picture of what the programmer does.

The next three chapters give the details of coding, using a fictitious machine with a simple three-address order code for the examples. The basic ideas of looping, address modification, transfer of control, use of subroutines, and the like are all clearly described. The description may be rather technical for the general reader, but it is not sufficiently detailed for use in training programmers. The basic ideas of autocodes, or compilers, as they are usually called in the United States, is described in chapter 7. The description is brief and basic, but it gives no hint of the power and widespread use of problem-oriented languages which one observes today, especially in the United States. Chapter 8, the concluding chapter, contains a description of variations in computers and peripheral equipment —such items as word length, size and type of store, magnetic tape, and input/output are mentioned.

The emphasis is strongly on machine-language coding, which is probably more widely used in England than in the United States.

JOHN G. HERRIOT
Computation Center,
Stanford University

Comprehensive, Well Arranged

Particle Accelerators. M. Stanley Livingston and John Blewett. McGraw-Hill, New York, 1962. xvi + 666 pp. Illus. $17.50.

The literature on accelerators, while extensive, consists mostly of papers in journals and project reports. There are only a few books and review articles. In *Particle Accelerators* the authors have produced the most comprehensive volume so far published on this subject.

The arrangement of the book is good. Most of the material is organized around accelerators, by types, with a few topics treated separately. Particle motion in magnetic and electric fields and certain components—ion sources, magnets, and shielding—are given separate chapters, which are generally good. The level of the book is appropriate to a beginning graduate student in physics or engineering, but substantial portions can be understood by undergraduates. The indexing is good, and the extensive references will be useful to all workers in the field.

The physical principles of all presently useful types of accelerators are clearly and completely explained, and the relevant mathematical expressions are presented for convenient reference. Considerable emphasis is also properly given to a technical description of accelerators and components, and some space is devoted to historical material. In these areas the book has shortcomings which mar an otherwise excellent effort. There are interesting descriptions of some pioneering accelerators—for example, the early low-voltage generators —and valuable material on the latest alternate gradient accelerators, on magnetic measurement techniques, and on shielding, for example, but there are also tiresome details on accelerators that are neither pioneering types nor examples of the latest technology. The treatment of sector focused cyclotrons, which have undergone intensive development in the last decade and which now dominate the field in the energy range of tens of Mev, is disappointingly brief. Heavy ion accelerators, another recent development that has interesting special features, are little more than mentioned. The selection of historical material is spotty—there is a good treatment of electrostatic accelerators and of betatrons, but the treatment of Lawrence's development of cyclotrons at Berkeley is not sufficient to convey the extent to which modern accelerators and accelerator laboratories derive from that development. The faults are probably due to the authors' having relied too much on their own personal experiences, which, while undeniably extensive, are not quite great enough to provide a framework for a definitive work covering the entire field.

Despite the faults enumerated and a few errors of fact, the book on the whole is good and will be a valuable addition to every physics library.

EDWARD J. LOFGREN
Lawrence Radiation Laboratory,
University of California, Berkeley

Magical Minerals

Applied Clay Mineralogy. Ralph E. Grim. McGraw-Hill, New York, 1962. viii + 422 pp. Illus. $12.50.

In this, his second excellent book on clay mineralogy, Grim has successfully compiled much of the scattered and unorganized information on the industrial uses of clays. Although information about some areas is abundant, much of it is empirical, and application is often based on rule-of-thumb. Grim has made an effort to explain many of the observed phenomena and properties in terms of the structure and composition of the clay minerals. Although these minerals play a vital role in many industries, the reason for many of their functional properties is not well known.

Kaolinite and montmorillonite are the clay minerals most widely used in industry, although illite, attapulgite, halloysite, and sepeolite have many uses. Some of the more important properties of clay minerals are their small grain size, their sheet-like shape, their charged lattice, and their ability to disperse, adsorb a wide variety of materials, and orient water molecules.

The structure and properties of clay minerals are briefly covered in the second chapter. The chapter on clays in ceramic products (89 pages) is the most complete and covers the field with which the author is most familiar. Such properties as plasticity, stress, strain, green strength, shrinkage, drying, dry strength, firing, high-temperature modifications, fusion, color, vitrification, permanent moisture expansion, translucency, glaze properties, and reheat volume changes are discussed. A large number of graphs are presented showing how these properties vary as a function of the type of clay mineral and the size, temperature, water content, and the like.

A chapter on clays in foundry molding sands (63 pages) describes how sand, various clays, and water are prepared to meet property specifications necessary to produce the wide variety of molds used in the metallurgical industry, and one on clay mineralogy in relation to the engineering properties of clay materials (74 pages) describes such properties as compression strength, permeability, swelling, consolidation, penetration, and density. Two brief chapters (29 and 26 pages) review the role of clays (in the discovery, recovery, refining, and preparation) in the petroleum industry. Here, even more so than in other industries, the reason for the effectiveness of clay minerals in producing desired results is seldom known.

A final chapter (78 pages) describes a large number of other uses for clays. For example, a cement floor may contain 40 percent clay; the paint on your wall is probably 25 percent kaolin; your cotton shirt may be finished with