

order from the chaos that comprises our current understanding of this primordial state of matter. The author, though not himself a theorist, does not shrink from using the full panoply of graph-theoretic expansions. Thus Goodstein does fair justice to the Yvon-Born-Green, hypernetted chain, and Percus-Yevich equations—topics about which most workers in condensed-matter physics are all too ignorant. At the end of each chapter appears a bibliography, annotated in the same breezy style as the text; in this fourth chapter, the author leaves little doubt concerning his opinions of the “reasonably simple but seriously flawed” monograph by P. A. Egelstaff and the monograph *Statistical Mechanics of Simple Liquids* “about which nothing is as simple as the title seems to imply.”

The two concluding chapters are more specialized in scope and perhaps will be omitted by those instructors who adopt this book for a one-quarter rather than a one-year course, or by those who wish to pursue the topics of the first four chapters somewhat more leisurely or in greater depth. Chapter 5, “Some Special States,” treats superfluidity, superconductivity, and magnetism; the concepts of earlier chapters are nicely exemplified in the discussion here. The fine sense of history remains omnipresent, and the reader is even led to speculate what was on the mind of Heike Kamerlingh-Onnes when he carried out his famous 1911 experiment that resulted in the discovery of superconductivity. The Curie constant and the Langevin function are both introduced in the same paragraph, and the author cannot resist noting that “Madame Curie was named correspondent in a celebrated divorce action taken against Paul Langevin.” Perhaps a second edition will include a few pages on liquid crystals, or at least those aspects of liquid-crystal physics that can be treated in the framework of magnetism and superconductivity.

The sixth chapter provides an introduction to phase transitions between different states of matter and to phenomena that occur near “critical points,” where the distinction between phases ceases to exist. Goodstein opens by whetting our appetites for simplicity: he presents the story of how G.I. Taylor was able, using dimensional analysis, to deduce the yield of the first nuclear explosion from a series of “Life” magazine photographs of the expanding fireball. He then proceeds to take us through standard material on mean-field theory, van der Waals theory, and Landau theory, before going on to a discussion of critical-point exponents and scaling laws. There is no mention of “universality” or of renormalization-group concepts, and in fact the entire chapter could probably have been written almost a decade ago. Nevertheless, it is welcome that a text on condensed-matter physics for first-year

graduate students should include a coherent and highly readable introduction to the topic of phase transitions and critical phenomena.

States of Matter, then, is a unique book. It is unique in that it represents perhaps the first introductory text to paint—in broad brush strokes—a picture of what much of the current excitement in condensed-matter physics is all about. It is unique in that substantial historical perspective is woven into the text, courtesy of Judith Goodstein. It is unique in that the author has not resisted the temptation to allow in print the sort of light-hearted remarks that characterize most lectures but that usually are edited out of published material.

It is my opinion that every serious student of condensed-matter physics would do well to read this book. For the time being, however, students may have to do this on their own, because most universities, unlike Cal Tech, are not so enlightened as to have recognized the need to structure curricula along lines recognizably different from those of one or two decades ago.

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Nuclear Structure

W. F. Hornyak

605 pp. Academic, New York, 1975.
\$49.50

For some years, Morris Preston's *Nuclear Physics* was probably the most widely used general nuclear-physics textbook in the United States. Suddenly, in the last few years, a number of new and comprehensive textbooks on nuclear physics have proliferated, including three multi-volume sets by Walter Greiner and Judah Eisenberg, Aage Bohr and Ben Mottelson, and Amos de Shalit and Herman Feshbach. This situation accurately reflects the significant progress made in the field in the 1960's and early 1970's (the correlation between the publication rate and the decline in financial support of nuclear physics is noteworthy). Now another addition to the list of nuclear textbooks has appeared, *Nuclear Structure* by William F. Hornyak. Hornyak, a member of the physics faculty of the University of Maryland, has pursued his research interests primarily in experimental nuclear spectroscopy in light nuclei, in particular in p-shell nuclei.

As the title implies, Hornyak's book deals only with nuclear-structure physics, whereas the sets listed above include both nuclear structure and nuclear reactions. The organization of *Nuclear Structure* is quite conventional. We inspect, in order, the nucleon-nucleon force, bulk nuclear properties (shapes, moments, total binding energies), microscopic models of nuclear structure, collective models, and finally electromagnetic and weak interactions in nuclei. Hornyak's approach is to treat a few basic topics in considerable detail; he tries to avoid the “it can be shown . . .” route.

The volume is in some sense a workbook: there are numerous exercises interspersed with the text, and Hornyak deals with simple models which have analytic solutions. This makes good pedagogical sense, and as a result there are a number of sections of the book that will be particularly useful to those who must, for the first time, plow through Slater determinants, exchange operators, vector spherical harmonics and so forth.

In the preface, Hornyak acknowledges that his approach may appear old-fashioned, with some of the “newer techniques” omitted. Several such omitted topics are second quantization, Brueckner-Hartree-Fock theory, the theory of effective residual operators and pairing theory. I would think that when a student has taken a graduate-level course in nuclear structure, he should have some possibility of being able to understand the current literature in nuclear-structure physics and some facility with the common tools of the field. These omitted topics are essential to this end.

The most significant drawback to *Nuclear Structure* is its price, almost twice that of the volume on nuclear structure in the de Shalit and Feshbach series. For this reason alone, *Nuclear Structure* seems destined for the library reference shelf.

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Computers for Spectroscopists

R. A. G. Carrington, ed.

275 pp. Halsted, New York, 1974. \$35.00

In *Computers for Spectroscopists*, twelve different articles by various authors deal with the problems of computer usage. All the authors are members of the Ultraviolet Spectrometry Group, an organization of long standing that includes most of the experimental spectroscopists active in electronic spectroscopy in British laboratories.

It has become essential for chemists and spectroscopists to gain some familiarity with the working language of the computer. Nowadays science graduates at most universities and technical colleges acquire a basic minimum exposure to computer technology in the course of their studies; it is the older generation for whom the problem can be acute. Those who work in association with a large computation center can leave much of the basic technology to the computer professionals and communicate through the secondary high-level languages and operating systems that are designed for this purpose. This cushioning from the inner mysteries of computer technology is bought at a price, because it leaves the scientist subservient to his computer.

The alternative is for the scientist to have his own computer, probably a mini-computer. With such a facility he will be in full control of his data acquisition and analysis, but he will then have the responsibility for operating the system. To do this effectively, he will require an intimate knowledge of what is going on within his black box and how to bend it to his will, for the smaller the computer the greater is the need for high-level systems operation and efficient programming.

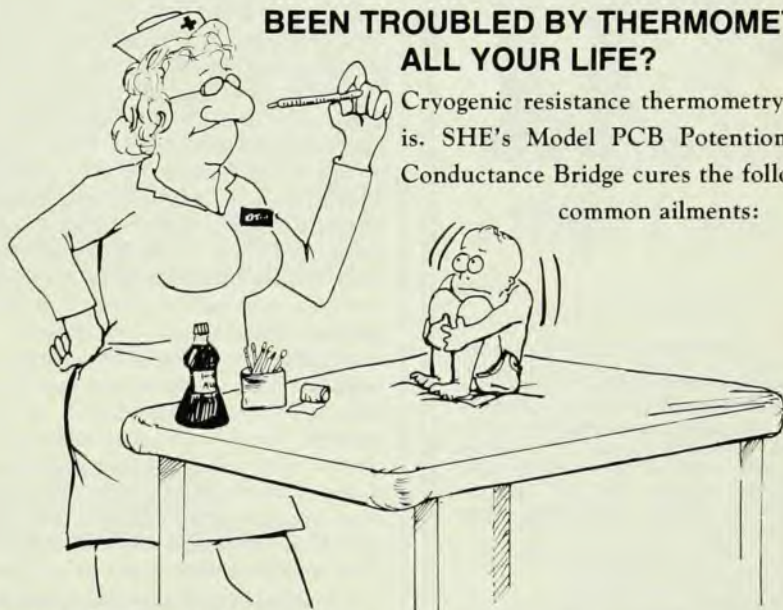
There is a broad separation of the subject matter into two sections, each of six chapters. These are called "Computers for Spectroscopy" and "Spectrometers and Computers." The first four chapters provide a general introduction to computer technology not specifically related to spectroscopy. As is fitting, Chapter 1 by R. F. Warren is an elementary introduction for the neophyte. J. Farren supplies a basic account of the hardware aspects of computer design and operation, and I. A. Dempster provides interesting and rather uncommon information about computer logic, which will be helpful in understanding the connection between the theoretical logic of binary processes and their realization by the computer hardware. D. J. Evans opens with a clear and concise introduction to machine-language and assembler-language programming; this will be particularly useful to those who wish to venture into optimal programming of their own mini-computers. Later sections of Evans's chapter offer a rudimentary introduction to FORTRAN and BASIC, but this is not enough to enable one to start to program in these languages. The author neatly sidesteps the complexities of FORTRAN formatting statements and the inefficiencies of the dimension statements; both are weaknesses in FORTRAN and a handicap to its efficient use by the beginner. In passing, I note that ALGOL gets scant mention in this book. Does this reflect a significant shift away from ALGOL, which was formerly much favored in the UK?

In Chapter 5, K. D. J. Root introduces us to the basic aspects of computer-

spectrometer interfacing. Donald Michie and B. G. Buchanan, deviating from the pattern set by the previous authors, deal in great detail with the heuristic DEN-DRAL algorithm as applied specifically to mass-spectroscopy data. A broader-based discussion of heuristic principles of programming would have been more useful here—so also would an extension to self-learning techniques based on the use of training sets, which would have filled a gap in the coverage of the subject.

The second section opens with J. Cuthbert's up-to-date account of Fourier spectroscopy, which could have been im-

proved by the inclusion of more recent references. B. J. Richardson's chapter on off-line data processing seems out of place in section 2; it is pitched at a very elementary level and—with more substance—might better have preceded or followed Chapter 1. A. M. Deane, C. J. Kenward and A. J. Tench discuss one specific program, the LABCOM data handling system developed at Harwell, in detail. LABCOM is a time-sharing supervisor, which handles output from a variety of spectrometers, coupled with a program library for the appropriate data analysis. We move to the practical



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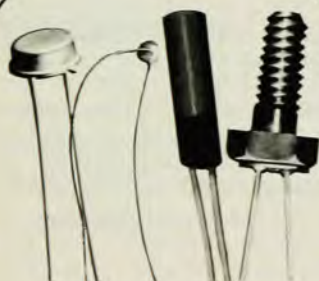
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problems of spectral data analysis in H. A. Willis's account of the use of the computer in quantitative spectro-chemical analysis. Methods based on measurements at discrete frequencies, band areas, and derivative and differential spectra are discussed. The examples are all drawn from infrared measurements, though this is an area where a great deal has been done with electronic spectra both in the ultraviolet and in the visible regions. The author appears less at home in his discussion of computer applications to qualitative analysis. The references he cites leave some uncertainty as to his familiarity with the more recent sophistications of the band-matching algorithms.

Chapter 11 by A. J. Everett is a frankly autobiographical account of one man's experiences in planning a computer service for a large chemical corporation. It can be read with profit by anyone facing this problem. One must keep in mind, however, that the choices are presented in terms of the computer technology and economics of 1970; the author himself takes care to warn of this. Finally, R. P. Young deals specifically with computer applications to infrared spectroscopy. Because he is a former collaborator of mine, and much of the material he presents is drawn from our areas of common activity, I am loath to comment save to say that I find nothing to criticize.

In summary, this is an interesting and readable book in which most spectroscopists will find something useful. It is well printed, and the text is admirably supported with tables, charts and figures. Some of the chapters are devoid of reference citations, and in many of the others references are sparse and antedate 1970. The book therefore is not helpful as an entrée into the more general literature.

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Radiation Physics and Chemistry of Polymers

F. A. Makhlis

287 pp. Halsted, New York, 1975. \$32.50

Within the last generation, technology has successfully produced artificial environments of high radiation levels and developed propulsion methods that carry human artifacts into naturally occurring regions of high radiation. Somewhat ironically, it has been found that one of the classes of materials that is marginally viable in reactor and space environments is also manmade—the polymers. Thus a general review of the properties of polymers under irradiation should have special value. In his

introduction, the author of *Radiation Physics and Chemistry of Polymers* states that his intention was to write "a comprehensive examination of all the physical, engineering, radiochemical, and applied aspects of the irradiation of polymers". I feel he has nearly achieved this goal in most areas but has missed by a wide margin in others.

It must be stated initially that the translation from the original Russian by the staff of the Israeli Program for Scientific Translations has produced an English version that is quaint, to use the most charitable description. Moreover, the translator is entirely unfamiliar with conventional Anglo-American



scientific jargon. Thus, "stopping power" is rendered as *braking power*, "range" as *path*, "kerma" as *cerma*, and the less well-established terms "LET" (linear energy transfer) or "REL" (restricted energy loss) are hybridized into *LEL* (linear energy loss). Also, the adjectival form of radiation is not *radiational* in English, and it is profoundly irritating to find such phrases as *radiational damage* used consistently throughout the book. Other readers will probably find their own examples of non-English, which detract from appreciation of a generally comprehensive and useful volume.

Makhlis, who is a member of the Resin Research Subinstitute of the Scientific Research Institute at Moscow, has published extensively on the subject of radiation damage to polymers since 1957. His insights, based on his own research and a very broad survey of the literature, are admirably exemplified in the third, fourth and fifth chapters, in which the radiochemical mechanisms of polymer change under irradiation, the influence of the physical state (especially temperature) on these changes, and the possibilities of radiation protection