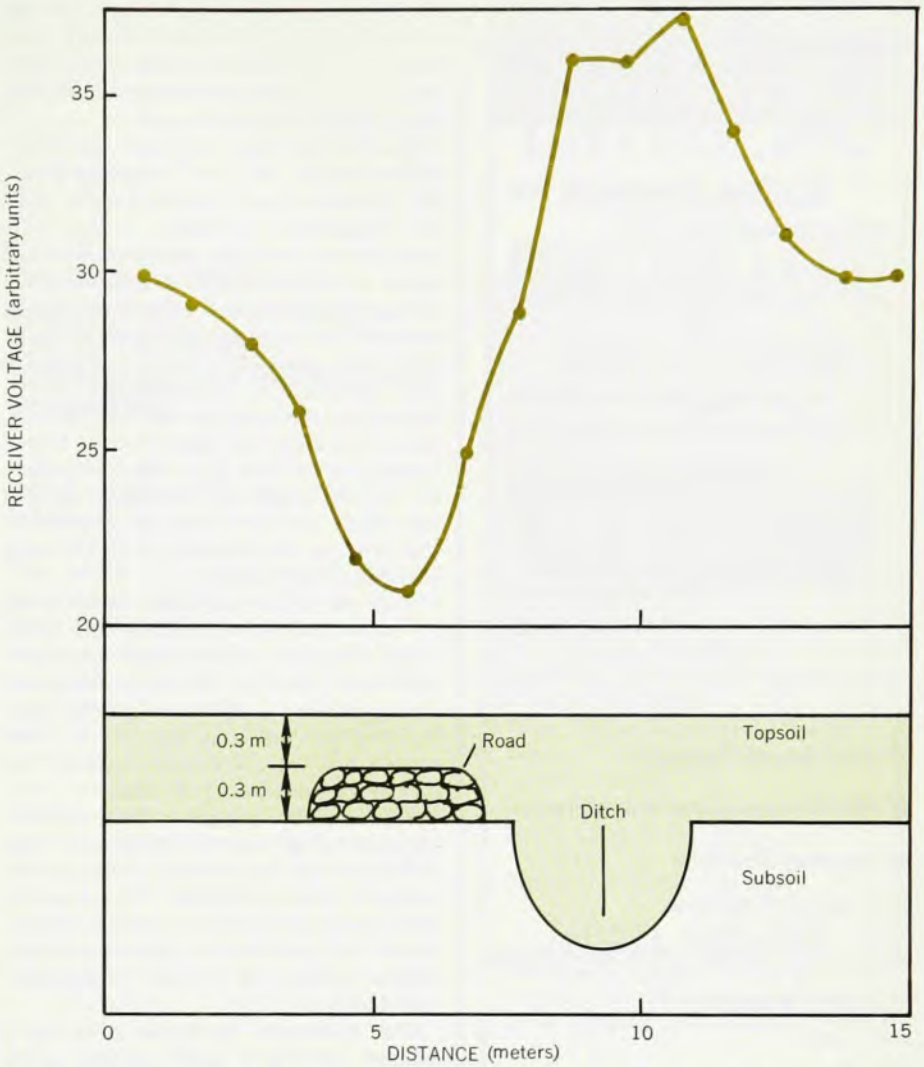
education and by experience to treat these techniques. Since 1942 he has been employed by what is now the British Steel Corporation. For several years he was in charge of work on the constitution of materials, specializing in x-ray diffraction. At present Andrews is Head of Physics and Theoretical Metallurgy, Research and Development Department, at the Swinden Laboratories, Rotherham. His present specialities are the development of nondestructive methods of testing and research on internal stresses. He is the senior author of the book, *Interpretation of Electron Diffraction Patterns* (2nd edition, Hilger, London, 1971).

I am disappointed that Andrews has not given us the type of detailed treatment of metallurgical techniques suggested by the title and by the preface, which begins: "This textbook is intended to cover the principal and well-established techniques which may be used in metallurgical practice and research. . . . There are already a number of excellent texts dealing with physical and structural metallurgy [that nonetheless] tend to give only outlines of techniques which are not really adequate for the needs of student or qualified, professional metal scientist who is required to learn about and work on some aspect of the subject. There appears therefore to be a gap here which the present book aims to close." The type of treatment conjured up by these words was written 20 years ago by A. V. Seybolt and J. E. Burke, *Procedures in Experimental Metallurgy* (Wiley, New York, 1953). The detailed instructions given by these authors on such topics as making furnaces, measuring temperatures, producing vacuum and growing crystals have aided countless students and research workers. Mention should also be made of the advanced, multivolume treatise edited by R. F. Bunshah, *Techniques of Metals Research*, Volumes 1–7 (Wiley-Interscience, New York, 1968–72).

Andrews intended to introduce each description of an experimental technique by brief background theory and to conclude with typical applications. Unfortunately, the portion on experimental techniques is almost invariably disappointingly brief. In the chapter, "Internal Friction Techniques," for example, the first 28 pages are devoted to an introduction and essential background. The torsion pendulum, the most popular technique, is then described in ten lines and a figure. Six additional pages are used for rather general descriptions of other techniques, and then 38 pages describe applications. A student would need to consult other sources to learn the details of constructing and operating a torsion pendulum.



An electromagnetic instrument is used to hunt for buried archaeological items. Different thicknesses of high-susceptibility topsoil cause the instrument reading to vary. After a figure that appears in M. S. Tite's book *Methods of Physical Examination in Archaeology*.

Not only is this pattern of treatment typical of other techniques, but two chapters are devoted entirely to background information: "Outline of Crystallographic Principles" and "Fundamental Basis of Diffraction." These topics are covered in standard textbooks and could have been omitted or drastically condensed, thus leaving space for a more detailed treatment of experimental techniques.

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Methods of Physical Examination in Archaeology

M. S. Tite
385 pp. Seminar Press, London, 1973.
£6.80

This book is an attempt to review in a systematic fashion the most significant chemical and physical methodology applicable to solving archaeological problems. These problems include finding sites for archaeological excavations, dating of artifacts and habitations, identification of sources of materials and the determination of methods of manufacture.

Methods of Physical Examination in Archaeology, with the advantage of single authorship, is in many ways more useful for anyone wishing to know about the potentials of chemical and physical applications to archaeological studies than the several composite authorship books that have appeared on this subject over the past ten years.

A major flaw in the book is that it is not always clearly aimed at either the physical scientist interested in archaeology or the archaeologist interested in a knowledge of physical and chemical methodology. Thus the all-too-frequent reviews of techniques and instrumentation are either incomprehensible (to a non-scientifically trained archaeologist) or banal (to the scientist) depending on the viewpoint.

The recognition of a flaw implies

that in general the work stands as an otherwise pleasing whole. I think that when comparison is made with the available books on this subject I would concur with such a judgment.

M. S. Tite has included such advances as the Ar^{40}/Ar^{39} stepwise heating method of age determination. He was apparently unaware of the even more recent work on use of amino-acid ratios and amino-acid racemization in dating fossil bones. These methods appeared in print in 1971 and 1972, so that the oversight can be excused. The amino-acid racemization technique has proven to be not only important in establishing ages of fossil bones beyong the 40 000 year limit of radiocarbon, but also for drawing climatic inferences for the time of deposition (for younger age deposits with the help of radiocarbon dating).

The use of the uranium decay series in travertine cave deposits and other dense inorganic calcium-carbonate precipitation sites is also not mentioned although this method of dating may be second in importance to the amino-acid racemization method for dating the early history of Man.

Although an adequate discussion of ancient metallurgy is presented, the discussion of the problem of sources of material is not as useful. This may be due to the scarceness of reliable information in this area. It may also be the proper domain of a more geologically oriented book.

The references at the end of each chapter provide a good starting point for reading in any of the areas discussed. The author has primarily devoted his energies in archaeology to the use of physical methods in site locations; consequently this chapter is the most authoritative and most thoroughly referenced one.

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The Raman Effect, Vol. 2: Applications

A. Anderson, ed.
629 pp. Marcel Dekker, New York, 1973. $45.00

The objective of *The Raman Effect* was to provide a basic coverage of the theoretical and experimental principles of Raman spectroscopy and discussions of some of its important applications in physics and chemistry. The first volume, reviewed in the December 1972 issue of PHYSICS TODAY, was devoted primarily to the theoretical aspects. This second volume contains discussions of selected applications by active research physicists and chemists at universities in Europe and the United States.

R. Stuart Tobias (Purdue) gives a detailed and concise review of a large number of applications to inorganic chemistry, including discussions of experimental procedures, interpretation of Raman spectra of inorganic compounds, equilibria and structures in aqueous and nonaqueous solutions, and cation–anion interactions and reactions in molten salts. It is predicted that in the future the primary use of laser Raman spectrophotometers will continue to be in the determination of molecular symmetries. Probably most specimens will be studied in the solid state because of the ease of excitation of the spectra with lasers. Studies of single crystals will be useful.

One of the most interesting challenges will be the description of the nature of the wide variety of chemical bonds found in inorganic compounds. Raman intensities are certain to be investigated more and more, especially for the measurement of molecular polarizability changes as the scatterer vibrates. Studies of equilibria in solutions should yield a better understanding of the structures present. Raman spectroscopy will be used for studies of systems under extremes of temperature and pressure, and will be an ideal method for the study of the structure and reactions of species in such solvents as liquid ammonia. For the inorganic chemist, laser Raman spectroscopy is probably the most exciting new tool developed during the last ten years.

Electronic Raman transitions are treated by J. A. Koningstein (Carleton) and O. S. Mortensen (Copenhagen). They discuss the symmetry of the scattering tensor, the transformation properties of the scattering tensor (especially the antisymmetric components), absolute intensities and depolarization ratios, experimental matters, selection rules and experimental results of the electronic Raman effect of the ytterbium ion in yttrium–gallium garnet and assignment of the electronic Raman transitions.

The longest article in the book is the one by Alfons Weber (Fordham) on high resolution Raman studies of gases. This contains detailed discussions of the theory of rotational Raman scattering, experimental techniques, observed Raman spectra, determination of molecular structures, dynamical aspects of structure determinations, and intensities, line widths and related problems. The presentations are lucid and comprehensive and should be required reading for students and researchers in this field.

High-resolution Raman spectroscopy consists of the study of the resolved pure rotational and vibrational–rota-