density matrix theory, the Hartree–Fock method, second quantization, diagrammatic perturbation theory, and Green's-function theory. The mathematical manipulations have been subordinated to physical arguments, but the formalism is still given in sufficient detail that the reader can follow most of the development without tremendous effort.

The diagrammatic perturbation theory is treated in great detail and applied to many situations. Summation of ring diagrams yields the correlation energy for the dense electron gas and in the context of temperature-dependent perturbation theory it produces the grand partition function. Plasmons are arrived at by using the linearized equation-of-motion method of Sawada, Green's-function perturbation theory and summation of particle–hole bubble diagrams.

The electron gas is treated again in the chapter on Fermi fluids. Its properties at low densities and its momentum distribution as a function of gas density are discussed, as are magnetic properties. Landau's Fermi-liquid theory is applied to $He^3$ with an illuminating discussion of zero sound and compressibility at first sound. Nuclear matter is deferred to a separate chapter and discussed in terms of Brueckner's reaction-matrix theory.

Interacting bosons are presented in several ways; first through Feynman's variational theory and then by the canonical transformation of Bogoliubov and again in the chapter on Green's functions by the method of anomalous propagators according to Beliaev. The Bardeen–Cooper–Schrieffer theory of superconductivity is outlined with detailed physical motivations, and there is a brief discussion of hard superconductors and the Ginzburg–Landau theory.

This book is strongly recommended to the student who wants to learn the mathematical methods and physics of the many-body problem.

The emphasis of *Many-Body Problems* is on the development of the necessary formalism, but there are also some applications to physical systems.

Accounts in varying detail are given of the mathematical methods pertaining to the Hartree–Fock method, many-body perturbation theory, Green's-function theory, Landau's Fermi-liquid theory, and the random-phase approximation. The preliminaries about antisymmetry lack the introduction of spin variables and discussion of the occupation-number representation, and the discussion of second quantization suffers from awkward notation.

Perturbation theory is presented at some length and after a terse development of the time-independent methods of Brillouin–Wigner and Rayleigh–Schrödinger, a more detailed discussion follows of the time-dependent methods of Goldstone and Hugenholtz. Rules are outlined for the calculation of the single-particle Green's function and the two-body Green's function is obtained in the ladder approximation. This approximation is equated to the random phase approximation and to the linearization of the equation of motion.

The notion of quasiparticles is introduced via the single-particle Green's function and discussed in the interesting chapter on Fermi liquids as they apply to $He^3$, and the quasiparticle method of Bogoliubov–Valatin is developed in connection with the theory of superconductivity.

Electron–phonon interaction is introduced in the "rigid ion" approximation and further developed in a discussion of the electron–electron effective interaction in the "jellium" model. Arguments using graphical techniques are employed to develop the clothed-phonon propagator.

The author states somewhere in the text that there is no substitute for learning the subject in complete detail, and I guess that this means that the book is not intended as a course text but rather as a limited review of some of the topics of many-body theory.

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## Physical Metallurgy, Techniques and Applications

**K. W. Andrews**
2 volumes: 340 pp., 347 pp. Halsted, New York, 1973. Volume 1, \$22.50; volume 2, \$24.00

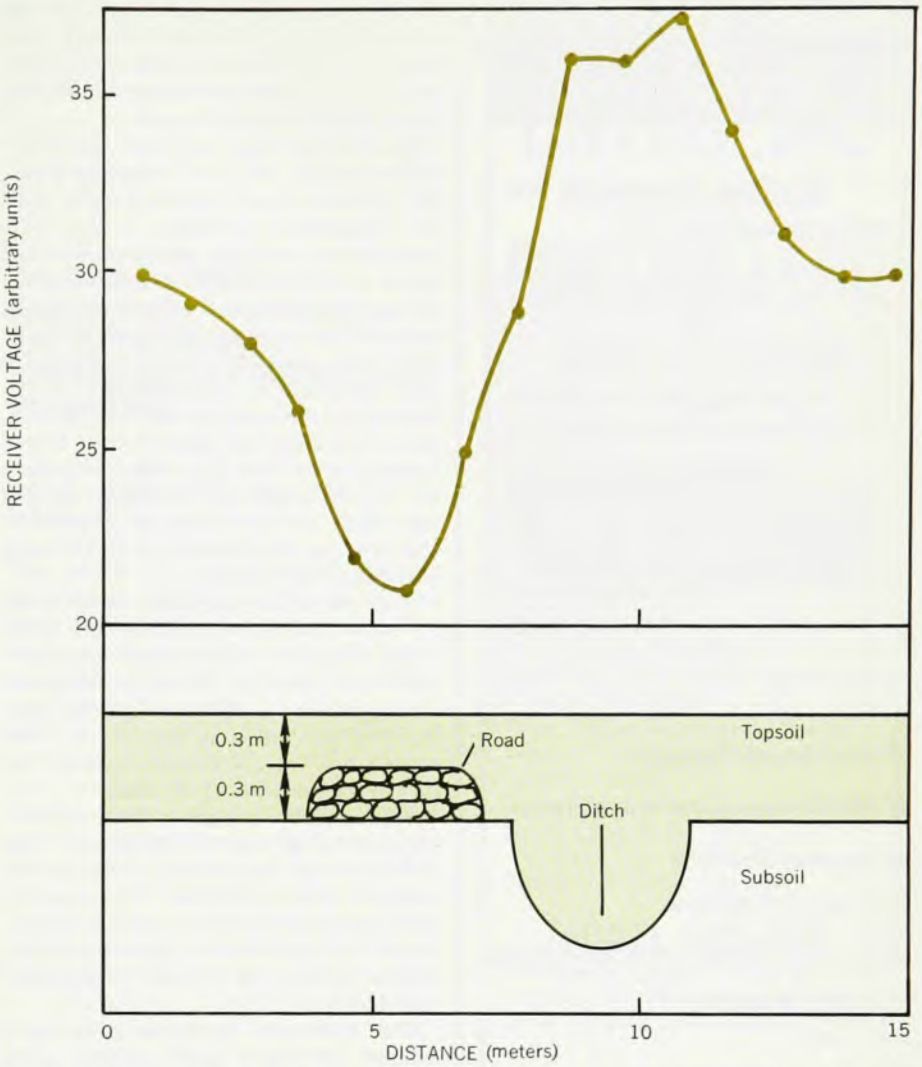
The field of physical metallurgy includes the structure, properties, reactions and deformation of metallic materials. Thus, it is related to but broader than the subject of the physics of metals. Many of the techniques used in physical metallurgy are also of interest to the physicist, especially because these techniques can be adapted to the study of nonmetallic materials. Among the techniques considered in the present two-volume work are temperature measurement, thermal analysis, thermal expansion, thermal conductivity, growth of crystals, zone melting, x-ray and electron diffraction, electron microprobe, radioactive tracers, optical microscopy, quantitative microscopy, electron microscopy, electrical measurements, magnetic measurements, internal friction and internal stresses.

K. W. Andrews is well prepared by

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