

to the genetic material, in which much more research is called for on the long-term effects on tissue produced by frequent small doses of X-rays and other forms of radiation usually assumed to be safe.

The author of the next chapter, Prof. Tracy M. Sonneborn, professor of zoology in Indiana University, discovered a mating reaction associated with the conjugation of *Paramecium*, which culminated in the establishment of the concept of the plasmagene in cytoplasm, and he writes that "The ultimate task will be to reunite the nuclear and cytoplasmic components of the genetic system in an integrated, interreactive conception of the genetic system of the cell and the study of the function of each in the work of the whole". Dr. R. W. G. Wyckoff has a chapter on the structure of crystals, and his work is illustrated with some remarkable electron-microphotographs of virus crystals, in which the actual molecules may be seen. Carl D. Anderson, the discoverer of the positron, sums up the present position with regard to our knowledge of the elementary particles of physics, and Farrington Daniels, of the University of Wisconsin, reviews the possibilities of the future use of atomic and solar energy; no less than fifty fields of research in the utilization of the sun's energy are listed.

Pure mathematics has been given consideration in a section by Emil Artin, of Princeton University, in which the theory of braids is worked out by combining topology and the theory of groups. Finally, there are important chapters on the fauna of Latin America by George Gaylord Simpson, and on the physical chemistry of polymers by Raymond M. Fuoss. Each chapter is well documented.

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PROGRESS IN THE STUDY OF REAL CRYSTALS

Institut International de Physique Solvay
Neuvième Conseil de Physique tenu à l'Université
Libre de Bruxelles du 25 au 29 septembre 1951.
L'État solide: Rapports et discussions. Pp. 577.
(Bruxelles: R. Stoops, 1952.) 650 francs.

THE scientific committee of the Institut International de Physique Solvay convenes periodically a conference at which problems of some branch of physics are reviewed. The reader learns from the table of contents or from an aside on p. 167 that the main theme of this conference report on the solid state is that of imperfections and transformations, and principally the former. The book is a collection of papers, with discussions, and the majority deal specifically with studies of metals, although most problems treated have a wider application. Some of the papers review an aspect generally, but most describe particular developments with which the authors have been personally associated. Much of the subject-matter has, of course, been published already, and indeed, as is perhaps inevitable in a field in which such rapid developments are occurring, has also been discussed at recent conferences of similar scope. There is, however, some new work of interest to the specialist, and although its nature makes it rather disjointed, the book is to be recommended to a wider circle as an authoritative account of the state of development at September 1951 of the topics discussed.

The book begins with a fascinating paper by C. S. Smith describing the recent work on grain boundaries which has been stimulated by comparing the polycrystalline solid with a soap froth. There are three other papers concerned directly with grain boundaries and their properties. W. G. Burgers, discussing recrystallization, gives a comprehensive review of new data and ideas which have appeared since 1940 and includes a survey of new techniques for studying structural changes. G. W. Rathenau describes the application of one of these—electron emission microscopy—to the direct study of grain-boundary migration in metals at high temperatures. Calculations on the energy of grain boundaries using the dislocation model are reported by W. Shockley.

There are five papers about transformations. E. Rudberg reviews recent Swedish work, and this is supplemented later by a brief note from G. Borelius. Age-hardening and the order-disorder transformation are treated by W. Köster and A. Guinier, while C. Crussard describes his theory of the interference of thermal waves and its applications. Lattice vibrations are also discussed in J. Laval's detailed account of his theoretical work on the elastic properties of a perfect crystal in which the interatomic forces are not central.

The remaining papers are all concerned directly with the theory of dislocations. E. Orowan discusses the dynamics of slip and examines critically some of the fundamental hypotheses of this theory. There are articles by F. C. Frank on crystal growth, F. Seitz on the generation of vacancies by moving dislocations, and A. H. Cottrell on the yield-point in iron. N. F. Mott discusses current ideas on work-hardening, recovery and creep, and there is a short note from U. Dehlinger.

The dislocation theory has made great strides since the Second World War. At the time of the Bristol Conference in 1947, perhaps the most convincing parts of the theory were the explanations it afforded of the influence of traces of impurity on mechanical properties (atmosphere theory), and of the phenomenon of polygonization. Since that time the observation of spiral steps on the surfaces of growing crystals has provided direct evidence for the existence of dislocations. Also, the actual propagation of slip lines across the surface of a specimen has been studied with the high-speed camera. At the same time, it is now possible to understand how slow-moving dislocations can multiply. Already, important new evidence of the co-operative movement of dislocation arrays, predicted and referred to briefly in the paper of W. Shockley at this conference, is available in the experiments of Washburn and Parker, while the comparison of absolute grain-boundary energies for small angular disorientations with the predictions of the dislocation theory appears to make possible the first quantitative test of this theory. Much of the theory remains, however, frankly speculative, and, as E. Orowan emphasizes, the need for experimental support for its foundations is acute. There is some ground for confidence, however, that this will be increasingly forthcoming in the near future.

Despite its title, English-speaking readers will be glad to know that some three-quarters of the book is in their language. It is perhaps unkind to comment on the numerous errors of editing which result; but it is impossible to refrain from quoting the apposite heading of "Creed and Polygonisation".

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