BOOK REVIEWS

Physics and Archaeology. By M. J. Aitken. 181 pp. Interscience Publishers, Inc., New York, 1961. $6.00. *Reviewed by P. Morrison, Cornell University.*

THEY do these things so well in Britain! Dr. Aitken, of the Oxford Research Laboratory for Archaeology and the History of Art, has produced a little nugget of a monograph on the uses of physical methods in summoning and in interpreting the eloquent testimony of the spade. The spade remains the key witness, but in finding hopeful spots to dig, in exploring the general layout of known sites, in giving absolute dates to the finds, and in delicate and nondestructive analysis of the chemical composition of what is found, a whole arsenal of aids from modern (and classical) physics is now at hand.

In this book, the widest variety of these methods is described. A brief mention, with a valuable and up-to-date set of references, is given to the older methods, from aerial photography to bosing (thumping the ground with a heavy rammer and listening). The heart of the book is a detailed account of the use of the proton magnetometer for field surveys of magnetic intensity and gradient, and of various laboratory magnetometers for the measurement of the weak remanent magnetism of fired clays. A briefer, but still rather detailed account of field-resistivity surveys, and a careful discussion of radiocarbon dating, stressing not the instrumentation but the nature and limitations of the method, also appear. In a final chapter, a variety of modern methods of analysis which have found archaeological application is sketched clearly and helpfully. (The coroner's verdict on the death of Eric XIV of Sweden has been rendered, four hundred years late, by the finding of mercury traces in his remains through neutron activation of a gamma-ray spectrum.)

Field-magnetic surveys are discussed in terms of the ten-microgauss sensitivity of a neat little transistorized proton magnetometer (with a cycle-counting circuit, it can measure the resonant frequency of water, distilled under nitrogen, and contained in a half-pint polyethylene bottle). It is not archaeological iron which these surveys seek; indeed, "the sensitivity to iron is inconveniently high" and mostly turns up "iron litter from the present intensive phase of the Iron Age". The original plan was to seek the ton or so of undisturbed, burnt clay in buried kilns of Roman Britain. In these green-gray, reduced clays, the remanent ferrimagnetism of magnetite is detectable under several meters of overburden as a frequency shift of a part in a thousand. More remarkably, mere filled-in pits and ditches (without any deliberately burnt clays, but simply soil anciently backfilled into an undisturbed substrate) are also detectable. Such backfill contains an enhanced content of the oxide maghenite (γ-Fe_2O_3), apparently produced from the common, weakly magnetic α-Fe_2O_3 (hematite) by the action of organic matter.

Magnetic dating by the measurement of the field direction and intensity induced in ancient ceramics at firing is also described, with plots of the earth's field intensity dating back to B.C. The Japanese have gone much farther. This work is essentially the study of hyperfine structure of paleomagnetic rock, and provides one example of many repayments which have been made by archaeology and art history to physics.

A neat account is given of de Vries' work on the fine structure of C^{14} activity in past time; with its recent extensions, this reveals fluctuations of as much as two percent trough-to-peak in a century. Whether magnetic influences on cosmic rays, solar flares, or climatic effects on mixing with ocean waters are responsible is unclear, but here a limit on radiocarbon-dating accuracy seems to appear.

The specialists in the field (if there are any) and those working in geomagnetism, radiogeochemistry, and the like, are sure to read this book and find it an indispensible aid; what I plead here is that many others, especially undergraduate students, be brought to know this book. Its fresh and novel set of problems, first-rate and varied concepts and approximations, and unexpected data, like the susceptibility of limestone, are all bound to expand the horizons of any student of physics. Dr. Aitken's wary guide to field work (don't dig on a cricket pitch, and don't measure with dampened string) will also do much toward training in that activity, whatever the techniques used. And in what other book will you see a handsome, decorated, Chinese porcelain bowl inside a large set of Helmholtz coils?

Thermodynamics: With Quantum Statistical Illustrations. By P. T. Landsberg. Vol. 2 of Monographs in Statistical Physics and Thermodynamics, edited by I. Prigogine. 499 pp. Interscience Publishers, Inc., New York, 1961. $14.50. *Reviewed by Stuart A. Rice, University of Chicago.*

MORE so than with many other branches of physics, the conceptual basis of thermodynamics has been continuously refined during the past century. I think there is general agreement that two of the high points in reformulation are Carathéodory's theorem and Born's interpretation and discussion of the modern definition of heat. Landsberg's book is written entirely within the spirit of these contributions. It is an analysis of the logical foundations of thermodynamics (with

Italian Physical Society—Proceedings of the
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Director: P. CALDIROLA, *Istituto di Fisica dell'Università, Milan*
January 1962, 241 pp., *approx.* $7.50

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Spring 1962

Physicomathematical Aspects of Biology
Director: N. RASHEWSKY, *University of Chicago*
Spring 1962

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Director: A. GOZZINI, *Istituto di Fisica dell'Università, Pisa*
Spring 1962

Physics of Solids (Radiation Damage in Solids)
Director: D. S. BILLINGTON, *Oak Ridge National Laboratory*
Spring 1962

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METHODS OF EXPERIMENTAL PHYSICS

Editor-in-Chief: L. MARTON, *National Bureau of Standards, Washington, D. C.*

Volume 3. **MOLECULAR PHYSICS**
Edited by DUDLEY WILLIAMS, *Ohio State University*
January 1962, *about* 750 pp.

This volume concentrates on general experimental methods employed to determine the sizes and shapes, the electric and magnetic properties, the internal energy levels, and the ionization and dissociation energies of molecules. Attention has been given mainly to stable molecules (i.e., atomic groups which maintain their identity under normal laboratory conditions) of relatively small size.

Volume 5. **NUCLEAR PHYSICS** ***(in two parts)***
Edited by LUKE C. L. YUAN, *Brookhaven National Laboratory, and* CHIEN-SHIUNG WU, *Columbia University*
VOLUME 5A, *November* 1961, 733 pp., $18.00 VOLUME 5B, 1962, *in preparation*

In this work, comprehensive information is given on measurement in both high energy and low energy nuclear physics. Methods for the measurement of each particular physical quantity are grouped together in order to facilitate their evaluation for feasibility, accuracies attainable, and limitations of their application under specific conditions. Attention is given to the necessary corrections involved in the conversion of experimental data.

Previously published:

Volume 1. **CLASSICAL METHODS**
Edited by IMMANUEL ESTERMANN
1959, 596 pp., $12.80

Volume 6. **SOLID STATE PHYSICS** ***(in two parts)***
Edited by K. LARK-HOROVITZ *and* VIVIAN A. JOHNSON
VOLUME 6A, 1959, 466 pp., $11.80
VOLUME 6B, 1959, 416 pp., $11.00

Lectures on
FIELD THEORY AND THE MANY-BODY PROBLEM

Edited by E. R. CAIANIELLO, *Istituto di Fisica Teorica, Università di Napoli*
1961, 327 pp., $9.50

These lectures were given at the First International Spring School of Physics, held at the University of Naples. The participating lecturers are among the world leaders in their fields. Their published lectures form an authoritative account of this important field.

ACADEMIC PRESS, New York and London

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some statistical connections) based, in part, upon the topology of thermodynamic phase space. The arguments are clearly put and examples are plentiful. The book is hard to read, but the reward is worthy of the effort.

In reviewing a work of this type, it is difficult to praise or criticize isolated points. Nevertheless, I think the author should be commended for the inclusion of such interesting sidelights as entropy in its information-theory context and nonblack-body radiation. The tenor of the text would not have been impaired, however, if a few more physical comments had been made explicitly rather than implicitly, e.g., that the sign of the temperature function is chosen by the criterion that dissipation of mechanical energy produces positive (or zero) change in the temperature in a suitably enclosed system. A discussion of temperature statistically in terms of the central limit theorem (see Bergmann, *Heat and Quanta*) would have been desirable and still within the spirit of the text. These are minor criticisms of an excellent book.

Landsberg's book is not intended as a first exposure to thermodynamics and probably not even suitable as a second. Despite this, a good student will gain much by reading it. Indeed, so will every physical chemist and physicist, to whom I strongly recommend this monograph.

Stellar Atmospheres. Jesse L. Greenstein, ed. Vol. 6 of Stars and Stellar Systems, edited by Gerard P. Kuiper and Barbara M. Middlehurst. 724 pp. U. of Chicago Press, Chicago, Ill., 1960. $17.50. *Reviewed by Rolf Landshoff, Lockheed Missiles and Space Division.*

WITHIN a star, photons are continuously being emitted and absorbed by the stellar material. Only a very small fraction of all the photons created actually leave the star, and it can be assumed that these all come from the outer layers of the star, its so-called atmosphere. Clearly, the physical condition of these layers determines the character of the emerging radiation and it should be possible to deduce the structure of this atmosphere from observed details of that radiation. This book applies itself to such a program.

Many important clues are revealed by the shapes, intensities, and displacements of spectral lines which may appear either in emission or absorption. Other information can be obtained from the intensity distribution of the continuous spectrum. To interpret the absorbed spectra, one investigates model atmospheres which are characterized by the particle density and by the temperature or some other measure of the energy density. In addition, stars all have an internal motion which for ordinary stars consists of a simple rotation. More exotic stars, such as variables or novas, undergo much more complicated motions. The models must be consistent with fundamental physical laws such as the conservation theorems, thermodynamics, quantum theory, etc. A very important branch of