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to illustrate the two main classes of unified field theories by examples which are fully discussed. Projective (5-dimensional) theories are represented by the theory of Jordan as modified by Thiry, while affine theories are represented by the most recent works of Einstein and Schrödinger. A very elegant discussion is first given of variational methods in the relativistic domain, and the basic equations in each case are set up in variational form. Both theories are discussed extensively with reference to the Cauchy problem, the consistency conditions and the conservation laws. In addition the affine theory is prefaced by a mathematical discussion of affine connections.

This book will not only be extremely valuable to anyone who wishes to acquire a thorough grasp of mathematical relativity, but the first portion may also be read with profit by anyone interested in mathematical physics, both from the esthetic and practical viewpoints.

Electrons, Atoms, Metals and Alloys (Revised Edition). By William Hume-Rothery, 387 pp. (Iliffe and Sons, London) Philosophical Library, New York, 1955. \$10.00. Reviewed by C. S. Barrett, *Institute for the Study of Metals, University of Chicago*.

Hume-Rothery wrote this book to appeal to the practicing metallurgist who wants to know about modern concepts of atomic structure and the relations that have been found between atomic structure and alloy structure. The book covers about the same ground as his earlier *Atomic Theory for Students of Metallurgy*, which was written for university students, but the treatment is entirely different from the earlier book. Having found that industrial metallurgists regarded his earlier book largely unintelligible, he set out to write one that could be read "with enjoyment, without hard work", and in "small doses". He decided to adopt a dialogue style, in which the Young Scientist explains things to the Older Metallurgist. He does not use the dialogue to introduce wit and humor—save for a delightful discussion of the Heisenberg uncertainty principle—but nevertheless makes good use of it to emphasize important principles, to review what is said in earlier chapters, and to clarify unfamiliar and confusing ideas.

There are some 75 pages on the hydrogen atom and the fundamental concepts of wave mechanics before one comes to a discussion of any of the metallic elements, and 75 more pages of atomic structure before one comes to anything on crystal structures. One cannot quarrel with the desirability and logic of this sequence, but the author is a bit optimistic if he thinks there are many older industrial metallurgists in this country who will take the time to go through all of this portion of the book carefully as a preliminary to reading the section dealing with theories of solid solutions, intermediate phases, electron compounds, and superlattices. British older metallurgists, I suspect, are better prepared for this, in education and temperament,

than those of the U. S. A. and Canada. There are, nevertheless, many physicists and chemists who should find the book an unusually readable review of basic alloy theory and basic principles of atomic physics. Nuclear physics is discussed in brief, and plastic deformation of metals is given a few pages.

There are no mathematical derivations or detailed discussion of theories, but much effort is given, on the other hand, to explanations of what the theories are about and why they are important. Jones' theory of alloy phases is given considerable emphasis, as in all of Hume-Rothery's books.

The concluding chapter of the book points out the need for more science in metallurgy in the future and is a rousing plea for more fundamental science courses and less technological courses in the training of metallurgists in universities, together with a plea for the metallurgical industry to hire more scientifically trained men than in the past. The average man entering the chemical industry, it is emphasized, has a much wider knowledge of the science of his subject and a smaller knowledge of technology than the average man entering the metallurgical industry—and this fact has contributed to the enormous progress of the chemical industry in the last fifty years. This chapter was written in 1947 and was based on conditions in Britain as the author saw them at that time. There has been a gradual change since that time in the direction that is urged, in curricula, in the type of research problems undertaken in the metallurgical departments of several British universities, and in the use of scientifically trained men in metallurgical industry. Nevertheless, changes in this direction have been slow, both in Britain and on this side of the Atlantic, and the chapter has a message that is still of value.

Variational Principles in Dynamics and Quantum Theory. By Wolfgang Yourgrau and Stanley Mandelstam. 155 pp. Pitman Publishing Corporation, New York, 1955. \$5.50. *Reviewed by Arthur Beiser, New York University.*

The variational principles of dynamics, which assert that a certain quantity (generally an integral of motion) be an extremum along the actual path, are intuitively appealing and have played an important part in the formulation of this subject. An account of their long (since 600 B. C. or so) and colorful history, together with an exposition of their present status, is contained in this book. The formal development of such topics as transformation theory and the Hamilton-Jacobi equation is conventional, but the historical and philosophical discussions make interesting reading.

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