

Books

Titanium. No. 4 of *Metallurgy of the Rarer Metals*. By A. D. McQuillan and M. K. McQuillan. 466 pp. (Butterworths, England) Academic Press Inc., New York, 1956. \$10.00. Reviewed by J. G. Castle, Jr., *Westinghouse Research Laboratories*.

The McQuillans begin with the fascinating story of producing and working titanium. After an excusably brief, but quite thorough treatment of the physical, thermal, and electrical properties of pure titanium metal, they devote the middle half of the book to the alloying of titanium by presenting the constitutional diagrams for many binary systems and the results of phase transformation studies of a number of titanium-rich alloys. Next the mechanical properties of titanium and titanium-rich alloys are well described. The final chapters cover the chemical properties of titanium insofar as gas-reactions and corrosion effects are concerned, with a 10-page finale on preparation technique for metallographic specimens.

Much of the information is first hand for the authors. And they have put together a pleasant mixture of industrial technology and laboratory materials studies, with emphasis throughout on the "basic properties of titanium metal and its alloys" and support by extensive references to original works.

Their presentation should serve ably both as a needed collection for today and a lasting record of reference information on titanium. In this opinion, there is agreement from M. A. Hunter, *Science* 123 1085 (1956).

Visible and Near-Visible Light. Vol. III of *Radiation Biology*. Edited by Alexander Hollaender. 765 pp. McGraw-Hill Book Co., Inc., New York, 1956. \$10.00. Reviewed by Joseph G. Hoffman, *Roswell Park Memorial Institute*.

Fifteen chapters by twenty-one authors make this a valuable review of photobiology. The first three chapters discuss physics, and the remaining twelve chapters present a comprehensive account of how living matter responds to light. I know of no other text that pulls together from the widely scattered literature such an array of facts and figures bearing on this single subject. It is a fitting third and concluding volume to the monumental series called *Radiation Biology*.

The editor's prefatory statement that the basic information in this volume is of greatest importance deserves emphasis. Biologists and chemists will find in it valuable material, and biophysicists, especially, will come to

regard it an essential source book. For example, the first three chapters are entitled: "Energy Exchange in Photoreactions", "Electronic Structure and Excitation of Polyenes and Porphyrins", and "Generation, Control, and Measurement of Visible and Near-visible Radiant Energy". They comprise an excellent discussion of the theory and practice of radiation measurements in and about the optical range.

Following the physical fundamentals, there are four chapters on photosynthesis and chlorophyll. Titles indicate the coverage: "Energy Efficiency in Photosynthesis", "The Mechanism of Photosynthesis", "The Absorption, Action and Fluorescence Spectra of Photosynthetic Pigments in Living Cells and Solutions", and "Chlorophyll Formation and Accumulation in Plants". These constitute a review of the basic material about photosynthesis, but they also contain much fascinating subject matter for the general reader.

The remaining eight chapters describe more special aspects of photobiology, some of which will deservedly become more widely known through this book. Chapter titles are: "Nitrate Reduction", "Phototropism", "Photoperiodism". In the one about "Seed Germination" are typical examples of factual material having a bearing on our understanding of living processes. Tobacco seeds, for example, are so sensitive to light that 0.01 sec. exposure to sunlight, or 15 min. of strong moonlight, stimulates germination. And in the chapter on "Viscosity, Permeability, and Protoplasmic Streaming" the change of electrostatic potential of illuminated plant parts relative to the nonilluminated parts is a story too long to recount here. There is also the remarkable story about how light starts streaming of protoplasm in cells. These brief allusions are inadequate to indicate the wealth of experimental data presented. The last three chapters are equally exciting. They are: "Electrical Phenomena in Vision", "Invertebrate Photoreceptors", and "Photodynamic Action and Its Pathological Effects". The volume is a must for the library of most basic scientists. It has author and subject indices, is thoroughly documented, and generously illustrated.

The Direction of Time. By Hans Reichenbach. Edited by Maria Reichenbach. 280 pp. The U. of California Press, Berkeley and Los Angeles, Calif., 1956. \$5.50. Reviewed by P. Morrison, *Cornell University*.

The most general and powerful branch of physics has always seemed to me to be thermodynamics. This is to be taken in its broadest terms: now it appears as the allegory of quantum statistics, again as the modern avatar, the theory of information. But always it remains the discipline through which the nature of being and becoming, of process and state, of knowledge and chaos are to be explained. If ever physics became natural philosophy, it was when Boltzmann, Gibbs, Ehrenfest, Tolman took up the mantles of the Abderan and the Peripatetic. In this book is yet another proof of this view.

Fancy talk, that. But it is inspired by a kind of

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By L. B. ARGUIMBAU, with transistor contributions by RICHARD BROOKS ADLER, The Massachusetts Institute of Technology. 1956. 646 pages. \$10.25.

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delight in reading this posthumous work of Professor Reichenbach. For a generation Professor Reichenbach has worked as almost no other man to bring to the interpretation of modern physics the critical and reflective thinking of a trained philosopher. Most physicists who retain an interest in philosophy, and many who wanted simply to understand physics, have read some of the earlier books of Reichenbach. This one is for me the best by a good deal. That is a physicist's judgment, and will find contradiction in reviews of philosophers. For here the author has laid down the careful analytical scalpel of the philosopher, so interested in exposing to the naked eye the flabbiness of the most commonplace structures. He has put in its place a powerful microscope, maybe even a spectrophotometer, and is finding rich content and new insight in ideas of the most widespread applicability. Here his somewhat too cold and careful positivism has been at last transformed into the fruitful opportunism in philosophy so dear to theoretical physicists.

The book's argument is too many-sided to summarize. It begins with an attractive account of the qualitative properties of time. Here we find a discussion of the causal chain and its open topology: no distant effect becomes the cause of its own remote cause. There are no loops in the causal net. Intervention (dear to the fiction writer) into the past is shown up as tautology. Then the statistical nature of the direction of time enters, and as far as our present knowledge now goes (and excluding a future cosmology of the whole), the direction of time is found to be "the direction in which most thermodynamical processes in isolated systems occur". This conclusion, which seems to me convincing, is squared in a very helpful way with Boltzmann's notions of the fluctuating entropy of the whole universe, and with a number of other familiar paradoxes of general statistical mechanics.

The next big section of the work, even more congenial to a physicist, is an account of time and "macro-statistics". The last term is the rubric under which one finds what is fashionably called information theory, here reduced to its proper status as a special case of the science of Gibbs and Boltzmann. In this section instruments and knowledge are closely discussed, in their bearing on the difference of past and future. The degree to which the philosopher here put on working clothes will be made clear by the fact that Fig. 29 is no logical diagram or even an entropy curve, but a pseudorealistic set of gears and cams representing a memory built of reversible elements, and all but bearing the label "Made in Copenhagen".

The last brief section is the most novel, the hardest, and perhaps the least well worked out. It touches upon the importance of quantum mechanics for all the above, and then proceeds to a discussion of the meaning of a particle. As a legitimate descendant of all the philosophy of becoming, it is the best quantum treatment of why one *can* step twice into the same river. The modification of the formulation of Bose and Fermi statistics is ingenious, but not yet satisfying. The book ends com-

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plete, though not quite finished (for a chapter on subjective time was lost to us through the untimely death of the author) on a properly anguished account of the Stückelberg-Feynman electronics, traveling backward in time. What this means, if it means anything clear, and what fundamental particle theory has still to say, are unanswered in the book—and everywhere.

The publishers have dressed this fine book in an unusually handsome binding and over-all design. But with an unworthy and un-Californian parsimony, they have spoiled the effect by composing the text in a legible, modern, and ugly substitute for letterpress.

The Laws of Nature. By R. E. Peierls. 284 pp. Charles Scribner's Sons, New York, 1956. \$4.50. *Reviewed by Ira M. Freeman, Rutgers University.*

Communication and free exchange of information are the life blood of science, as every practicing scientist realizes. A few have seen the necessity and felt the responsibility for extending this precept to include communication of the results of their work to the public.

None but those who have seriously tried it can truly appreciate the fact that interpreting science is painfully hard work, performed against tremendous odds. Unlike the popularizer, the scientist expounding his results to other specialists is armed with the beautiful weapon of technical vocabulary, carefully fashioned to suit his purposes. In the exact sciences he is, in addition, the possessor of the most wonderful piece in the whole communications armory: the gleaming sword of mathematical analysis.

In the book under review, Professor Peierls attempts to convey to the nontechnical reader something of the spirit and accomplishments of modern physics. Since the author has been so eminently successful in his more technical expositions (see, for instance, *Quantum Theory of Solids*, reviewed in this journal, Vol. 9, No. 5, May, 1956) I expected his excursion into the field of public education in science to be of comparable excellence. Regrettably, this promise has not been fulfilled in *The Laws of Nature*.

The main reason for this, I think, is a common enough failing among those who would interpret science to the uninitiated: they give in to the temptation to tell *all*! Dr. Peierls' book ranges over the whole of classical and modern physics, describing not only facts and theories but indulging in considerable philosophical and critical discussion as well.

The chapter headings are Motion and Force; Electricity and Magnetism; Light; Atoms and Electrons; Atoms in Crowds; Relativity; Quanta, Waves and Particles; The Behaviour of Atoms; Electrons at High Speed; The Atomic Nucleus; Mesons and other New Particles.

The text is not without its felicitous phrases and apt analogies but they hardly suffice to take the curse off the more numerous passages where the going is heavy. And there are a few rough spots that could easily have been avoided. For example, in several places the ex-