

no problems, so that an instructor using this book as a text would have to find or devise his own. The book is amply illustrated with many instructive diagrams, and seems to be relatively free of typographical errors.

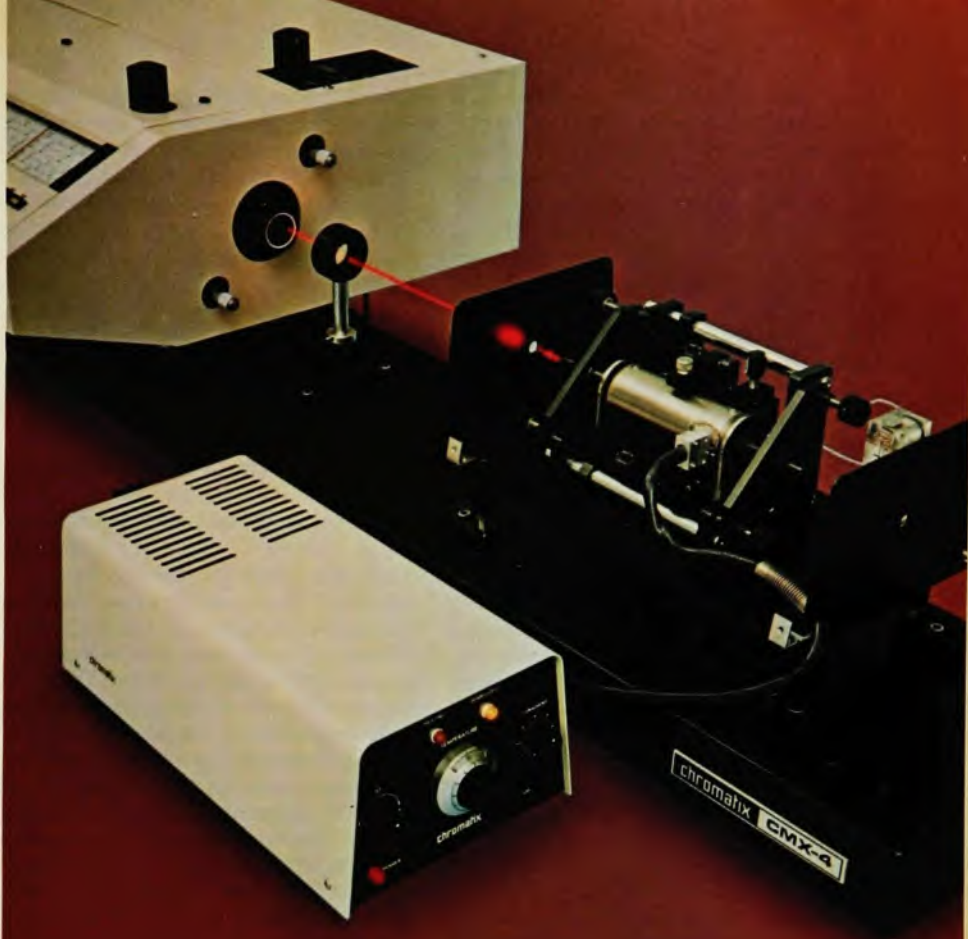
OSCAR K. RICE
University of North Carolina
Chapel Hill

Fields of Force: The Development of a World View from Faraday to Einstein

W. Berkson
370 pp. Halsted, New York, 1974. \$19.75

This book is largely a sustained argument for a "realistic" philosophy of science. According to such a view, scientific hypotheses (laws and theories) are regarded as explaining the world; they do not merely classify data. More specifically, the author, William Berkson, argues that the best world picture is the most classic theory of fields—Michael Faraday's. Berkson was a doctoral student of Karl Popper and he notes that his teacher's "philosophy of science permeates the work." Popper views the scientist as always attempting to falsify hypotheses deductively; he can never legitimately verify them inductively. How, then, is Popper's philosophy to be reconciled with Berkson's realism? That is, how can Berkson emphasize that hypotheses describe the real world when his teacher will not let him assert that hypotheses are true or possibly true?

Berkson's lack of adherence to strict falsificationism makes for difficulties in the prefatory discussion of his overall purpose. Since childhood, he has wanted to "understand the mysterious world." He finds that relativity and quantum mechanics attempt to give a general world view, but when taken together, they are incoherent. Having these two apparently exhaustive hypotheses sets up a situation in which a "crucial test" can be performed. According to strictly falsificationist (deductive) logic, one need only falsify one hypothesis to confirm the other. Berkson gestures in this direction, adumbrating two problems for quantum theory. However, neither his preference for unified world pictures nor that of Einstein and others is likely to convince the contemporary physicist. Likewise, his dismissing without explanation previously attempted reconciliations of the two theories in the form of quantum field theory will cut little ice. Berkson deviates from the received logic in devoting his book to confirming



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relativity as a viable world picture. But he has not conclusively ruled out its alternative—or even discussed whether quantum mechanics is an alternative—and he will hardly convince working physicists to turn to Faraday's world picture. And his urgings for them to test versions of that view (G. G. Stokes's theory of ether drag and Oliver Heaviside's theory of ether stress) will likely fall upon deaf ears.

As a philosophy of science in the usual impractical sense, Berkson's modified falsificationism is much more plausible. He follows Joseph Agassi in complementing Popper's logic of research with Emile Meyerson's psychological theory of explanation, which "consists in the discovery of *unchanging* things and principles behind the changing and diverse world of our experience." Meyerson, then, provides the required reconciliation between Popper's falsificationism and Berkson's realism. As a scholarly history of field theory, the book is uneven: on Faraday and Maxwell, it has seven chapters and utilizes some manuscript sources; in just two chapters on Lorentz and Einstein, inevitably even some printed sources must be overlooked. For the later period, the book will serve better as a popular history for scientists and

laymen. Berkson's writing style is every bit as engaging as Popper's: It is concise, unpedantic and personal.

PETER A. BOWMAN
University of Tennessee
Knoxville

Introduction to the Theory of Space-Charge Optics

Gy. A. Nagy, M. Szilagyi

514 pp. Halsted, New York, 1974. \$24.50

Space-charge optics deals with the motion of charged particles in static fields which the particles modify by their presence. The equations that describe this type of flow are non-linear partial differential equations, and self-consistent analytic solutions are difficult to obtain. Historically the problem was made tractable for solutions in closed form by a suitable choice of coordinate system and, with the single exception of the flow between infinite parallel planes, by the neglect of the velocity spectrum of the particles.

Sparked by the electron-gun techniques pioneered by John Pierce, the field saw a period of rapid growth that

extended from the late 1930's to the mid 1960's when many of the problems relating to the formation and control of space-charge electron beams for efficient microwave tube devices were solved. Initially laminar-flow models prevailed, but by the mid 1950's C. C. Cutler and others revealed by experimental beam studies the serious shortcomings of design procedures that neglect thermal velocity effects, and more realistic models were developed in which the demand for self-consistency was relaxed in favor of the inclusion of thermal-velocity effects. This period also coincided with rapid advances in computer technology; closed-form solutions of flow in idealized geometries soon gave way to approximate solutions of practical geometries obtained by finite difference techniques employed in iterative procedures.

Many of the techniques for dealing with space-charge problems were worked out at Stanford University by a group that included Peter Kirstein, Gordon Kino and William Waters. Their book *Space Charge Flow* provides an excellent and broad perspective of the subject.

The book under review does not attempt to cover the field of space-charge optics as completely as the above men-

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