

have been expected to reach maturity at a much earlier time, as was indeed the case with ordinary fluid dynamics. Huddleston suggests that the maturing of plasma physics awaited the development of sophisticated diagnostic technology during and after World War II.

The eleven technical chapters in this book cover the entire spectrum from gamma rays to quasistatic magnetic fields, and from the introductory to the erudite. The subject matter of several individual chapters has been treated more exhaustively in other books and review articles. *Plasma Diagnostic Techniques*, however, provides by far the greatest concentration of useful material available today in a general review. It will prove a valuable asset to experimental plasma physicists in all aspects of the field, and thus is likely to enhance the process of evolution-by-diagnosis envisaged by Huddleston.

A chapter on basic macroscopic measurements by coeditor Stanley Leonard covers a miscellany of elementary techniques. R. H. Lovberg's discussion of magnetic probes will prove useful to experimentalists. Francis F. Chen provides a uniquely broad and penetrating analysis of Langmuir-probe theory. One fears, however, that the average nonmathematically inclined experimentalist may become discouraged from ever using them.

Seven chapters on radiation diagnostics lead off with R. W. P. McWhirter's authoritative discussion of theoretical plasma models and spectral intensities. W. L. Wiese's chapter on the broadening of spectral lines leaves most of the theory to its references, but provides a valuable comparison of various calculations and experimental results. Eugene B. Turner discusses the hardware of optical and

ultraviolet spectroscopy. T. F. Stratton's chapter on x-ray spectroscopy reflects the invigorating influence of high-temperature controlled-fusion experiments (the inverse Huddleston effect?), which indeed is evident throughout this book. Far-infrared techniques are covered by M. F. Kimmitt, A. C. Prior and V. Roberts; optical interferometry by Ralph A. Alpher and Ronald R. White; and microwave techniques by Charles B. Wharton.

J. E. Osher's chapter on particle measurements ranges from direct analysis of energetic plasma constituents

to neutron diagnostics for fusible plasmas. The appearance of a brief section on laser-scattering diagnostics at the end of the book serves to remind the reader of how quickly even an authoritative review of current techniques is outstripped by fresh developments.

Very extensive lists of references are given in all the chapters, and constitute a treasury of information in themselves.

* * *

Harold P. Furth heads one of the groups doing controlled-fusion research at the Lawrence Radiation Laboratory, Livermore.

A thorough compendium

HIGH SPEED PULSE TECHNOLOGY. Vol. 1, Capacitor Discharge, Magnetohydrodynamics, X-Rays, Ultrasonics. By Frank Frungel. 620 pp. Academic Press, New York, 1965. \$24.00.

by *Herbert Malamud*

This book reminds your reviewer of the well known joke which ends, "But who wants to know that much about the red-banded woods warbler?" The difference is of course, that many people indeed will be interested in this red-banded woods warbler.

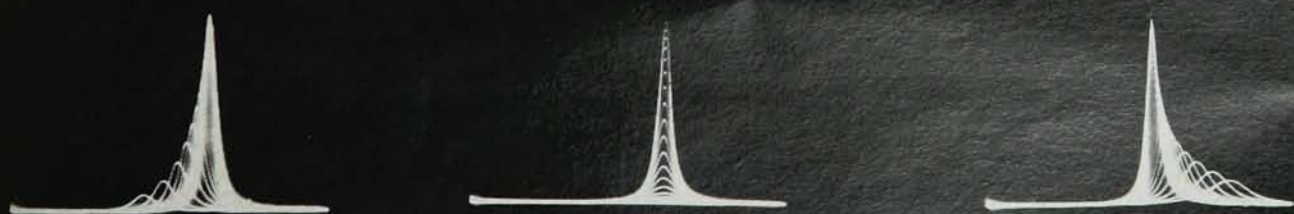
Frungel's book was first published in German in 1960. It is, judging from volume 1 here under review, encyclopedic in scope, details, accurate, and above all, useful in choice of subject.

The first chapter covers the use of capacitors in discharge circuits, discussing construction of capacitors, the materials used, possible troubles or faults which can occur, as well as the equivalent circuit and capacitor capabilities.

The second chapter covers pulse-switching means, including ignitions, thyratrons, various spark gaps, and magnetic contactors. Frungel couldn't have known of one useful high power spark gap configuration, the inverse pinch switch (U.S. Patent No. 3 046 436, July 1962, C. Cavalconté; *Rev. Sci. Instr.* **34**, 1439 (1963), R. G. Jahn, et al.), which deserves inclusion in his discussion.

Chapter III discusses various power transmission lines, and includes a discussion of impedance of the line as well as construction and capabilities.

Following are chapters on conversion of capacitor energy into current impulses, direct and through transformers, conversion into voltage pulses (by transformer as well as cascade circuits), the use of pulse forming lines and cyclic operation including high efficiency charging through inductors. Descriptions are given of several applications, such as Kerr-cell



BECAUSE

in January, 1965 a group of scientist-educators met in San Francisco, we now have the MERRILL PHYSICAL SCIENCE SERIES, a collection of specially written, integrated materials, in short, paperback form for college physical science courses.

The objectives of the program: (1) to provide the non-science student with the best possible science education consistent with his background; (2) to provide the individual instructor with the widest possible selection of material and the most highly flexible order of presentation; and (3) to provide the opportunity for a specialist in each science to contribute the material that he felt was vital to an understanding in his area.

The Editors of the Series, Robert Foster and Walter A. Gong of San Jose State College, outlined the problem as follows: "Far too often, instructors trained in various specialties have had to attempt to fit the wide range of goals, abilities, and backgrounds of their students to a textbook, when the converse, of course, would be much more satisfactory."

Here is the authors' solution to the problem posed: William Shockley of Stanford University and Walter A. Gong of San Jose State College collaborated to write MECHANICS—they give a unique view of the logical structures of science and then develop their applications to Mechanics.

Francis E. Dart of the University of Oregon wrote ELECTRICITY AND ELECTROMAGNETIC FIELDS. He helps the student discover and put into logical order the basic concepts used in describing and understanding electricity and magnetism.

Isaac Maleh, in MODERN PHYSICS, progresses from the atom, to elementary particle physics, and then to space and time concepts and relativity theories. He provides continuous flow diagrams to show the student where he has been and where he is going.

The other four volumes include GEOLOGY by Robert J. Foster, San Jose State College; ASTRONOMY, by E. G. Ebbighausen, University of Oregon; METEOROLOGY by Albert Miller, San Jose State College; and CHEMISTRY by John S. McAnally, Occidental College. (The volumes range from 120 to 170 pages, and all except MECHANICS, \$2.25, are priced at \$1.75 paperback; \$3.95 clothbound.)

We cordially invite you to examine this new Series. Please write to Boyd Lane:

Charles E. Merrill BOOKS, Inc.
1300 Alum Creek Drive
Columbus, Ohio, 43216

HIGH & LOW

mechanical strength
temperature
stability
transmission of UV,
visible, & IR
radiation
chemical and wear
resistance
thermal conductivity
electrical resistivity

optical dispersion
dielectric loss

This unique combination of properties is found in single crystal sapphire. Adolf Meller Co. offers a wide variety of standard sapphire parts — rods, bars, tubes, spacers, spheres, lenses, windows, and optical flats — at a reasonable cost. Custom fabrication service also is available.

Get the low-down on these high quality products by contacting Meller.



ADOLF MELLER CO.

P.O. Box 6001
Providence, R.I. 02904
Tel: (401) 331-3717

C. W. ARGON ION LASERS

The Industrial Optics Company Argon Ion Lasers are now being manufactured and sold by the Orlando Research Corporation. These lasers offer the highest value available today in intermediate power C. W. Lasers for medical research, scattering experiments, holography, communications research and other applications. They represent the finest in engineering design and are carefully manufactured using the best components available. The ORC Argon Lasers are operated at intermediate power outputs to obtain long term reliability.

Prices start at \$2995.00 for a complete Argon Ion Laser System which produces over 50 milliwatts at 4880A. Completely automatic systems capable of higher output powers are also available.

ORLANDO RESEARCH CORPORATION

604-B West Oak Ridge Road
Orlando, Florida 32809
Tel. (305) 855-3718

operation, conversion of capacitor energy into x-ray and neutron pulses, conversion into heat as for welding and induction hardening, exploding wire and plasma pulse generation, conversion into pulsed magnetic fields for various purposes such as plasma studies, the magneto-optical shutter and metal forming and conversion into acoustic impulses, both in air and under water.

A final chapter discusses metal working by spark erosion, explosion shock waves and electroerosion machining. A bibliography of forty-two pages, author and subject indexes and a manufacturer's index complete the volume.

A combination of detail and specialization gives the book maximum utility as a compendium of information for people interested in the field of pulse technology; its value here probably exceeds its possible textbook value due to just these characteristics. I recommend it highly to those interested in a great deal of information about red-banded woods warblers.

Herbert Malamud is director of physics research for the Radiation Research Corporation in Westbury, N.Y.

Radiation transfer

SOME ASPECTS OF NON-EQUILIBRIUM THERMODYNAMICS IN THE PRESENCE OF A RADIATION FIELD. By Richard N. Thomas. 210 pp. Univ. of Colorado Press, Boulder, 1965. \$5.00.

by B. E. Freeman

This book contains the updated and edited lectures presented by the author in 1961 at the Institute of Astrophysics of the University of Paris on the effect of deviations from local thermodynamic equilibrium (LTE) on the spectra and especially on the line profiles emerging from extended gaseous ensembles. Throughout the lectures the author is particularly concerned with the interrelation between the non-LTE distribution of occupation numbers and the non local character of the problem. In low-density gases, transitions between low-lying bound states are predominantly radiative rather than induced by collisions with free electrons. Consequently, bound-state populations are strongly influenced by the radiation intensity

in the spectral region of the lines. In optically thick gas systems, this radiation intensity arises from emission in a volume having a radius of approximately one mean free path surrounding the point in question. The state of the gas and the profiles of radiated lines are thus determined by the solution throughout the atmosphere of the coupled equations of transfer of radiation and rate of change of occupation numbers. Hence, the solution depends not only on properties at one locality but on a self-consistent nonlocal solution.

The lectures mark the maturing of the non-LTE point of view among those astrophysicists (among whom Thomas performed pioneering studies) who maintain that an examination of all microscopic processes determining the occupation numbers of the state of the gas is required in most radiative-transfer problems. In fact, a notable advance in understanding the solar atmosphere has been achieved using the non-LTE approach in that many of the observed features of line profiles have been qualitatively explained. Of equal importance is the insight developed into the structure of the equations, which provides a guide to the selection of dominant terms among the overwhelming number of possible transitions. Thomas illustrates this approach by applying it to several models of the solar chromosphere to obtain representative line profiles and he emphasizes its use in the inverse problem, central to stellar spectroscopy, of interpreting stellar spectra to infer the parameters specifying the state of the atmosphere. The techniques, however, are basic for the analysis of laboratory plasmas as well. Consequently, as Thomas suggests, this book holds interest not only for astrophysicists but for a much wider audience.

The nonequilibrium approach to the calculation of the self-radiation from the gas is developed in seven chapters of the book, which correspond to individual lectures of the series. The first two lectures relate the intensity of radiation emitted from the gas to the optical depth and the source function in the gas. In the third lecture, occupation numbers and line-profile coefficients are related to

STEPPING STONE TO A CAREER IN SPACE



Manned flight to the moon is a major step in America's long-range program of space exploration. What will be the next major step? Will the moon become a space station 240,000 miles distant, from which future probes can be made for Mars, Jupiter, Saturn and beyond?

Bellcomm, systems engineering contractor of the National Aeronautics and Space Administration, offers rewarding employment opportunities for persons well qualified in such fields as computing and programming, physics, mathematics, engineering, flight mechanics, chemistry, propulsion, guidance and trajectory analysis.

If you are interested in a career in space and believe that you qualify, Bellcomm will welcome your résumé. Address it to Mr. N. W. Smusyn, Personnel Director, Bellcomm, Inc., Room 1411-J, 1100 17th St., N. W., Washington, D. C. 20036. Bellcomm is an equal opportunity employer.



Bellcomm, Inc.
A Bell System Company