ment in their solutions. Many of the results are used later in the text.

As a textbook for a graduate student and as an introduction to a powerful tool in the analysis and synthesis of optical systems for a research worker, this book is very highly recommended. The misprints are few and easily spotted. The method of analysis is clear and carefully presented. The illustrations are well chosen and placed appropriately in the body of the text. The list of references at the end of each chapter is complete enough to allow for further exploration into any area covered by the text.

References

1. Grant R. Fowles, *Introduction to Modern Optics*, Holt, Rinehart & Winston, New York (1968), pp. 108-9. No argument is presented at all.
2. Max Born and Emil Wolf, *Principles of Optics*, Pergamon Press, New York (1959), pp. 378-9. Monochromaticity is discarded.

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Mary E. Cox is an instructor in the physics department at the University of Michigan, Flint College. She has been conducting research in the field of holography.

An inclusive treatment of physical optics

OPTICAL INTERFEROMETRY. By M. Francon. 307 pp. Academic Press, New York, 1966. $13.50

by STANLEY S. BALLARD

Here at last is an inclusive, detailed, authoritative book on interferometry. Research workers and serious students in this burgeoning field of physical optics should greet this new book most enthusiastically. It is appropriate that the author, M. Françon is from the Institut d'Optique of Paris, where so much of the pioneer work in physical optics has been done during recent decades. He is one of the leaders in these activities, and is well known both in France and internationally through his other writings and his many lecture series. He is noted for the vigor and clarity with which he presents complicated topics and for the excellence of the diagrams and illustrations that he employs.

The experimentalist may find chapter 1 rather heavy going, as it examines the subject of coherence in depth and with appropriate mathematical aids. The following chapters are somewhat less awesome; they give useful information on various types of interference devices, categorized by the method of producing interference: by wavefront division, by amplitude division, by utilizing two beams, by multiple-beam devices, by polarization techniques and by lasers. The subjects of interference and partial coherence and of intensity interferometry are discussed in chapters 8 and 9, respectively.

Chapter 12, on the interferometric measurement of the optical transfer function, will be of interest and value to persons who may wish to construct devices to perform this practical measurement. Next are chapters on thin films, interferometric spectroscopy and interference in the measurement of length. The final chapter mentions several diverse applications of interference in wind-tunnel aerodynamics, in controlling the homogeneity, flatness and parallelism of glass plates and polishing defects and in measuring the thickness of thin films; interference microscopes and optical holography are the last two topics.

Throughout the book the modern approach of coherence theory is employed. There is little on the actual design of interferometers or the practical problems that arise during their use, although both the experimental and the theoretical aspects of each topic are treated.

There is a seven-page bibliography and a short subject index. The book is copiously illustrated with simple, clear, informative line drawings. There are no halftones, and I regret that at least one picture of interference fringes is not included, especially as Françon is known to have such an excellent collection.

It can be confidently expected that this book will take its place among the very important volumes devoted to a selected field of modern optics.

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The reviewer is professor of physics and chairman of the Department of Physics and Astronomy at the University of Florida.

INTERFERENCE FRINGES produced by heated gas inside an automobile dome lamp. The laser hologram that produced the image was exposed first with the lamp unlighted and then, after a four-minute delay, with the lamp lighted.

Nuclear statistics

RANDOM MATRICES AND THE STATISTICAL THEORY OF ENERGY LEVELS. M. L. Mehta, ed. 259 pp. Academic Press, N. Y., 1967. $12.00

by EUGEN MERZBACHER

As a complicated system composed of more than a few constituents, which interact according to imperfectly known laws, the nucleus has often been treated by statistical methods. In a highly excited heavy nucleus, the number of states per unit energy interval is very great, and the wave functions of these states are complex and exhibit few simple regularities.

Statistical methods have been in use in nuclear physics since the 1930's when the first estimates of mean level spacings were made, usually on the basis of an independent-particle model for a large number of fermions. The state of the theory of nuclear level densities were reviewed by T. Ericson (*Advances in Physics* 9, 425, 1960).

Improvements in resolution of nuclear reaction cross-section measurements in the past few years have made it possible to determine details of the statistical distribution of nuclear states beyond the average level spacing. Neutron spectroscopy, in particular, has yielded information about the frequency distribution of nuclear level spacings and level widths and has motivated a new approach toward the statistical treatment of energy levels and wave functions (widths), following the initiative of Eugene Wigner. The starting point of all such investigations has been a declaration of partial ignorance of the

Hamiltonian, of which the excited nuclear states are eigenstates. The theories postulate a reasonable probability distribution of an N-dimensional Hermitian matrix consistent with the available relevant information, and seek to infer the resulting distribution of eigenvalue spacings by mathematical analysis, especially in the limit of large N. The connection with the experimental data on nuclear levels is based on the hypothesis that the local statistical behavior of the energy levels is identical with the statistical properties of the eigenvalues of a large matrix. Around 1950 the study of matrices with randomly distributed elements became an active, if rather specialized, field of theoretical physics, although the statistician J. Wishart had already considered certain random matrices in 1928. Many of the important papers were collected in a reprint volume (*Statistical Theories of Spectra: Fluctuations*, Academic Press, New York, 1965) together with an introductory review by the late Charles E. Porter.

Although Porter emphasized the physical aspects from which the mathematical problems arose, most of the literature is concerned with the intriguing mathematics of random matrices. A set of fundamental papers by Freeman J. Dyson and by Dyson and M. L. Mehta, in 1962 and 1963, acquainted many theoretical physicists with the status of the statistical theory of energy levels of complex systems. Mehta, who has made significant contributions to the subject, has now written a systematic technical monograph on the mathematical theory of random matrices. This book is an excellent guide to the problems that have been solved and to those that, while formulated easily, remain unsolved. The book poses the mathematical problems clearly and contains complete proofs of most results. The "threefold way" of Dyson, corresponding to ensembles of Hermitian matrices that are invariant under orthogonal, symplectic or unitary transformations, is emphasized, but other ensembles are also discussed. The uninitiated may be surprised to discover how sophisticated mathematical techniques are required to calculate the distribution of level spacings even after the joint probability distribution of the eigenvalues has been found for any particular ensemble of random matrices.

On the other hand, the reader should not expect to find here any extended discussion of the physical basis for the choice of the commonly used matrix ensembles, other than the general symmetry requirements; nor should he be encouraged by the subtitle, "The Statistical Theory of Energy Levels," to expect to learn of the physical relevance of the many specific results. It remains unclear if, and under what conditions, statistical information about nuclear spectra (or about the spectra of the elementary particles) can be utilized profitably in gaining new understanding of the general properties of the interactions. However, in spite of numerous nontrivial misprints, some uninformative chapter headings and a misleading description on the dust jacket, Mehta's book satisfies the aim of providing an authoritative introduction to the mathematical theory of random matrices and their eigenvalues.

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Eugen Merzbacher, Visiting Professor of Physics at the University of Washington, 1967–68, has been interested in the interpretation of the spacing between neutron resonances. A professor of physics at the University of North Carolina, the reviewer wrote a text on quantum mechanics.

For the social metaphysicians

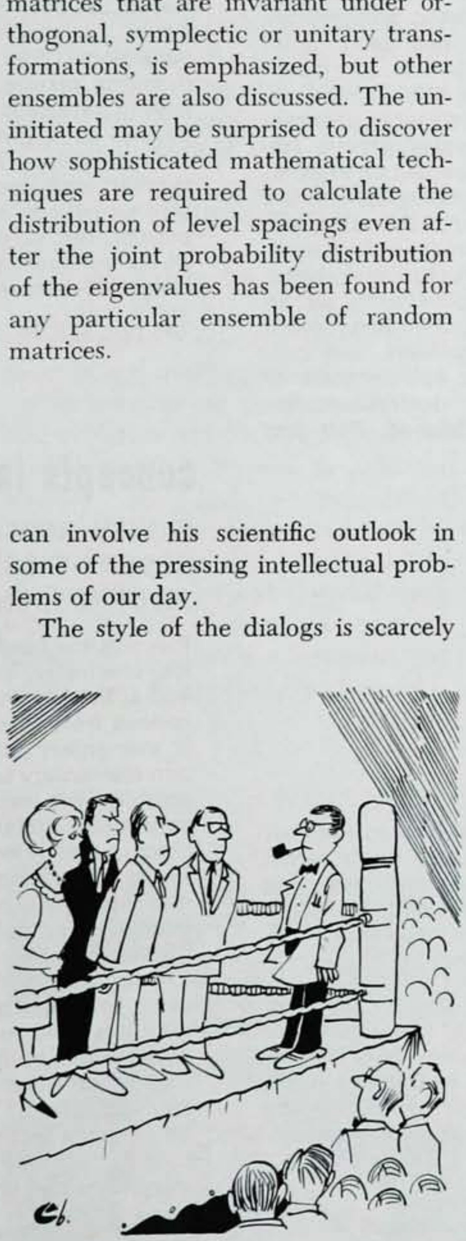
DIALOGUES ON FUNDAMENTAL QUESTIONS OF SCIENCE AND PHILOSOPHY. By A. Pfeiffer. Trans. from German. 128 pp. Pergamon Press, Oxford, 1967. 25s

BY RICHARD SCHLEGEL

One of the therapies for the alienation of science from contemporary student thinking would be a searching criticism and discussion of philosophical aspects of science. I say "philosophical aspects" but what is wanted, I think, is not so much what professional philosophers of science do (even though their contributions would give essential background understanding), but rather, a consideration of the interplay today between the content of science and its effects in our general culture.

A. Pfeiffer (we are told in the preface, written by Kurt Mendelssohn of Oxford) was a physics student in Berlin in the late 1920's, is now a professor at an East German university and has preferred not to migrate to West Germany. In his *Dialogues* he has shown us a way in which a physicist can involve his scientific outlook in some of the pressing intellectual problems of our day.

The style of the dialogs is scarcely



SOCIETY VS. THE INDIVIDUAL. The participants in Pfeiffer's dialog ". . . readily agree on the ethical superiority of society over the interests of the individual, and they speak against an egoistic ethic. . ."

lively, and something of Germanic heaviness of word and sentence comes through with the translation. Frequent reference to Immanuel Kant's philosophy and recurring concern with the existence of a "higher" transcendental realm that supports man's moral sense give the American reader a feeling of being rather far from the home base of Anglo-American philosophical presuppositions. Indeed, in a broad way, the book might be described as a confrontation of 19th-century German philosophical idealism with the empiricism–naturalism of current Russian thinking.

The opening dialogs, which are concerned with philosophical implications of quantum mechanics, are, in my judgement, the weakest part of the book. The author asserts (although, nondogmatically) that uncertainty in nature is nothing more than a result of our ignorance of the details of elementary physical processes. The arguments conclude firmly in favor of objectivity of all atomic phenomena; but there is no meaningful presenta-