BETTMANN ARCHIVE

DALTON

nificance in the history of chemistry, physics, meteorology and physiological optics, one must understand what was happening around him more than what he was doing. This is just where the value of this book lies.

In September of 1966 the Manchester Literary and Philosophical Society and the Manchester University Institute of Science and Technology joined in celebrating the bicentenary of Dalton's birth. They brought together some of the world's leading historians of science to discuss Dalton's work, and the papers presented form the substance of this volume. These papers contribute more than just a detailed historical analysis of Dalton's many activities.

It is apparent that in inviting the speakers, the organizing committee did not ask them to prepare papers on particular aspects of Dalton's life and work, but rather they appear to have asked the question "What comes to your mind when you think of Dalton?" The result is excellent. We are provided with the kind of insight into Dalton's time that every student of the history of science needs to have, and this collection of essays gives stature and relevance to a man whose scientific ideas in almost every detail have now been displaced and superseded. It is a book that should be widely read and will continue to be useful to students of the history of science for many years to come.

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Theory of X-Ray and Thermal Neutron Scattering by Real Crystals

By Mikhail A. Krivoglaz
(Trans. from Russian) 405 pp. Plenum, New York, 1969. $25.00

The complete theory of x-ray diffraction was first described by C. G. Darwin in 1914 in two papers that are remarkable for their comprehensiveness. The theory was rederived in a somewhat more elegant formalism by P. P. Ewald in three papers published in 1916–17. Over 20 years elapsed before amplification in the books written by Max von Laue in 1941, W. H. Zachariasen in 1945 and R. W. James, who wrote the most comprehensive exposition, including detailed discussions of various experimental tests carried out prior to his book's publication in 1948.

There are really two theories of x-ray diffraction, that is a kinematic theory that ignores possible interactions between the incident and diffracted beams and a dynamic theory that does not. Darwin showed how the kinematic formulation can be modified to include dynamic effects; Ewald concentrated on the dynamic theory, and Zachariasen showed how a single formalism could relate the two. The three books deal with the effects of thermal vibrations and other possible defects occurring in crystals.

The burgeoning interest in solid-state sciences during the second half of this century has focused increasingly more attention on the imperfections occurring in crystals and on x-ray methods (and to a lesser extent on neutron methods) for detecting and characterizing them. Although both relatively perfect and imperfect crystals are encountered in nature and in the laboratory, Mikhail Krivoglaz, in his book, uses "real" to denote crystals containing sufficient imperfections to allow him to concentrate on the kinematic theory. The basic relations in this formulation are developed in chapter 4, which also indicates that they are equally applicable to x rays and to thermal neutrons having wavelengths of the order of 0.1 nanometers. In this chapter Krivoglaz classifies defects into two groups, depending on whether they primarily reduce the intensities of sharp Bragg reflections or whether they also distort and displace them. The treatment here is brief; therefore the reader really should study one of the three books mentioned above before undertaking a critical reading of the rest of Krivoglaz's tome.

The first three chapters are devoted to developing a fluctuation theory for crystals and relating it to local fluctuations in composition, order parameters, atomic displacements, lattice constants and forces causing such fluctuations. This is done both for the macroscopic (continuum) and microscopic (lattice dynamics) versions of general-elasticity theory.

Chapters 5–7 then consider the interaction of x rays (or neutrons) with various kinds of defects. Specific equations are derived for a variety of defects ranging from fluctuations in long-range order, through dislocation lines and loops, to point defects, as they occur in solid solutions, ferroelectric crystals, near phase-transition points, and so forth. Krivoglaz deals with a rather large number of phenomena and clearly demonstrates the convenience and power of the fluctuation-theory approach. This is, of course, the author's personal imprint, for he has been actively developing this approach for the past 15 years. *In fact, this feature distinguishes the book from all others and makes it such a welcome addition to scientific literature.*

The last three chapters are grouped together as "Inelastic Scattering of X Rays and Thermal Neutrons in Crystals," and depict the interactions of x rays with phonons. Three short appendixes presenting specialized mathematical relations and a rather extensive bibliography round out the book. The original Russian text was published in 1967, and the English translation includes several insertions by Krivoglaz, updating its comprehensiveness.

In addition to prior familiarity with x-ray diffraction theory, the reader must have a good grounding in modern physics and in mathematics in order to follow the rather succinct developments. The necessary physics is adequately presented but not self-evident without mature reflection. One also may find it desirable to familiarize oneself with other treatments of many of the same topics in books of the current decade by W. A. Wooster, by André Guinier, by J. L. and M. Amorós, and by B. E. Warren.

The English translation is quite good and relatively free of idiomatic difficulties that often plague translators who are not intimately acquainted with the technical vernacular. There are only a few errors in an otherwise well produced book.

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Plasma Physics, Vol. 2

By J. L. Delcroix
188 pp. Wiley, New York, 1969. $9.95

Interest in ionized gases began originally in the 1920's with the study of electron discharges. It increased considerably with the efforts to design controlled thermonuclear reactors and, more recently, with the study of ionospheric phenomena.

Following his *Introduction to the Theory of Ionized Gases* (1959), J.L. Delcroix decided to treat his subject in greater depth. The first volume, of a planned three-volume treatise on plasma physics, appeared in 1963 and dealt with the relationship between hydrodynamics and kinetic theory; the third volume will deal with completely ionized gas. All three are based on a course by Delcroix, professor at the Faculty of Science of Paris University, Orsay.

This second volume treats weakly and moderately ionized gases. Their definition depends on whether or not the collision frequency of electrons among themselves, ν_{ee}, is small compared to the frequency with which the electron temperature relaxes toward that of the neutral molecules. These molecules are in turn very much smaller than ν_1, the frequency with which the electron velocity distribution relaxes towards isotropy. Even for the moderately ionized gas ν_{ee} is small compared to ν_1.

The book employs two methods of approach: one using the Boltzmann equation and the other a set of macroscopic equations. The former is applied to the two basic problems of determining electron motion caused by an electric field and that caused by diffusion. The macroscopic theory is, in principle, less exact and, to see how well it can be expected to work, it is applied to the same two problems. Subsequently it is used in more complex problems, such as ambipolar diffusion, positive-column plasmas and the phenomenon of volume recombination and attachment. In the appendix the author has collected some of the most important collision cross sections, with ample source references. Because it is intended as a textbook for students entering the plasma-research field, the book strongly emphasizes theoretical methods, which are presented clearly and concisely. The few applications treated are presented quite briefly and some areas, such as ionospheric physics, wave propagation and radiative transfer, are not touched upon at all.

The proofreading has not been as careful as one would like; the most confusing misprint is in the equation representing the assumption of congruence, where the symbol for velocity is replaced by that for collision frequency. However, the trivial mistakes do not impair the usefulness of this short monograph on theoretical methods of treating transport and other nonequilibrium processes in weakly ionized gases.

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Principles and Applications of Underwater Sound

Carl Eckart, *ed.*
295 pp. Department of the Navy, Washington, D. C., 1968. (Reprint of the National Defense Research Committee Report, 1946.)

This book was originally published as one of the reports summarizing the technical work done during World War II by division 6 of the National Defense Research Committee. This division was the largest scientific group in the US after the radar and atomic energy divisions. Its activities were closely correlated with similar work in Canada and the UK, principally through the leadership of the division chief, John T. Tate.

The nature of underwater-sound studies required that they be conducted at many locations throughout the world where proper oceanographic conditions existed. In Canada the work extended from Esquimaux, B. C., to Halifax, N. S., and in the UK from Portland on the English Channel to the laboratories on the land and sea locks in Scotland, especially at Fairlie on the Clyde and at the Firth of Forth. In the US important centers were at New London, Conn., Orlando, Fla., and at Point Loma, Calif. Because of the extremely critical demands to combat the German submarine menace, which continued throughout the war, the allied efforts were directed almost exclusively to practical development work and engineering projects. In all these activities however, it was essential to determine reliable scientific data on the acoustical properties of the ocean, the sea bottom, the surface waves and the many factors affecting echo-ranging gear, listening systems, antisubmarine torpedos and subsurface warfare tactics in general. This volume brings together a major part of these fundamental measurements that were made under the stress of wartime conditions. The measurements have been supplemented by more recent work done under less stringent conditions, but this book is primarily an unusually clear exposition of the war research. Carl Eckart, who spent this period at Point Loma, has edited this volume with great understanding and selectivity.

The book is chiefly concerned with the basic principles of underwater sound, including sound propagation in the sea and the oceanographic conditions that determine the transmission, refraction, echoing, scattering and reverberation of sound in the sea. The ocean considered as a medium for sound transmission could hardly be less favorable. In contrast to the almost ideal propagation conditions for radar in the atmosphere, the ocean is highly absorbing, and sound propagation is greatly complicated by surface noise, bottom reflections, volume reverberation and, above all, vertical-temperature gradients, which have a complex and rapidly changing character.

These temperature variations were almost unknown at the beginning of the war but because of the pioneering work of Columbus Iselin and his associates at Wood's Hole Oceanographic Institution and also of the staff at Scripps Institute of Oceanography in La Jolla, Calif., temperature gradients were recognized early as a crucial factor in operating all underwater-sound gear. Another complication was that sound channels, which arise from the temperature gradients and density variations in the ocean, often permit sonic signals to travel great distances, but they also introduce additional hazards that complicate the rapid use of underwater-sound equipment.

This book will be of real interest not only to those specifically concerned with underwater-sound applications for the Navy, but also to others who