Book Reviews

Field Theory and Fundamental Dynamics

Mathematical Theory of Elementary Particles. Proceedings of a conference held in Dedham, Mass., September 1965. ROE GOODMAN and IRVING SEGAL, Eds. M.I.T. Press, Cambridge, Mass., 1966. 198 pp., illus. $6.

The perplexing problems that face elementary-particle physics have given rise to widely diverse "schools" of approach. The book under review presents conference papers by members of the school that seeks a workable mathematical foundation prior to an application to the real world. In some ways there is as much diversity of approach within this school as between schools, and such a conference serves the double purpose of exposing the contributors' research to each other as well as to the outside world.

The frustration that has for over 30 years met attempts to find an adequate formulation of fundamental dynamics through quantum field theory has spawned several heretical approaches to these problems. Notable for his ingenuity is the conference coorganizer, I. Segal, and his contribution to the present volume, although confined to a potent analysis of classical scattering theory, is ultimately to be applied to his own particular approach to nonlinear quantum field theory. We may cast the contribution of Greenberg on parafields in the category of unusual approaches that may illuminate elementary-particle theory; and in a short contribution D. Ruelle analyzes for pedagogical purposes a simple axiom system akin to that of quantum field theory. A number of contributions (notably those by A. Jaffe, E. Nelson, and A. Visconti) reexamine, with the use of careful and precise mathematical language, prescriptions that were developed in a heuristic manner during the "revolutionary period" between 1949 and 1955. While it is true that many precise statements fully in accord with physical intuition can be obtained for butchered theories (for example, by putting the system in a box, introducing a momentum space cutoff, or regularization of divergent integrals), the ultimate questions as to existence, uniqueness, and specific properties of the solutions of the nonbutchered theories remain virtually as elusive as they were in the revolutionary period. At the present stage axiomatic field theory, as the approach of the present school is often called, is at its best in establishing very general properties, such as the connection of spin and statistics and the so-called *TCP* theorem, and in disproving a number of the intriguing speculations that abound in this field of interest. The contributions of S. Coleman on the attempts to obtain meaningful relativistic symmetries of the U(6) variety, the nonexistence proof for a cutoff $\lambda\phi^3$ theory by A. Jaffe, and to a lesser extent the contribution of R. F. Streater on spontaneous breakdown of symmetry fall into these categories. Models and methods previously employed in statistical mechanics are profitably used by K. Symanzik in his analysis of Euclidean quantum field theory in a space-time having a positive definite metric. Analyticity aspects are exploited by J. Tarski in his analysis of the special problems peculiar to zero-mass particles in a space-time of two dimensions, and in the structure analysis of the holomorphy envelopes of multiple field expectation values by G. Källén. The contributions of algebraic topology, especially that of homology theory, to the analysis of singularities of Feynman integrals are outlined by M. Froissart. It is to be regretted that the contributions of some of the other speakers with novel approaches to these problems were not included in this volume.

The last paper in the book, which actually corresponds to the opening address of the conference, is an assessment of present-day axiomatic field theory by A. Wightman, who stresses the hope shared by all devotees of this school that real insight into the dynamical consequences of fundamental particles might best be gained through the techniques of field theory and that these techniques as elucidated by the powerful methods of modern mathematics may conceivably be on the verge of giving us certain truths about specific theories. Whether research of a mathematical nature will ultimately provide the road to a better understanding of elementary-particle physics is, of course, a subject of much controversy. Nevertheless, it is a comforting thing to read reports where the conclusions are at least a logical consequence of the assumptions. The co-editors are to be complimented on their undertaking and execution of a topical conference of this nature.

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Microscopy

Advances in Optical and Electron Microscopy. Vol. 1. R. BARER and V. E. COSSLETT, Eds. Academic Press, New York, 1966. 293 pp., illus. $11.50.

Optical and electron microscopes are surely the most common instruments now used by the tens of thousands of workers concerned with microstructures or morphology. Papers on instrument developments and techniques are numerous and widely scattered, a condition which has stimulated publication of various cross-indexed bibliographies. Comprehensive review articles are even more useful, and several outstanding examples have appeared in the *Advances in Electronics* series and elsewhere. R. Barer, a biologist, and V. E. Cosslett, a physicist, have now launched a new *Advances* series specifically committed to reviews on microscopy. The editors point out, however, that the articles will not conform to a set pattern and may range from very objective, critical reviews to frank expressions of personal points of view. The six articles in the first issue illustrate the promised variety.

P. A. G. Monro deals exclusively with measurement under the microscope of the velocity of moving particles—blood cells moving in living