metrodynamics, such as space and time, are familiar from everyday experience. This is surely one of the reasons why this theory has stimulated thought in circles far beyond the small group of active researchers. Lacking in the literature has been a book treating these recent developments in a manner suitable for this larger audience.

Graves's book considers general relativity from the point of view of the philosopher of science. In the first part of the book he criticizes and revises important past interpretations of the nature of reality and develops his own philosophical framework for the discussion of physical theories. He then turns to his main concern, the evolution of concepts of space and time which culminated in general relativity. He traces this development from the Greek philosophers to the modern ideas of the Princeton school. Nearly a third of the book is devoted to a discussion of the physics of general relativity.

Although the mathematics is kept at a minimum, this book is not a popularized textbook of geometrodynamics. It is, rather, a scholarly work which attempts some completeness in its description and criticism of the views and attitudes that various thinkers have held. Graves does not confine himself to the most recent or most popular versions of physical theories. Thus, many typical conceptual questions and difficulties that arise when one is first confronted with the ideas of general relativity are discussed in more detail than in many texts. This book gives a fair idea of the complexity of the subject, and does not use analogies or pictures for simplification. It is not easy reading, and for a complete understanding the reader should be familiar with differential geometry and with much of the philosophical literature. For a qualitative understanding of the main line of argument, however, the book is reasonably self-contained. In fact, the last third does not rely extensively on the earlier parts and could profitably be read separately as an introduction to the main ideas of geometrodynamics.

Graves is at his best where discussing the striking new ideas in general relativity and the objections and misconceptions they have generated. Here for the first time in a book accessible to philosophers and others is a description of some of the new developments since Einstein. A number of errors and awkward arguments do not detract significantly from the discussion. The book's weakest point is its abrupt ending and omission of some important issues. In particular, there is virtually no mention of recent work on the inevitability of gravitational collapse and singularities. It would be difficult to find a topic of more impact on philosophical ideas about space and time than these singularity theorems. Graves's survey of the literature seems to have stopped in 1965, and only Wheeler's foreword puts this issue in its proper perspective. Also on the philosophical front one would like to see the discussion carried to greater completion: after the detailed discussion of the physical facts of general relativity, their consequences for ontology are confined to a few pages in the epilogue.

In spite of these limitations this book is a valuable source of information. It goes further than anything written before in explaining general relativity to philosophers and philosophy of spacetime to physicists.

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Solid State Physics

Physics of Crystalline Dielectrics. I. S. ZHELUDEV. Translated from the Russian edition (Moscow, 1968) by Albin Tybulewicz. Vol. 1, Crystallography and Spontaneous Polarization. xxii pp. + pp. 1–336, illus., + index. Vol. 2, Electrical Properties. xx pp. + pp. 337–620, illus., + index. Plenum, New York, 1971. Each volume, $25; the set, $45.

The dust jackets of the English translation of Ivan Stepanovich Zheludev's book promise, "*Physics of Crystalline Dielectrics* is an invaluable source of current information for solid state physicists, electrical engineers, and materials scientists." Unfortunately, the dust jackets are incorrect—owing to delays in the publication of the Russian edition and the translation into English, this treatise is almost a decade out of date. Thus the work concentrates on crystallographic structure and the phenomenological description of dielectrics; there is no reference to the neutron- or light-scattering experiments of the late '60's or to lattice-dynamical theories appreciably more recent than W. Cochran's and P. W. Anderson's papers on soft modes. Furthermore, the overpriced two-volume English translation omits the final 10 percent of what was a single Russian volume.

For those readers who do not require the most current information, Zheludev's 1964 review will, however, provide an enjoyable survey of the physics of ferroelectric, antiferroelectric, and pyroelectric materials. Only the first chapter of volume 1 may be difficult for a first-year graduate student—its discussions of symmetry, crystallography, and group properties are marred by the use of Shubnikov notation, some typographical errors, and an occasionally imprecise translation of the Russian. To some extent, the difficulties a novice might encounter with the Russian Shubnikov notation are alleviated by a fold-out dictionary which gives the equivalent Schoenflies and international notations for point groups. Still, chapter 1 is best read with pencil in hand, and the many tables should be examined carefully.

The central portion of the first volume consists primarily of equationless descriptions of the structures of oxygen-octahedral, hydrogen-bonded, and hindered-rotation ferroelectrics and antiferroelectrics. These sections are presented in a catalog-like style, with many figures and graphs included.

The last two chapters of volume 1 (on the pyroelectric effect and the theory of spontaneous polarization) are more quantitative than the rest of the volume, and might have been more at home in the second volume, along with material on relaxation, conduction, and piezoelectricity. All of these more quantitative chapters imitate the down-to-earth style of Charles Kittel's *Introduction to Solid State Physics*, while presuming only a knowledge of differential equations and some matrix algebra.

The overall impression the book leaves is that it is an encyclopedia of dielectrics which emphasizes facts more than understanding but illustrates the facts with many well-chosen figures, graphs, and tables. Like an encyclopedia, *Physics of Crystalline Dielectrics* is quite useful even though the information in it is not current; libraries that serve solid state laboratories should definitely obtain copies of it. Those researchers who expect to refer to it often, and who can afford the price, may wish to purchase both volumes; readers with a more casual interest in dielectrics will enjoy reading a library copy.

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