of Kepler, Descartes, and others at the beginning of the 17th century. Knowing what we know today, one is tempted to be surprised or even contemptuous that a mechanistic interpretation of vision was adopted so slowly, but the problems are by no means solved. We know only a little of the mechanisms at work within the retina in the processing of an image for transmission down the optic nerve and have even less understanding of the subsequent fate of the image. It is healthy to recapitulate the struggle that was necessary to solve the problem of the first steps in vision.

An article by T. Mulvey on "The history of the electron microscope" again gives us a feeling for the pace and character of an important scientific development. It is to be regretted, incidentally, that the fundamental patents of Reinhold Rüdenberg, which are discussed in Mulvey's references (Gabor, Freundlich), were not mentioned. Rüdenberg's priority as inventor was upheld in American courts and, much later, in Germany, though it is clear that commercial secrecy and his difficulties as a Jew in Berlin severely limited the influence of his ideas. Mulvey's paper correctly describes the development of the electron microscope, in which Rüdenberg apparently played no part; but the invention was legally his.

Two papers are devoted specifically to the optical microscope, S. Bradbury on "The quality of the image produced by the compound microscope: 1700–1840," and G. L'E. Turner on "The microscope as a technical frontier in science." Both give valuable new quantitative information about the actual performance of the microscopes available to early users. Papers by J. R. Levene on "The mechanism of accommodation" and Joseph Needham and Lu Gwei-Djen on "The optick artists of Chiangsu" complete the book.

W. LEWIS HYDE
Institute of Optics, University of Rochester, Rochester, New York

A Formalism for Quantum Physics

Lectures on Quantum Field Theory. P. A. M. DIRAC. Belfer Graduate School of Science, Yeshiva University, New York; Academic Press, New York, 1966. 159 pp. $7.50.

P. A. M. Dirac, the author of this somewhat puzzling book, is a giant of 20th-century theoretical physics. His name has long been an everyday adjective for physicists who speak, for example, of the Dirac equation, the Dirac delta function, and of Fermi-Dirac statistics. Any teacher of quantum mechanics will sooner or later refer his students to "Dirac's book" (*Principles of Quantum Mechanics*, first published in 1930). In that astounding work, Dirac achieved a definitive and lasting formulation of the new quantum mechanics, almost at the moment of its birth.

The present volume is the record of a series of 32 lectures on quantum field theory given at Yeshiva University in 1963–64. Special emphasis is placed on quantum electrodynamics (the quantum-theoretical version of Maxwell's electrodynamics), the most successful dynamical theory of modern times. Since its foundations were laid by Dirac himself (1926), these lectures are of particular interest.

The book is devoted largely to an exposition of a novel point of view concerning the divergence difficulties of quantum electrodynamics. Dirac believes that the most serious divergence is that associated with the so-called vacuum fluctuation diagrams. He asserts that these terms are simply dropped in the "usual" treatments, unlike the divergences which are handled by mass and charge renormalization, and that "one really gives up all pretense of logical development in places." This point of view leads Dirac to far-reaching conclusions: the Heisenberg picture of quantum mechanics is "good," the Schrödinger picture is "bad," and the two are not equivalent. Furthermore, the state vectors are not elements of a separable Hilbert space.

The overall aim of the lectures is to formulate quantum field theory entirely in the Heisenberg picture, thereby "cutting a lot of dead wood from the usual presentation." The kind of space in which the dynamical variables or q-numbers operate is not specified. For quantum electrodynamics, Dirac makes the "radical assumption" that a physical state corresponds to a q-number rather than to a vector. The interpretation of the new formalism is illustrated in part by computations of the anomalous magnetic moment of the electron and the Lamb shift, but is otherwise left incomplete.

Dirac's opinions regarding the necessity of inequivalent Schrödinger and Heisenberg pictures and the need, in particle physics, for a state space "bigger" than a Hilbert space will probably not be shared by many theorists at the present time. A quite different point of view regarding the difficulties of quantum field theory is expressed, for example, by R. F. Streater and A. S. Wightman in their book *PCT, Spin, and Statistics, and All That* (Benjamin, 1964).

The conversational flavor of the lectures has been preserved, and the reader's enjoyment is enhanced by the realization that he is being piloted through the infinite electron sea by the man who invented it.

J. SUCHER
Department of Physics and Astronomy, University of Maryland, College Park

A Culture in Mexico

The Mixtec Kings and Their People. RONALD SPORES. University of Oklahoma Press, Norman, 1967. 287 pp., illus. $5.95.

For over 500 years before the Spanish Conquest, the southern Sierra Madre of Mexico was populated by the Mixtecs, a people with a culture characterized by sophisticated gold jewelry and multicolored picture books. While other Mesoamerican cultures have received scholarly attention, the Mixtec has been relatively ignored. The neglect appears strange in the presence of the elements for systematic study which Spores details: accessible archeological sites in abundance, 16th-century documents, and present-day native Mixtecs.

The Mixtec Kings and Their People constitutes a pioneer effort at bringing together some of this material and making inferences from it. The author has visited the sites he describes, and deciphered and translated many of the documents he draws upon from archives in Mexico City and Seville. His conclusions are painstakingly drawn. All this gives the work its authoritative tone.

Although historical documents are utilized extensively, the approach is anthropological: it extracts generalities from the data. The picture that emerges for prehispanic times shows the Mixtecs living in limited valley enclaves in