Really comprehensive crystallography

SINGLE CRYSTAL DIFFRACTOMETRY. By U. W. Arndt, B. T. M. Willis. 330 pp. Cambridge U. Press, Cambridge, England, 1966. $15.00

by Leonid V. Azároff

Many of the early experimental methods used in x-ray crystallography were developed in England, beginning with the pioneering work of W. H. and W. L. Bragg. (It is not unusual to find some of the vintage equipment still in active use today.) This includes the original Bragg spectrometer, which employed large single crystals and ionization chambers having very low quantum-counting efficiencies. The necessity of orienting the crystal and positioning the detector in two separated steps makes the manual operation of a diffractometer a rather tedious process. By 1936, an automatic diffractometer was developed by A. W. Wooster and his colleagues in England but it also employed low-efficiency detectors and could not rival the operating ease and, therefore, the popularity of photographic methods for the recording and measurement of x-ray diffraction intensities.

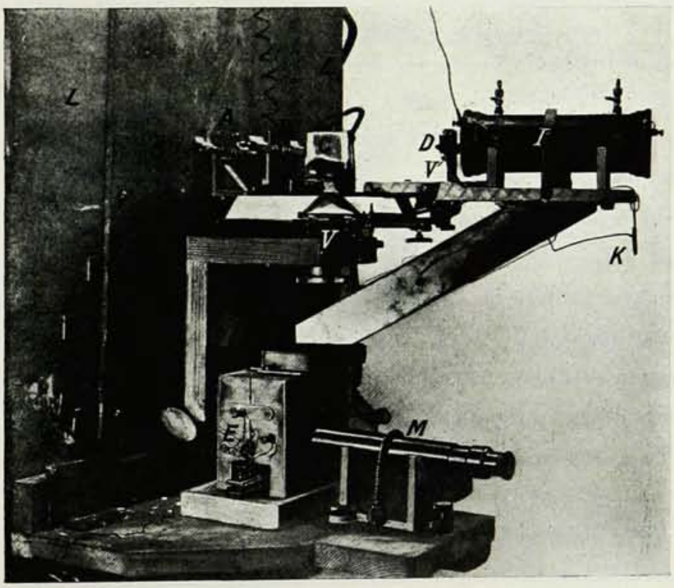
After the development of more efficient ionization detectors, notably the Geiger-Müller counter, x-ray diffractometry began to gain in importance once again. In the case of single-crystal diffractometry, its increasing popularity was largely abetted by the growth of neutron-diffraction facilities, since photographic films are notoriously poor detectors for thermal neutrons. It is historically appropriate, therefore, that the first really comprehensive discussion of modern developments in single-crystal diffractometry should have been written in England by two crystallographers who have been intimately involved in its renaissance both in the areas of x-ray and neutron diffraction.

The measurement of the diffracting powers of many thousand crystallographic planes constitutes the first step in the determination of a crystal structure. Most students learn one particular way of doing this, usually determined by the equipment available in their mentor's laboratory. The monograph here reviewed, provides them with all the necessary background to understand the principles underlying the operation of their particular instrument as well as that of other instruments that they may wish to consider at a later time. It also clearly outlines the similarities and differences that arise when diffractometers are used with neutron and x-ray sources. It begins with a description of the basic aspects of the diffraction geometries that can be employed and the design principles for diffractometers.

In chapters 4 and 5, the characteristics of various ionization detectors are considered along with the attendant electronics required to record incident neutron or x-ray beams. In chapters 6 and 7, the characteristics of x rays and neutrons are compared, and the special requirements that each imposes on such instrumental components as collimators, monochromators, etc., are fully expounded. Finally, the strategies for measuring background and diffraction intensities and the accuracies attainable are evaluated, with a concluding chapter devoted to computer control of automatic diffractometers. A succinct appendix juxtaposes the peculiarities of x-ray and neutron diffractometry, and a fairly complete literature list provides sources for more detailed descriptions of the topics discussed.

The organization and presentation of the text and accompanying illustrations are so arranged that it is possible to peruse the monograph rapidly, to gain an overall idea of what single-crystal diffractometry encompasses, or it can be studied more thoroughly, to gain a deeper appreciation of many of the details involved. The authors avoid detailed derivations of mathematical formulas, particularly for the manifold geometrical and physical correction factors that already have been treated amply in the literature. They similarly avoid extensive descriptions of practical details, substituting for such discussion a brief review of fundamental considerations and a collection of literature references. All this makes the monograph highly readable and most useful for those who are familiar with x-ray crystallography generally but not necessarily with single-crystal diffractometry.

Because of the generality of most discussions, the monograph could be used equally well as an introduction to single-crystal methodology itself. Thus the book should find use in advanced college courses as well as form an indispensable adjunct to the li-



X-RAY SPECTROMETER used by W.H. and W.L. Bragg.
LLL: lead box
A,B,D: slits
C: crystal
I: ionization chamber
V: vernier of crystal table
V': vernier of ionization chamber
K: earthing key
E: electroscope
M: microscope

braries of all those who have an interest in the experimental study of the atomic arrangements in single crystals.

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Probabilistic and statistical problems

AN INTRODUCTION TO PROBABILITY THEORY AND ITS APPLICATIONS. VOL. 2. By William Feller, 626 pp. Wiley, New York, 1966. $12.00

by T. Teichmann

The first volume of Feller's *An Introduction to Probability Theory and its Applications* set a new and welcome trend in the field by combining mathematical rectitude with practical applicability in a manner satisfying both to purists and to those interested in applying results. Its many readers, most of whom had probably given up hope of seeing volume 2 will welcome its somewhat unexpected appearance, after some sixteen years, and find that the wait, if lengthy, has been worthwhile.

This second volume embraces a variety of topics connected with continuous sample spaces. It includes lengthy discussions, both abstract and applied of the most "popular" densities (to wit, a uniform, an exponential and a normal, and their extension to more than one dimension). The basic measure-theoretic foundation of the theory is given, followed by the general properties of distributions and moments in multidimensional spaces. The remainder of the book then involves interrelated discussions of important subjects in probability theory together with important applicable techniques in analysis. The probabilistic subjects include the laws of large numbers, the central limit theorem, infinitely divisible distributions, Markov processes, random walks and renewal theory. The techniques include Laplace and Fourier transforms, semigroups and general harmonic analysis. It is not practical to list all the significant problems treated or discussed, and even those treated quite cursorily often give applicable results or criticisms.

The concentrated information presented in this volume is alleviated by the conversational (and sometimes mildly ironical) style of its presentation and by the frequent interposition of examples of both mathematical and statistical interest, including many left for the reader. This book will prove interesting and helpful to almost everyone concerned with probabilistic or statistical problems that are not completely elementary, and its readers will be grateful to Feller for his perseverance and enthusiasm in completing his venture.

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Dynamical theory of diffraction

MICROSCOPIE ELECTRONIQUE DES LAMES MINCES CRISTALLINES. By G. Saada. 324 pp. Masson, Paris, 1966. 76 F.

by L. Marton

A few months ago I had the pleasure of reviewing in these columns a book by P. B. Hirsch, A. Howie, R. B. Nicholson, D. W. Pashley and M. J. Whelan entitled *Electron Microscopy of Thin Crystals.* It is no accident that almost simultaneously another book appeared on the same subject by a French author.

For many years the electron microscope was an instrument used by practically no one but the biologists and sometimes the chemists. Gradually it was accepted by the metallurgists as a useful tool, but it was hard to convince any physicist that the electron microscope would be useful to the physicist. Maybe the explanation is that most of the phenomena in which the physicist is interested were somewhat below the resolving power achieved in the early microscopes, and that only the recent development of improved resolution of the microscope has made physics research accessible to the instrument. Whatever the cause may be, I am happy to report that the situation is very rapidly changing and the almost simultaneous appearance of these two books is a good sign of the acceptance of the electron microscope by the physicist.

I do not want to imply that the improved resolution of the electron microscope alone is responsible for this new development. The development of the dynamical theory of diffraction was one of the prime reasons why interpretation of the electron micrographs of crystalline matter became possible, and without interpretation, none of the experimental results would

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