

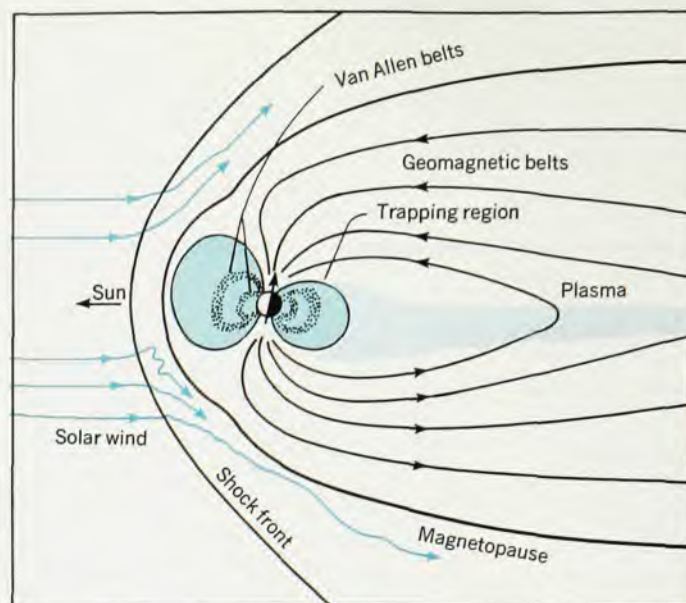
sections are as injectors into circular machines and as positron sources for injection into storage rings or for direct use of positron beams. There is a very interesting discussion on radiofrequency particle separators which, although logically not belonging in the category of electron accelerators, generally use the same technology.

The proton and heavy-ion linear accelerator theory and realization occupies the second half of the book. The organization is similar to that of the electron section; there is first a very extensive treatment of the theory of the accelerating structures, including a very useful section on numerical computation. This is then followed by analyses of orbit dynamics, including numerical methods of solving focusing and phase problems. Of particular importance is the inclusion of extensive papers on collective effects and imperfections; much of this had not been available in the literature.

The sections on proton linear-accelerator technology are written in a somewhat encyclopedic manner, since there are such a large number of relatively smaller topics to discuss, ranging all the way from basic considerations of structures to the more common accelerator items such as beam monitoring and shielding.

A chapter discusses the applications of various ion linear accelerators that are now in practical use. The principal role of proton linear accelerators at this time has of course been as injectors for circular machines, and for this purpose they have been continually improved. Although the proton linear accelerator was first used by Alvarez and collaborators as a primary source of beams for nuclear-structure physics, this use is only now returning to the forefront at the Los Alamos Meson Factory. Heavy-ion machines have of course seen use in nuclear chemistry for some time. Some more esoteric applications, neither of which have come into practical realization, are the use of extremely high-intensity ion linear accelerators as intense neutron sources (such as the now terminated ING project in Canada), and as a "negative control rod" to use such neutrons to convert depleted uranium in a subcritical reactor assembly into fissionable plutonium. Again, application has been discontinued after the experimental work carried out at Livermore almost two decades ago. It is clear, however, that the proton linear accelerator at this time remains the most powerful tool developed for the generation of extremely high-intensity high-energy beams.

Superconducting techniques are discussed in a separate division because they are still suffering from major unknowns in terms of actual realization. Applications are, in increasing order of difficulty, microwave particle separa-



Interaction of the solar wind with the earth's magnetic field. (From *Space Observatories* by Jean-Claude Pecker, Springer-Verlag, New York, 1970.)

tors, microwave accelerating structures to be used as adjuncts to circular accelerators, microwave electron accelerators and, finally, proton linear accelerators. Each of these applications and their present technological status is fully discussed.

This book is, of course, not of very general interest to high-energy physicists because it is fundamentally a compendium of specialized contributions describing all facets of linear accelerators—theory, practice and applications. The quality and editorial control of each article appears uniformly high and the book will remain a standard reference book on the subject. This reviewer feels that for the first time he has been paid very highly for writing a book review in exchange for retaining a copy of the book, since this particular volume sells for an incredible \$61.00.

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Wolfgang Panofsky, who has worked for many years in high-energy physics and particle accelerators, has been director of the Stanford Linear Accelerator Center since 1961.

Plasma Dynamics

By T. J. M. Boyd, J. J. Sanderson
348 pp. Barnes & Noble, New York,
1970. \$10.75

Interest in the study of ionized gases, that is, plasmas, dates back to the 1920's, when it centered around the phenomena of electric discharge in gases. Since then the importance of plasma physics has increased tremendously in connection with the efforts toward controlled thermonuclear fusion and direct conversion of heat into electricity, and lately in relation to the spectacular growth of space sciences, such as planetary ionospheric, magnetospheric, and radiation-belt physics. Astrophysics is yet another discipline where

a knowledge of plasma physics is valuable.

A book on plasma physics, therefore, attracts a large audience. Naturally, quite a number of books exist dealing with the various aspects of plasma physics. Even so there appears to be a need for introductory textbooks aimed at the undergraduate or graduate level. In this context, T. J. M. Boyd and J. J. Sanderson have done a welcome job in preparing this text on plasma dynamics. Because of their involvement in university-level teaching for the past few years, the authors have been quite successful in their attempt at writing this text.

The layout of the chapters in the book is logical. It starts with a description of the orbits of charged particles. The macroscopic equations are introduced next, paving the way for the presentation of hydromagnetics. Plasma waves are dealt with at some length, separate chapters being devoted to waves in cold and warm plasmas. Plasma kinetic theory is presented in the last chapter.

Each chapter is extensive in scope. For example, the chapter on waves in cold plasmas touches upon all sorts of topics: Alfvén waves, ion cyclotron waves, Appleton and Hartree's magneto-ionic theory, whistlers, etc. But the treatment is not in depth. This is, probably, because the book is aimed mostly at undergraduate or graduate level students. In the discussion of radiation processes in plasmas, the scope has been restricted to the discussion of fully ionized plasmas. The consideration of plasma line (or band) radiation, which requires quantum-mechanical treatment, has been omitted.

The very useful topic of plasma kinetic theory is squeezed into one last chapter. Naturally, only simple applications have been chosen. The discussion is limited to one-component (electron) plasmas by using the simplifying assumption of fully ionized plasmas with

the ions forming a uniform background of positive charge. This, however, appears appropriate in view of the introductory nature of the book and the requirements of the audience to which the book is directed.

Each chapter has a summary of the important formulas and a good selection of problems. The bibliography is adequate and attempts to draw attention to almost all available authoritative texts or treatises on the topics covered. Similarly the references to the original literature, although not exhaustive, are sufficient.

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The Maxwell Equations: Non-Relativistic and Relativistic Derivations from Electron Theory

By S. R. DeGroot

179 pp. Interscience, New York, 1969.
\$8.95

It is well known that at about the beginning of the 20th century Hendrik Lorentz derived Maxwell's electromagnetic field equations for ponderable media from his electron theory with appropriate statistical procedures.

The purpose of the present volume is to provide a review of Lorentz's method together with summaries of the more complete recent work in this field by A. D. Fokker (1920) and P. Mazur and B. R. A. Nijboer (1953). Refinements of the latter investigations are also considered. The author, professor of theoretical physics in the University of Amsterdam, is a well known authority on nonequilibrium thermodynamics.

The field equations are derived by methods that may be characterized as nonrelativistic and relativistic respectively. The program is an ingenious combination of statistical mechanics and electromagnetic theory. Though the analysis is somewhat involved, there is adequate emphasis on the physical significance of the various steps and the final results. The general reader who does not wish to follow the complete development will find the historical introduction of great interest and value.

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Plasma Waves in Space and Laboratory, Vol. 1

John C. Thomas, Bjorn Landmark, eds.

486 pp. American Elsevier, New York, 1969. \$23.50

The plasma waves with which this collection of articles is concerned are, by and large, either those propagating in the near-earth environment, or their

laboratory analogues. They are electron plasma waves of natural origin (very low frequency emissions) or man-made (Alouettes, Explorer XX and so on). The papers purport to be tutorial-review material, presented as introductory lectures at the NATO Advanced Study Institute on Plasma Waves in Space and the Laboratory, held at Røros, Norway during April 1968. (Volume II of the proceedings contains the research-level papers.) This book is more than the usual conference proceedings, then, giving as it does something of an overview of geomagnetic plasma resonances and their interpretation, plasma antennas and VLF observations and theory. However, there is much overlap between the articles, with the relevant dispersion relations presented again and again and with much obfuscation arising from the differences in notation. In fact, it is my opinion that the next international conference on plasma waves might well be devoted to selecting a common language, perhaps publishing its proceedings as *Plasma: Laboratory, Astrophysical, and Ionospheric Notations* (PLAIN). To the uninitiated looking for a way into the research literature or to the conference participants, this book will be useful. As with many areas of physics, however, the time is ripe for that labor of love, a good review article or monograph, and plainly several of the authors here could provide it.

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The Invisible University: Postdoctoral Education in the United States

Sponsored by National Research Council

310 pp. National Academy of Sciences, Washington, D. C., 1969. \$10.00

With the great deal of attention given to higher education today, it seems surprising that so little is known and published about one particular aspect of it—postdoctoral education.

During the past 12 years a number of attempts have been made at compiling some statistics and evaluating them. None of these studies provide an overview of the nature and scope of postdoctoral education in the US. For example, in 1962 Bernard Berelson published a report in the *Journal of Higher Education* titled "Postdoctoral Work in American Universities." It was based on visits to 16 campuses, interviews with government representatives and information from questionnaires sent to about 40 universities. A more limited study was the one conducted in 1958 by Arthur S. Cain, Jr and completed by

Lois G. Bowen, which investigated only medical fellowships. In 1965 the National Science Foundation examined different aspects of postdoctoral education at eight universities but never published the findings. Thus, to replace the fragmentary information with a comprehensive study, *The Invisible University—Postdoctoral Education in the United States* fills a real gap. Richard B. Curtis, the study director, explains the need for that study in terms of the success that postdoctoral education experienced. As a larger community becomes aware of a growing number of postdoctoral students, an increasing number of academicians, legislators and administrators seek basic facts about this invisible university to substantiate recommendations for its future.

The idea of a national study of postdoctoral education came from Sanborn C. Brown of the Massachusetts Institute of Technology, who became chairman of an advisory committee. The National Research Council of the National Academy of Sciences sponsored the study and five federal agencies plus the Alfred P. Sloan Foundation provided the financial support. Except for the first six months when Robert A. Albery directed the study, Richard B. Curtis of Indiana University was the full-time director and author of the report.

Starting with a historical view of postdoctoral research and the definition of postdoctoral appointments, the book presents detailed accounts of the following three aspects: (a) sources of funds for postdoctoral fellowships, (b) composition of their recipients and (c) effects on the host institutions.

The largest source of support is the Government. In particular, only one third of the funds for postdoctoral education comes from nongovernment sources, and for physics this fraction is one quarter. With these funds each sponsoring agency or foundation is basically purchasing the creation of knowledge; postdoctoral training for the scholar is just a byproduct. When the author discusses stipends and refers to the relatively higher income scholars forego in accepting fellowships, it becomes obvious that the emphasis has changed in the last two years. A tight job market for physicists places postdoctoral appointments in great demand. But even in 1967 the difference between the stipend and the starting salary for physicists who became assistant professors was rather small. American Institute of Physics studies do not agree with the physicists' salaries measured by the National Academy. They show that the median starting salary was \$800 per month.

A major part of the book is devoted to the composition and analysis of the group that receives this advanced education. The most surprising statistic