Some complicated derivations are given in the excellent Appendix. A set of problems for the student and a bibliography are given at the end of each chapter.

The book is strikingly up-to-date; one evidence of this is the great preponderance of references of the last fifteen years in the numerous footnotes. Another is the terminology, e.g., *phonons* for lattice vibration waves and *excitons* for propagated excited electronic states.

Treatment of the solid state, even in an introductory course, cannot very well be given in "popular" language; the author has wisely made no attempt to write an armchair discussion for the average scientist. This volume is intended for a student well-grounded in physics; knowledge of atomic physics and elementary quantum mechanics, as well as a good mathematical background, is presupposed.

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Thermionic Valves. Their Theory and Design. By A. H. W. Beck. 570 pp. Cambridge University Press, New York, 1953. $12.00.

There have been a variety of books written about vacuum tubes. Some are historical monuments to an early state of the art. Some emphasize mathematically neat problems, such as the calculation of the amplification factor of triodes, while largely neglecting such important matters as noise and bandwidth. Some are compilations of various published works, little altered and little digested. Recently, there have been a few specialized books on certain types of tubes. Among these is the earlier *Velocity-Modulated Thermionic Tubes* by the present author, in which he has treated well the particular field in which he has had most practical experience.

This new book is different. It is comprehensive. It is not an undigested reprinting of material from various sources. By and large, the space given to various topics is judiciously governed both by what there is to say and by whether, in the expert opinion of a practical worker in the field of microwave tubes, it is worth saying.

The topics covered are many. Part I treats thermionic emission, secondary, field, and photo-electric emission, and fluorescence. Part II considers electrostatic fields, and from thence goes to electron optics and electron flow, without and with space charge. Part III, which is longer than all the rest of the book, covers low-frequency negative-grid tubes, transmitter tubes, velocity-modulated tubes, ultra-high-frequency triodes, traveling-wave tubes and related tubes, magnetrons, and picture converters and storage tubes. Appendices discuss recent work on oxide-coated cathodes, space-charge waves, and noise in traveling-wave tubes.

The approach is theoretical, and the book deals with the general properties of tubes rather than with specific tube types; however, particular tubes are sometimes used to illustrate a point. The book will get one well started toward an understanding of each topic it treats, and it refers the reader to more detailed work. The author says that "a reader who has mastered the contents should be able to make a critical appreciation of current research papers." This is true enough, but where can we find so energetic a reader?

This altogether admirable book is recommended as "of use to graduates with a first degree in physics or electrical engineering and those who are starting independent work in this field. . . ." The book is excellent for reference, but there is more material than could be covered thoroughly in a course of reasonable length. Some of the sections, such as that on noise, would be very tough going without the aid of a really able teacher. Also, to understand some topics thoroughly, one would have to draw on material outside of the book. This is particularly true of the very tricky field of thermionic emission, which is a study all of itself, and is related to the operation of vacuum tubes only in that tubes need a source of electrons. It is to some extent true of the sections on noise.

Should a course cover all aspects of a field, or should it explore one segment exhaustively? And, which should a text do? Mr. Beck has valiantly essayed to treat concisely but on a high level virtually everything important about vacuum tubes except valve techniques and manufacture. In this long and expensive book he has succeeded in doing this. He has produced a unique and important work which those in the tube field will want to have and to refer to.

J. R. Pierce
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High Altitude Rocket Research. By Homer E. Newell, Jr. 298 pp. Academic Press, Inc., New York, 1953. $7.50.

Since the inception of the high-altitude rocket program in 1946 about 200 rocket launchings have been conducted with various instrumentations; most of the firings were made from White Sands, New Mexico, but a number were conducted from ships in the Pacific and Atlantic oceans. This research has been producing a flood of new data about the properties of the atmosphere and about the extraterrestrial radiations. The publications of the results, however, have not always kept step; many are still contained in internal and essentially private (although unclassified) reports, while published papers are scattered throughout the literature in journals of physics, geophysics, astrophysics, meteorology, electrical engineering, etc.

In these past eight years the high-altitude sounding rocket has proven itself a valuable tool for conducting *in situ* measurements of atmospheric properties which could only imperfectly be deduced from observations at lower altitudes. It is especially in the study of incoming photons and corpuscular radiations that the rocket excels; e.g. the solar spectrum in the far ultraviolet and x-ray regions could hardly even be inferred from sea level.

The present book is the first one which covers these new results and also describes the rocket techniques used in obtaining them. The author who has headed the Rocket Sonde Section of the Naval Research Labora-

tory since shortly after its inception is well-qualified to write this volume. He has succeeded in producing a book which gives detailed descriptions of most of the important experiments carried out in rockets (including all the published ones), together with theoretical background for the analysis of the results. This volume should also prove invaluable as a reference work, due mainly to its well-executed and detailed tables (of which there are 37), and its very extensive list of references. [The reviewer noticed only one incorrect reference: No. 38 on p. 280.]

The first three chapters deal mainly with the rocket vehicles which have been used in the upper-atmosphere program and the problems encountered in using them: the German V-2 rocket, the WAC Corporal which was the first U. S.-developed high-altitude sounding rocket, the Aerobee which is now widely used for upper-atmosphere research, and the large NRL Viking rocket. The varying performance characteristics of these rockets dictate to a large extent the manner in which the upper air physicist must approach his measurements. The text brings out clearly the advantages and handicaps of rockets for high-altitude experiments. Chapter 3 in particular deals with the all-important problem of recovery of data from a rocket.

Chapter 2 discusses some of the restrictions placed on experiments by payload, space and weight limitations, by the high acceleration, the unpredictable rocket motions, the high velocities and the resultant aerodynamic heating, and, above all, by the short times which rockets spend in the regions of interest.

Chapter 4 presents in some detail the results on pressures, densities and temperatures up to 220 km. A brief account is given in Chapter 5 of atmospheric wind measurements. Chapter 6 reports the results on the solar ultraviolet and x-ray spectrum as obtained with spectrographs, photosensitive materials, and photon counters, while Chapter 7 deals mainly with the distribution of ozone in the atmosphere. Experiments on the ionosphere are described in Chapter 8 which includes also an account of the detection of ionospheric current sheets with magnetometers. Chapter 9 deals with measurements of the cosmic-ray flux above the appreciable atmosphere, the composition and energy spectrum of the primary radiation. Finally, Chapter 10 gives a brief account of high-altitude photography of the earth from rockets.

The author has confined himself to rocket experiments only and has wisely refrained from covering the whole field of upper-air research. It might have been useful, however, to enlarge on the interpretation of some experiments, e.g. on the conductivity and wind systems of the ionosphere as deduced from current measurements, or on the implications of the new results on solar x-rays for the formation of the lower layers of the ionosphere.

In spite of the great wealth of detailed information which this volume presents it has remained readable, due mainly to its extensive use of tables. The execution of the book is outstanding, the tabular material and line drawings perhaps more so than the photographs. (There are 93 figures.) The book is also quite up to date; it includes, for example, a reference to a Conference on Rocket Exploration of the Atmosphere held in August, 1953 at Oxford, England. It can be highly recommended to all who wish to inform themselves about the many important results obtained in the high-altitude rocket program.

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Advances in Biological and Medical Physics. Volume 3. Contributors: E. R. Blout, P. Grabar, P. Kirkpatrick, W. V. Mayneord, H. H. Pattee, Jr., E. Pollard, D. Pressman, W. K. Sinclair, A. K. Solomon. Edited by John H. Lawrence and C. A. Tobias. 368 pp. Academic Press Inc., New York, 1953. $8.00.

Biophysics is a rapidly growing and expanding subject whose ultimate boundaries are not yet definable. The well-read biophysicist must lean heavily on review volumes such as this one, which is the third in its series. It is an essential contribution not only for the technical exposition in its seven chapters, but also for the range of its subjects because they give insight into the directions in which biophysics is expanding.

Of the seven chapters, four are devoted to some aspect of radiations and ionizing particles and their applications. There is a wide diversity of radiations discussed. Kirkpatrick and Pattee, in their chapter on Approaches to X-Ray Microscopy, give a much-needed review which covers all of the methods by which x-rays have been used for "seeing" small and large objects. There is an illuminating analysis of the insurmountable technical difficulties in making x-ray lenses, a subject which is in the speculative stage.

At the other extreme, away from speculative research, is the timely chapter on Dosimetry of Artificial Radioactive Isotopes by Mayneord and Sinclair. Physicists working with radiotherapeutic problems will find here a review of information having considerable practical value along with a brief outline of the status of the physical theory. The material presented by Mayneord and Sinclair is basic in the use of radioisotopes. This is also true, although in a different sense, of the chapter by Solomon, The Kinetics of Biological Processes, Special Problems Connected with the Use of Tracers, dealing with the complex dynamic equilibria which tracers can be made to elucidate in living systems. The inclusion of this chapter is noteworthy in that it describes the kinetics of systems which are of interest to physiologists, pharmacologists, and biologists in general and handles them as problems in physics. The isotope tracers are incidental to the vastly larger and complex picture of the dynamic systems described.

The review by Pollard entitled Primary Ionization as a Test of Molecular Organization makes the reader aware of new possibilities in the use of primary ionizing. There was a time when ionizing radiations were used to determine the sizes of viruses and genes and sensitive centers. In Europe the subject became known