

ishments. Rather, I would argue that the best laboratories are those that are able to maintain a sense of urgent mission. A new laboratory generally has a sense of urgent mission. It becomes old only when its mission has become rusty and when its management has too little imagination or energy to redeploy and revitalize its mission. A laboratory might be old chronologically and its division leaders may be in their late 50's; yet if the laboratory is fired by a new and exciting mission, it is young in Sir Edwin's sense.

The question of missions is strongly involved in the relation between a research establishment and the governmental or industrial agency that supports it: and in every one of the essays attention is devoted to the relation between the laboratory and its supporting agency. In one respect, the point at issue finally is "Who runs the laboratory—the laboratory management or the staff of the agency that supports the laboratory?" I suspect that every one of the British research directors would answer unequivocally, the laboratory management, of course. American research directors, especially those involved in contract research for the government, would surely be less positive. For with the elaboration and strengthening of Washington staffs, the inevitable tension between laboratory management and headquarters staff as to how things should be done tends to become a dominant issue. Since the project office in Washington finally controls the funding of a project, what the laboratory director can do is always constrained by the project officer's power to provide funds or not to provide funds. The laboratory management must steer a somewhat precarious course that is influenced in substantial degree by the headquarters staff, with their ultimate fiscal power. Who finally prevails depends upon such intangibles as the management's prestige and competence, its skill in maneuvering, and the confidence the laboratory and its management enjoy at the highest levels of the agency for which the laboratory works.

To balance the inevitable growth of the scientific agency staffs American

laboratories often establish intermediate hierarchies that serve as counterweights to the headquarters staff. This layer of administrators frees the working scientist of the necessity for sparring directly with the funding agency, and it gives the highest level of laboratory management the time and energy to occupy itself with the "main concerns of management"—establishing the laboratory's sense of mission, maintaining its scientific tone and excellence, and counteracting the inherent centrifugal forces that thwart the achievement of the mission. Actually I suspect that the British situation is not so very much simpler than is the American (though the UK has the advantage of being smaller, and the American contractor system accentuates the separation between laboratory management and headquarters staff). And from the one essay dealing with a defense establishment, RAE, I gathered that the relations between headquarters staff and laboratory staff must involve a good deal of the give-and-take that we Americans have come to take for granted.

Though the book is largely devoted to research performed outside the university, many of the authors speak of the connection between their institutions and the universities. The matter has acquired an urgency in recent years as the universities and the laboratories find that they are competing for the same funds. Adams, in describing the relation between CERN, the national laboratories, and the universities, urges a strong flow between these institutions, but urges that each must retain its identity and strength: "if . . . national and international laboratories took over the teaching functions of the universities, or if one of the three types of institutions is starved of resources, then the whole pyramid will crumble." By contrast, Sir Gordon Sutherland of NPL comments, "There is a great unused teaching potential in the National Physical Laboratory. . . . The NPL might even become the nucleus of a postgraduate technological university with associated research institutes." I suppose I find these two views curiously reversed: an institution such as CERN devoted to basic research could much more readily tol-

erate the university, discipline-oriented, and individualistic organization than could a mission-oriented institution such as NPL. Or does Sir Gordon visualize only the more basic parts of the National Physical Laboratory as forming the nucleus of his new technological university?

The essays in *The Organization of Research Establishments* are rewarding reading, especially to a research administrator who learns from these essays that his problems are not unique. They would perhaps have been more useful if the Research Directors had let their hair down more. But this is asking too much: there is a kind of etiquette that forbids a research director from admitting publicly that anything is going badly, or that his agency is behaving unreasonably.

Yet some of the essays, notably the ones by Fisk, Adams, Vick, and Lewis, I found to have an openness and sparkle that reflect well not only upon the research director who wrote the piece, but also upon the institution that he directs. Surely CERN must have prospered under a man who, in speaking of language difficulties, writes "The language problem resolved itself quite simply. It was soon discovered that an inability to express oneself forcibly in another language lowered the tensions normally experienced in a research laboratory. In any case, the real difficulty lies not in understanding what somebody else is saying, but in forgiving him for saying it, and this has little to do with language difference." The author of this gem is J. B. Adams, who now heads the fusion laboratory at Culham. Does anyone want to make book on how the British will do in the thermonuclear sweepstakes?

Philosophy and physics

CONCEPTIONS DE LA PHYSIQUE CONTEMPORAINE. Les interprétations de la mécanique quantique et de la mesure. By Bernard d'Espagnat. 154 pp. Hermann, Paris, 1965. 24F.

by R. B. Lindsay

It is generally taken for granted that in order to pursue successfully the



WILEY AND INTERSCIENCE BOOKS MEAN PROGRESS ...

THE ELECTROMAGNETODYNAMICS OF FLUIDS

By W. F. HUGHES and F. J. YOUNG, both of the Carnegie Institute of Technology. A comprehensive introduction to Magnetohydrodynamics with emphasis on electrodynamic fundamentals and engineering applications. Many are problems solved in detail with quantitative results to emphasize their physical significance. Electrodynamics is treated in detail for moving bodies. The book includes special relativity, induced electromotive force and energy considerations. Quantitative solutions to many practical problems are presented in analytical and graphical form. Problems are worked in sufficient detail to teach problem solving methods. A detailed discussion of thermodynamics and body forces in moving media is given and two dimensional channel flow problems are treated in detail. Transients, wave motion, aerodynamics, thermal convection and development of flow are carefully considered. 1966. Approx. 624 pages. \$17.50.

MATERIALS USED IN SEMICONDUCTOR DEVICES

Edited by C. A. HOGARTH, Brunel College, London. A source book giving detailed information and references to ten semiconducting materials of importance in technology: germanium; silicon; selenium; lead sulphide, selenide and telluride; indium antimonide, bismuth telluride; antimonides of cadmium and zinc. Each chapter includes material on methods of preparation, band structure, electrical, optical, and general physical properties, applications in devices or technology. References to the original literature are given where possible. The book comprises a systematic coverage of the material, otherwise available only in scattered review articles. An Interscience Book. 1965. 243 pages. \$14.00.

SIGNAL DETECTION THEORY AND PSYCHOPHYSICS

By DAVID M. GREEN, University of Pennsylvania, and Bolt Beranek and Newman, Inc., and JOHN A. SWETS, Bolt Beranek and Newman, Inc. A systematic presentation and analysis of psychophysical problems, both methodological and substantive, from viewpoints of statistical decision theory and statistical communication theory. Treats sensory and decision aspects of detection, measurement techniques, and a variety of applications. 1966. Approx. 476 pages. Prob. \$12.95.

SPECIAL RELATIVITY Second Edition

By W. RINDLER, Southwest Center for Advanced Studies, Dallas. A self-contained presentation using familiar techniques of special relativity. The book presupposes, apart from some scientific maturity and a willingness to think with a fresh mind, only elementary calculus and vector theory and—in the chapter on electrodynamics—the rudiments of Maxwell's theory. The subject is introduced simply and such topics as the relativity of simultaneity, length-contraction, the clock paradox, etc., are fully discussed. Basic tensor theory is presented concisely in the appendix. From this the reader quickly develops the "tensor mentality" so useful in relativity. Exercises are an integral part of the text. Physical implications of the theory are fully explained and every effort has been made to answer the questions every beginner in relativity asks. One of the University Mathematical Texts Series. 1966. 196 pages. \$2.95.

SUPERCONDUCTIVITY Second Edition

By E. A. LYNTON. A largely descriptive introduction to superconductivity. Useful as a first survey for those who will do more intensive study, this monograph will also help those who seek a basic reference work to acquaint them with the present state of the subject. One of the Methuen Monographs on Physical Subjects. 1965. 190 pages. \$4.50.

SLOWING DOWN AND THERMALIZATION OF NEUTRONS

By M. M. R. WILLIAMS, Queen Mary College, University of London. Describes the many techniques that have developed to solve neutron slowing down and thermalization problems. The first part of the book deals with neutrons whose motions are influenced by the temperature and physical state of the moderator and the second, with the slowing down to energies of about one electron volt. Presents in a systematic manner the mathematical techniques necessary for understanding the interaction of slow neutrons required to solve the linearized Boltzmann transport equation with the physical problems of the solid and liquid state. A North-Holland (Interscience) Book. 1966. \$19.50.



TOMORROW'S SCIENTISTS NEED THE FINEST BOOKS...

INTRODUCTION TO SOLID STATE PHYSICS

Third Edition

By C. KITTEL, *University of California, Berkeley*. A completely revised edition of the standard introductory textbook in solid state physics. Greatly simplified, reorganized for greater clarity, and profusely illustrated. The emphasis is on simple clear modern explanations and experimental results. There is broad coverage of modern topics, including BCS theory of superconductivity and type I and II superconductors; thorough treatment of magnetic resonance methods; neutron diffraction methods; and elementary excitations (i.e., phonons, magnons, plasmons, polarons, and excitons). 1966. Approx. 624 pages. Prob. \$12.50.

STATISTICAL PHYSICS

By GREGORY H. WANNIER, *University of Oregon*. A unified presentation of thermal physics that contains under one cover the essentials of thermodynamics, statistical mechanics, and kinetic theory, and includes major fields of application. The major assertions of statistical mechanics are outlined, starting from first principles. Thermodynamics is treated as a consequence of statistics. Kinetic theory is treated as an independent subject, but emerging connections to statistical mechanics are indicated. The Second Law is proved from statistical mechanics and the instrumental role of Ehrenfest principle is stressed. An analysis of the validity of relaxation time approximation for the Boltzmann transport equation is given. 1966. Approx. 464 pages. Prob. \$11.50.

EXPERIMENTAL TECHNIQUES IN ELECTRON SPIN RESONANCE

By CHARLES P. POOLE, Jr., *University of South Carolina*. Completely describes the apparatus and experimental techniques used in Electron Spin Resonance research. The book shows how to build and use an electron spin resonance spectrometer, and how to interpret data obtained from it. A number of experimental techniques are described such as vacuum systems, irradiation methods, variable temperature techniques, polarography, double resonance, etc. A special emphasis is given to relaxation time measurements and line shape analyses. 1966. *In press*.

PERTURBATION THEORY AND ITS APPLICATIONS IN QUANTUM MECHANICS

Proceedings of an Advanced Seminar conducted by the Mathematics Research Center, United States Army, and the Theoretical Chemistry Institute at the University of Wisconsin, Madison, October 4-6, 1965. Edited by CALVIN H. WILCOX, *University of Wisconsin, and Member, Mathematics Research Center, U.S. Army*. A survey of basic perturbation theory of self-adjoint operators on Hilbert space, recent research on the theory and its applications to the quantum mechanics of atoms and molecules. The book presents some of the most recent work by leading researchers in these fields. Topics covered include a general survey of the ways in which perturbation theory is used to determine physical properties of molecules; additional applications of perturbation theory to quantum chemistry; and a survey of the basic mathematics of perturbation theory. 1966. 428 pages. \$6.95.

SURFACE TENSION AND ADSORPTION

By RAYMOND DEFAY, ILYA PRIGOGINE, and A. BELLEMANS, *all of l'Université Libre de Bruxelles*. Translated by DOUGLAS HUGH EVERETT, *University of Bristol*. Based on "*Tension superficielle et adsorption*" by Defay and Prigogine, first published in 1951, this book reflects the rapid development in the field since the first edition. The book provides detailed thermodynamic background to research in surface chemistry. Most of the volume is based on the systematic use of the Gibbs description of surfaces, except that the general discussion does not depend on the assumption of chemical and adsorption equilibrium at the surface. A basis is thus provided for a discussion of the change of surface tension with time (dynamic surface tension). Special attention is also paid to the development of a more complete, though necessarily more complex, thermodynamic description of interfaces that leads to the same results as the Gibbs description in the two limiting cases of a freshly formed surface and of a surface at which adsorption equilibrium has been attained. 1966. Prob. \$15.00. *In press*.

trade of a physicist, that is, to participate actively in the program of describing, creating and understanding human experience, it is unnecessary to hold any particular professional philosophical view. Thus to be successful the physicist need not believe in the existence of a "real" world as the basis of experience, nor is he forced on the other hand to subscribe to the notion that, because many abstract theories have worked remarkably well, our experience is really only a figment of our imagination. So one might be tempted to conclude that philosophy has nothing to do with physics. Actually this ignores the persistent desire to provide an interpretation of modern physical theories which is not content with their role as mere tools for predicting experience but insists that the concepts of these theories shall be related somehow to the great ideas of space, time, number, probability, causality and the like which have long served the human mind in its search for meaning in human experience. The greatest physicists of our time have felt this desire, and the writings of men like Planck, Einstein, Bohr, De Broglie, Schrödinger and Heisenberg reflect their attempts to satisfy it.

The author of the book under review, the well-known professor of theoretical physics at the University of Paris, has felt himself impelled to study once more the meaning to be attributed to the concepts of the quantum theory. The result is a volume which, though perhaps unduly verbose, is worthy of considerable attention.

After an introduction justifying his concern over the whole problem and a very brief resumé of the fundamental principles of quantum mechanics, the author proceeds to divide his book into two main parts, devoted respectively to what he calls the realistic interpretation on the one hand and the positivistic or empiricist on the other. By the realistic point of view he means the assumption that on the microscopic level, systems can exist and have well-defined properties wholly independent of any observer or measuring instrument. On this view the "knowledge" of the observer has nothing to do with the existence of

the system and its behavior. The author then endeavors to show how quantum mechanics can be interpreted in terms of the realistic hypothesis. There is a fair amount of detailed analysis presented in the Dirac notation. This includes an analysis of the Einstein, Podolsky and Rosen paradox and the problem of measurement. The difficulties are found to be great and the conclusions are negative. The next step is to investigate macroscopic systems under what the author calls the unirealistic hypothesis, which he expresses in the form that everything that exists in the world is purely physical in nature and obeys the principles of quantum mechanics. This view also is found to be untenable.

The second part of the book is devoted to an exposition of what the author calls the positivistic or empiricist point of view. To him the positivist or empiricist in physics (and he treats the terms as essentially synonymous) is one who believes that the only legitimate aims of the science are to provide an accurate and economical description of actual observations and to construct a formalism which permits the prediction of new observations on the basis of those already made. Probably few physicists would quarrel with this. Indeed, if by "constructing a formalism" means to invent a theory with full play allowed to the human imagination, this statement just made would fit practically all theoretical physicists and indeed a great many who do not think of themselves as at all positivists or empiricists in what they believe to be the professional philosophical meaning. Terminology can be deceptive. The interested person should read Professor d'Espagnat's book to see how ingeniously he develops his critique. In this part of the volume there is an interesting discussion of the views of Niels Bohr and other adherents of the Copenhagen school as well as the objections raised by Einstein, Wigner and others.

The book concludes with a mélange of observations on the relevance of ancient Greek philosophy for modern physics, including numerous references to Plato and Pythagoras. The author sums up by expressing his belief that the great contribution of

modern physics to science is its defiance of dogmatism and its insistence on the freedom to invent new ideas to meet new experience.

* * *

R. Bruce Lindsay, who is dean of the graduate school at Brown University, has been interested in relations between physics and philosophy for many years.

Compositions of diamond-like substances

THE CHEMISTRY OF DIAMOND-LIKE SEMICONDUCTORS. By N. A. Goryunova, J. C. Anderson, ed. 244 pp. MIT Press, Cambridge, Mass., 1965. \$10.00.

by *Lars C. Luther*

The author of this monograph is a member of the Leningrad Physico-Technical Institute. She and her co-workers have published numerous articles since 1950 reporting on experimental work in the semiconductor field with special emphasis on multi-component solid solutions. The present text, whose original Russian version appeared in Leningrad in 1963, is based in part on lectures given in the Chemistry Department of Leningrad University in 1958-1961.

The book is divided into three chapters. An introduction dealing with theoretical aspects is followed by a small encyclopedia with a large bias. In the encyclopedic articles on each of the Group IV elements and the III-V compounds, a considerable amount of detail is summarized (physical appearance and constants, methods of preparation, etches, etc.) However, arriving at the II-VI and I-VII compounds, the discussion becomes very cursory. Throughout these articles the author's interest is reflected in a prominence of phase diagrams. A review article on solid solutions between III-V, II-VI and I-VII compounds completes the middle section. The final chapter contains an interesting qualitative discussion of the variation of properties within groups and periods.

In the theoretical introduction some of the author's original work is presented. Most important is her discus-