

tromagnetic field. In June 1947 Kramers presented some of these results at the Shelter Island conference, and his contributions played an important role in unraveling the meaning of the Lamb shift. Dresden feels that Kramers was shortchanged by not receiving sufficient credit. Perhaps. But he represented a style of doing physics that was inimical to the American theorists who had gathered at Shelter Island to prove to the world that the United States was as impressive in "pure" physics as it had been during the war in applied and engineering physics.

The immediate challenge was to get the numbers out to explain the magnitude of the Lamb shift and the new values of the hyperfine splitting in hydrogen H and D isotopes that I. I. Rabi, John E. Nafe and Edward B. Nelson had measured. Hans Bethe did that for the Lamb shift. Robert Oppenheimer, Julian Schwinger and Victor Weisskopf all suggested during the conference that the Lamb shift must be an electromagnetic-radiative effect. Bethe gave a lecture on the infrared problem and discussed the Bloch-Nordsieck and the Pauli-Fierz papers. In the latter paper, a fully *quantum mechanical* treatment of the interaction between a nonrelativistic charged particle and the electromagnetic field is given and an explicit mass renormalization is carried out to remove the electromagnetic self-energy. In his lecture Kramers dealt with the *classical* theory only. Bethe's famous train-ride paper, in which he calculated the nonrelativistic Lamb shift, is much closer in spirit and style to the Pauli-Fierz paper than to Kramers's work and lecture. I suspect that without Kramers in attendance at the Shelter Island conference, developments would have proceeded much as they did in fact.

Dresden quotes a lecture in which Kramers attempted to sketch a "miniature" scientific biography of Peter Debye: "You want to know about the scientist because your human... intuition tells you that there is an exaltation to be experienced which in turn can produce an exaltation into yourself, because even with all the uncertainty about the man and his field—there is so much in both of you—that is near to you, that it reflects something of your being and aspirations." Dresden has done that for Kramers. Rarely have we been given so rich, so penetrating and so valuable an account of the mind, the style and the life of a first-rate scientist and of his science. Dresden has indeed given us an insight into our very own being and aspirations.

Incompleteness, Nonlocality and Realism: A Prolegomenon to the Philosophy of Quantum Mechanics

Michael Redhead

Clarendon P. (Oxford U. P.),

New York, 1987. 191 pp.

\$45.00 hc ISBN 0-19-824937-3

The 1980s have seen a revival of interest in the problem of interpretation in quantum mechanics. Largely motivated by the results of the precision experiments by Alain Aspect and his collaborators in 1982, the revival was further stimulated by the 1985 centennial of Niels Bohr's birth, which was also the semicentennial of the famous Einstein-Podolsky-Rosen paper that questioned the completeness of quantum mechanics. The voluminous and very helpful collection of original articles on the interpretation problem compiled by John A. Wheeler and Wojciech Zurek in *Quantum Theory and Measurement* (Princeton U. P., Princeton, N. J., 1983) aided greatly in providing the necessary background. As a consequence there has come about a considerable clarification of the available conceptual options and much deeper insight into the issues of locality and separability. But questions remain.

No one entering this research field today would have an easy time working through the extensive recent literature. This glut alone is sufficient reason to welcome Michael Redhead's book. It provides a thorough introduction and an excellent digest of much of the most important recent literature. It is also the first book on the subject in about 15 years and is quite different in style from its predecessors by Frederik Belinfante (*Survey of Hidden-Variable Theories*, Pergamon, Oxford, 1973), Bernard d'Espagnat (*Conceptual Foundations of Quantum Mechanics*, second edition, Benjamin, Reading, Mass., 1976), Max Jammer (*The Philosophy of Quantum Mechanics*, Wiley, New York, 1974) and Erhard Scheibe (*The Logical Analysis of Quantum Mechanics*, Pergamon, Oxford, 1973). With its crossing of the disciplines of physics, mathematics and philosophy of science, writing the book successfully required considerable expertise.

Redhead is extremely well qualified for the task. A British theoretical physicist who did research in quantum mechanics and quantum electrodynamics, he has since turned to the philosophy of science. He was an active and successful participant in

the debate following Aspect's experiments and has contributed a number of key papers. He is now the head of the department of history and philosophy of science at Cambridge University. Not surprisingly given this background, he has written a rather technical book. In the preface Redhead states that his book was written for both physicists and philosophers. But I suspect that most philosophers will have some difficulties with its mathematics, even if they can get through its physics, and many physicists will have problems understanding the philosophical issues. A mathematical appendix, which briefly reviews set theory, vector spaces and lattice theory, will help the insufficiently prepared reader. The author wisely steers clear of overly sophisticated mathematics by restricting himself almost throughout to finite-dimensional vector spaces and by providing just a short review of Gleason's theorem. An extensive bibliography will permit readers to pursue specific questions on their own.

While the last chapter, dealing with quantum logic, stands somewhat separate from the rest of the book, the bulk is divided into two parts of nearly equal length. The first is a review of those aspects of quantum mechanics and of its three most important interpretations that are necessary for understanding what follows. The second, more difficult part starts with a careful, very clear review of the Einstein-Podolsky-Rosen paper and then plunges into the heart of the matter: the vexing nonlocality problem. This problem is studied in detail in the contexts of both the Bell inequality theorem and the old Kochen-Specker paradox. This second part requires considerable sophistication in all three overlapping fields (physics, mathematics and philosophy) for a full appreciation. For instance the author distinguishes among no fewer than seven different definitions of locality, carefully analyzes all of these for their mathematical and philosophical consequences, and then compares them with one another.

Throughout the book's discussions, the author keeps three different interpretations of quantum mechanics in the reader's mind. These are the hidden-variables view, the complementarity view and the potentiality view. Most physicists usually dismiss the first of these out of hand in an unscientific manner. Here, the serious arguments for a dismissal are carefully marshaled. The second view is of course the Copenhagen interpretation, championed primarily

by Bohr. It is the one found in most texts and is usually presented without criticism. Never fully explicated and in many respects left ambiguous by Bohr and his collaborators, the Copenhagen interpretation has encountered considerable conceptual difficulties upon closer examination. The potentiality view was proposed by Werner Heisenberg and is sometimes called quantum realism (to be clearly distinguished from the classical realism advocated by Albert Einstein). These three views violate different definitions of locality; each view requires nonlocality in a different sense. The author does not advocate one particular view but leaves the choice to the reader.

This very carefully written book clears the metaphysical fog where most needed. Redhead has managed to squeeze a great deal into less than 200 pages. But I would have liked a longer book. The author excluded the problem of the reduction of states—the collapse of the wavefunction—beyond a very clear mathematical statement of it; that is understandable given the difficulty of that yet unsolved problem. But I can see no good reason for the author to exclude his own very attractive proof of the peaceful coexistence of the apparently contradictory concepts of nonlocality and special relativity (which demands a finite propagation velocity of signals). But this is not a serious criticism. The book is attractive and remarkably free of misprints (I found only four), but it is expensive. In summary, I believe that Redhead's book belongs in the collection of everyone seriously interested in the foundations of quantum mechanics.

Fritz Rohrlach
Syracuse University

Dynamics of Proteins and Nucleic Acids

J. Andrew McCammon and
Stephen C. Harvey

Cambridge U. P., New York,
1987. 234 pp.

\$39.50 hc ISBN 0-521-30750-3;
\$19.95 pb ISBN 0-521-35654-0

Our picture of biological matter has undergone many revolutions since the last century, when even the discrete molecular nature of proteins was in doubt. By the 1970s, through the techniques of x-ray crystallography, an architecturally beautiful, but static, picture of proteins and nucleic acids had come into being and indeed made contributions to central problems of biology. What was lacking

EG&G PARC's

*The Latest On Optical
Multichannel Analyzers
And Accessories*

OMA[®] Update

New, Enhanced IBM-Compatible Software

EG&G PARC's M1461/90 software package takes full advantage of the personal computer (including the PS/2) in acquiring data with the OMA III 1461 buffered interface. This configuration of OMA, PC, and M1461/90 software provides cost-effective, sophisticated parallel light detection that is simple, yet powerful enough to run the most complex OMA experiments.

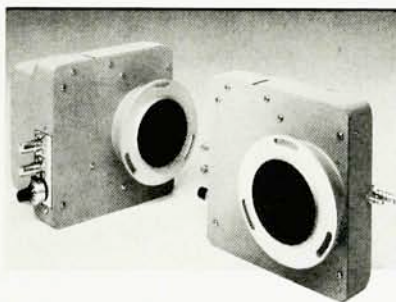
Some key features of this exciting new software include:

- REAL-TIME Live Display
- Direct Storage to RAM or Hard Disk
- Sophisticated Print-Plot-Display
- Spectrum-based Data Manipulation



■ DAD... Custom Data Acquisition Design Ability

OMA III systems including a 512-element detector and the M1461/90 software start as low as \$13,000. M1461/90 software runs on the IBM PC, XT, AT, PS/2 and most compatibles.



OMA Line Extended With New, Low-Cost, High Performance Detectors

M1455A and M1456A, the latest editions to our family of OMA detectors, provide low-cost, variable gain, inten-

sified linear diode array detection in applications that require high sensitivity over the entire UV-VIS range, fast time resolution or rejection of ambient background light.

Both detectors feature many significant enhancements:

- Operating Temperature: -5C; -35C with Liquid Assist
- Precision Variable Gain Control
- Improved S/N... Exclusive COOL CATH[™] Reduces Photocathode Noise
- Wide Range Of Intensifiers: Spectral Sensitivity And Time Resolution (Gating) Can Be Optimized To Match Your Specific Experimental Requirements.

For more information, contact your local PARC sales representative or call us at (609) 452-2111.



EG&G

PRINCETON APPLIED RESEARCH

P.O. BOX 2565 • PRINCETON, NJ 08543-2565 • (609) 452-2111

United Kingdom 0344 / 423931 • Canada (416) 475-8420 • Netherlands 030 88 7520
West Germany 089/926920 • France 1 60 779356 • Italy 02 7386294

IBM is a registered trademark of the International Business Machines Corporation

J07007

Circle number 59 on Reader Service Card