degree. Yesteryear's uncrossed frontiers between the living and inert are seen to be intellectual expedients which are now outgrown. Our question remains that of the Ionians: In what common terms can we make unified sense of the whole architecture of the material world? Our answer is more satisfying, however, for the progress of the 20th-century matter-theory gives hope that a common system of fundamental concepts can embrace material systems at every level of organization.

The authors have set themselves an awesome goal, and their steps towards it are impressive. The treatment of technical material is on the whole accurate and penetrating, at least in the specialties in which the reviewer has claim to any background. In less familiar regions, I find that the treatment often strikingly elucidates matters obscured by less skillful expositors. The style is exciting and flowing, and the reader finishes a chapter with a sense of anticipation rather than relief.

Of criticisms I have two. The first is minor: The historical treatment, though literally accurate, sometimes makes for unwarranted inference—for example, the work of Rutherford and Bohr on the planetary atom is described with four references to Cambridge's Cavendish Laboratory, and with none to the University of Manchester. Yet it was at the latter that Rutherford and his pupils from 1907 through 1919 performed the alpha-scattering experiments, postulated the Bohr-Rutherford model, and first transmuted a nucleus!

The second is not so minor: A reader unfamiliar with the current biological literature would gather that the notion of a common set of concepts embracing systems at every level is universally accepted. But an important segment of responsible scientists still holds that the extensive degree of organization in living material as compared with that in nonliving material constitutes a qualitative difference between the two. Perhaps this neovitalism deserves its day in court.

This pair of talented authors, trained initially in science and then turned to the humanities, have brought an exemplary contribution to understanding and appreciation between fields of intellectual activity. Here is general education at its best.

Fifty Years of X-Ray Diffraction. Internat'l Union of Crystallography Commemoration Meeting (Munich, July 1962). P. P. Ewald, ed. 720 pp. Oosthoek Publishing Co., Utrecht, The Netherlands, 1962. $11.25. *Reviewed by Malcolm Barlow, Stanford Research Institute.*

MAX VON LAUE'S discovery of x-ray diffraction by crystals was made at the Ludwig Maximilian University of Munich, and it was in Munich, in July 1962, that scientists celebrated the fiftieth anniversary of this event. This volume, written to commemorate the occasion, looks back on von Laue's discovery, and aims to cover the development of x-ray diffraction over the past five decades.

The historical background to the discovery of x-ray diffraction is described in the initial chapters of the book. The knowledge of x rays and theories of crystal structure up to the time of von Laue's discovery are clearly stated, and Professor Ewald vividly relates how von Laue first conceived, and then experimentally verified the idea that crystals irradiated with x rays might give rise to interference phenomena. The work of W. H. Bragg and W. L. Bragg, and their development of crystal-structure analysis is then described, and this leads to a new chapter dealing with the principles of x-ray diffraction. The presentation of material up to this point is excellent, but unfortunately this standard is not maintained throughout the book.

In the next seventeen pages the various problems and methods of crystal-structure analysis are reviewed; however, some important aspects are not covered adequately. For example, the problem of phase determination is dealt with only briefly, and little mention is made, either here or elsewhere, of new methods such as direct, image-seeking, and superposition techniques.

Well-known workers in the field of x-ray diffraction then review topics such as the growing power of x-ray analysis, organic and inorganic structures, the impact of x-ray diffraction on physics, and x-ray spectroscopy. A short account of the dynamical theory of x-ray diffraction, extended to cover electron and neutron diffraction, completes the first part of the book.

The next part of the book consists of a fine collection of biographical essays of famous crystallographers. These are written informally, and the biographies of Max von Laue, W. H. Bragg, Charles Mauguin, and

Max von Laue

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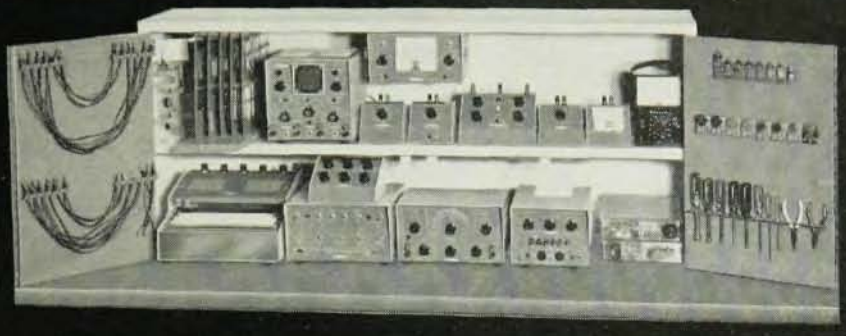

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E. S. Federov are especially interesting. An account of the development and growth of the main x-ray schools is included in this collection. Personal reminiscences of 34 crystallographers conclude this volume.

To sum up, this volume will not be of great value either as a textbook or reference book; nevertheless, it still makes an interesting contribution to the existing literature on x-ray diffraction, and many scientists will benefit from reading it.

The Professor and the Prime Minister. The Official Life of Professor F. A. Lindemann, Viscount Cherwell. By Frederick, second Earl of Birkenhead. 399 pp. Riverside Press, Cambridge, and Houghton Mifflin, Boston, 1962. $5.95. *Reviewed by R. P. Hudson, National Bureau of Standards, Washington, D. C.*

BECAUSE of the many contradictory facets of his character, his distinguished career, and direct influence on the course of World War II in his position as scientific adviser to Winston Churchill, Frederick Lindemann would inevitably be a fascinating biographical subject, even without the well-publicized attack by C. P. Snow in the Harvard Godkin Lectures of 1960, wherein Lindemann was held up as a dreadful example of the dangers of placing a scientist in a position of power among nonscientists.

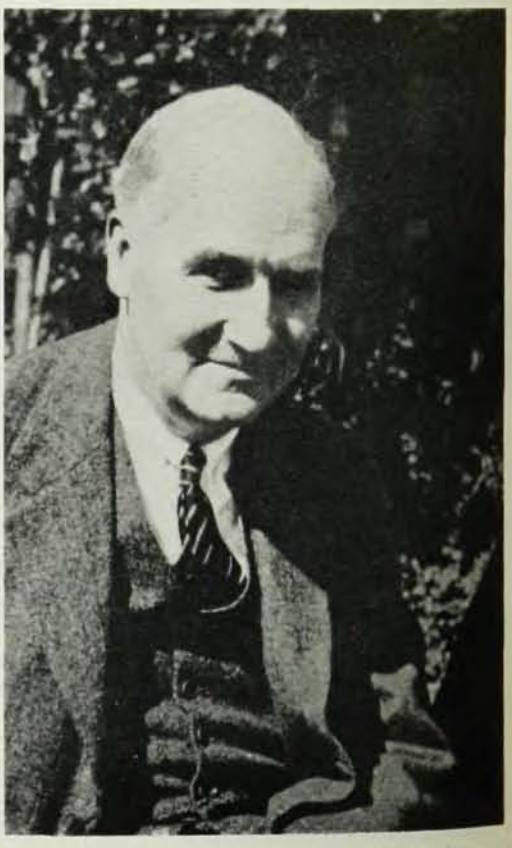
Lindemann was undoubtedly a most complex character on the surface; a man who both inevitably and evitably inspired controversy; a consultant on matters of enormous consequence whose judgment did not always match his eminence. But this book leaves as many questions unanswered as it purports to answer. Lindemann's reputation as a brilliant young physicist is a far from complete explanation of his double triumph in 1919, at the age of 35, of election to the Chair of Experimental Philosophy in Oxford and to fellowship in the Royal Society—honors seldom bestowed without powerful and energetic advocacy. Nor are we told why he should have been attracted by the "sorry legacy" of the old Clarendon Laboratory, constructed in (and moribund since) 1872 in a university where scientists were largely either derided or ignored. The gaining of entrée by this "outsider" into the aristocratic circles, whence stemmed his eventual career, is alone a biographical gem, but this story is left to our imagination.

As the "official life" and written by a close personal friend, it tends, of course, to side with the subject when the latter's reputation is at stake. But Birkenhead fails, I believe, to dispose of the criticism leveled by Lindemann's "enemies" that personally he made disappointingly small contributions to science after assuming the Chair, though the author devotes many pages to this topic. And what *did* occasion Lindemann's sudden and enduring animosity to his good friend Tizard, and was his disruptive behavior in the "Tizard Committee" conditioned solely by this hostility?

To some he presented a picture of charm, generosity, sardonic wit, and towering intellect; to others—arrogance, infantile spite, cynicism, and crankiness. The author ranges over the whole canvas but somehow the picture remains blurred. For thirty years, including the embattled war and post-war years, he was Winston Churchill's confidant and technical adviser; at different times in his career he had been a rising light in the new dawn of physics, an outstanding amateur tennis player, Oxford professor, and politician; yet he remained a shadow before the British public.

The rejuvenation of physics in Oxford did not hit its stride until the mid-thirties when there arrived from Germany the refugee scientists whom Lindemann had invited and personally helped to settle. By 1939, with the opening of the new Clarendon Laboratory, a notable advance had been made from the tragicomic situation obtaining in 1919. Granting the appalling difficulties and hostility encountered (more clearly detailed in Harrod's generally less substantial book), the contemporary leisurely pace of science, and with the public purse as yet withheld, one should not leap to belittle this administrative achievement for consuming Lindemann's twenty most precious years.

In his wartime post, his triumphs, failures, and even routine activities must have had enormous consequences, but the author does not analyze this in any depth. As with Snow's book, this period of Lindemann's life is presented by Birkenhead largely within the framework of his continuing conflict with Tizard. The



F. A. Lindemann