laser Raman Spectroscopy to Organic Chemistry." It does not mention applications to solid-state physics nor to problems in molecular physics. It is in the tradition of treatises like K. W. F. Kohlrausch's *Der Smekal-Raman Effekt* (1931), James Hibben's *The Raman Effect and Its Chemical Applications* (1939) and Lionel Bellamy's *The Infrared Spectra of Complex Molecules* (1958), though it is not nearly so comprehensive as the earlier works (about 300 references in all compared with 2000 in Hibben and a similar number in Bellamy's 1958 edition). Part of this is due to the short lifetime of laser Raman spectroscopy in organic chemistry (about six years), but it must also be said that the book does not compare with the earlier works in depth.

The author is an organic chemist by training and he has clearly directed this volume to the experimental chemist. The introduction gives a general account of Raman spectroscopy in qualitative terms that would not appeal to physicists. There follows a brief survey of experimental methods (mainly the details of preparing chemical samples for spectroscopic study) that is the best feature of the work. The remainder of the text consists of a survey of the relationships between Raman frequencies and the chemical subgroups from which organic molecules are constructed. There are good chapters on the Raman spectra of polymers and biological materials, and a concluding one on the remote detection of air and water pollutants by Raman techniques.

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Nuclear Physics

M. G. Bowler
420 pp. Pergamon, New York, 1973. $18.00

As the outgrowth of teaching nuclear physics at Oxford for the last ten years, M. G. Bowler has written a very good, basic introductory text for a first semester of nuclear physics either at the advanced-undergraduate or beginning-graduate student level. A good one semester of quantum mechanics is certainly a necessary and probably a sufficient prerequisite for the scope of this text.

The text makes no claim to being a complete encylopedia for nuclear physics. It is not. Instead it concentrates on the fundamental properties of nuclei and their decays, examining in depth the roles of angular momentum and isospin. Fermi's golden rule forms the backbone of the book and Bowler uses it as the starting point for the discussion of various nuclear decays and their various transition probabilities and selection rules. Nuclear reactions are also approached in this way, with the emphasis in this area on quantum mechanics in the two-body problem, barrier penetration, structure resonances and partial-wave analysis.

There is virtually no discussion of topics such as direct reactions and nuclear models, so that this text is cer-