

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 back-filled into an undisturbed substrate) are also detectable.

Such backfill contains an enhanced content of the oxide maghemite ($\gamma\text{-Fe}_2\text{O}_3$), apparently produced from the common, weakly magnetic $\alpha\text{-Fe}_2\text{O}_3$ (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, radiogeochimistry, and the like, are sure to read this book and find it an indispensable 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