Book Reviews

Fisher's Ideas

R. A. Fisher: An Appreciation. Papers from a seminar and lecture series, Minneapolis, 1978, S. E. FIENBERG and D. V. HINKLEY, Eds. Springer-Verlag, New York, 1980. xii, 208 pp., illus. Paper, $14. Lecture Notes in Statistics, vol. 1.

Statistical science impinges on most fields of science and many areas of human endeavor. It has been more powerfully influenced by R. A. Fisher than by any other single person. His thought was subtle, he expressed himself carefully, and his ideas are not always well represented in our current textbooks. The subject of statistics is itself subtle and puzzling, whereas textbooks try to persuade the reader that all is clear and straightforward. Anyone much concerned with statistics should not miss becoming acquainted at first hand with Fisher's statistical writings, both the books and the research papers. There are, however, several impediments to doing so. Fisher writes in a conservative Victorian style that now seems remote. He often manages to be simultaneously lucid and obscure. Relevant mathematical arguments are sometimes omitted and when not omitted often seem imprecise. And at times his peculiar personality comes through in ways likely to irritate the reader. But after accommodation to these idiosyncrasies, the reader is rewarded. Fisher had a greater measure of understanding, insight, and imaginative energy than anyone else in the field.

This book presents a series of short papers on Fisher's principal statistical writings. Written by the editors and other faculty and student members of the University of Minnesota and by three guest lecturers, Joan Fisher Box, William Cochran, and David Wallace, the papers summarize contents, outline controversies, and sometimes express Fisher's material in more modern terms or relate it to later developments. The editors say in the preface: "The lectures were not intended as authoritative critiques of Fisher's work, but rather as introductions to and reviews of the key ideas in his writings. . . . We hope that the lectures here will help to introduce others to Fisher's work, so that yet another generation of statisticians can gain an appreciation of the relevant impact that his ideas still have on the way scientific research is conceived, carried out, and understood." Topics covered include early work on the correlation coefficient and degrees of freedom in the χ^2 test, development of analysis of variance and design of experiments, the brilliant and difficult discoveries in estimation and fiducial inference, discriminant analysis, distributions on the sphere, and Fisher's interventions in the debate on smoking and lung cancer.

The book seems to meet its objective well. Anyone contemplating browsing for the first time in Fisher's *Collected Papers* will find it a helpful guide. Anyone already somewhat familiar with Fisher's writings may find it less interesting and should perhaps turn elsewhere for inspiration. Joan Fisher Box's biography of her father (*R. A. Fisher: The Life of a Scientist*, Wiley, 1978) presents much fascinating, little-known information, calculated to encourage the reader to return to Fisher's writings with fresh interest and insight. And in Jimmie Savage's article "On rereading R. A. Fisher" (edited by John Pratt, *Annals of Statistics*, 1976) we see one powerful intellect savoring and evaluating the work of another powerful intellect, with splendid results. Among the contributors to the book under review there are fine intellects, but they have kept too closely to their stated purpose for that kind of magic.

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Gauge Theories

Field Theoretical Methods in Particle Physics. Papers from a NATO Advanced Study Institute, Kaiserslautern, Germany, Aug. 1979. WERNER RÜHL, Ed. Plenum, New York, 1980. x, 598 pp., illus. $69.50. NATO Advanced Study Institutes Series B, vol. 55.

During the last five years there has been extensive study of gauge theories, which are currently regarded by a number of experts as a correct mathematical description of the laws of nature governing both the macroscopic universe and the microscopic world of elementary particles. Gauge theories are not new to theoretical physics. The classical theory of electromagnetism is a gauge theory with an Abelian gauge group, as is the great edifice of space-time as geometry built by Einstein in his general theory of relativity. In the latter case the gauge group is the general linear group that arises by allowing arbitrary coordinate transformations. In 1954, Yang and Mills proposed that the fundamental laws for elementary particles should be described by a gauge theory with a non-Abelian gauge group, and results over the last decade and a half lend considerable support to this view.

The present volume contains a series of 21 lectures covering various aspects of the mathematical and physical development of gauge theories as applied, with one exception, to particle physics. The exception is H. Römer's contribution, which deals with attempts to fashion a quantum theory of gravity by means of a Euclidean Feynman-Kac integral for the gravitational action. The discussion in the main concerns the gravitational analogs of instantons, which have played a central role in studies of Yang-Mills theories by t'Hooft, Atiyah *et al.*, Singer, and others. Clearly future work should have much to say about the Euclidean version of Einsteinian gravitation.

The 20 remaining papers are concerned for the most part with the quantum field theoretic aspects of gauge theories, either on a lattice or as quantum chromodynamics. My own involvement has been with the rigorous existence theory for gauge fields within the framework of constructive quantum field theory. In this vein there is an excellent paper by J. Fröhlich on the geometry of gauge theories, particularly on the lattice, and recent work directed at proving the existence of the two-dimensional Abelian Higg's model by taking the limit of zero lattice spacing in a gauge-invariant finite-size lattice approximation. Fröhlich gives a broad account of the ideas and techniques needed for this work as well as a nice example of a principal bundle—a ball rolling on a fixed plane. Aspects of lattice gauge theories more in the direction of statistical mechanics are dealt with by F. Guerra in a paper concerning cluster expansions, recursive equations, and duality. Such techniques are essential for development of the lattice theories as dynamical schemes in their own right rather than just as a convenient cutoff for the continuum theory that maintains gauge invariance. One other paper that complements the lattice picture is by S. Yankielowicz, who discusses the