works are not even included at the end of this chapter. In general, in this area, too few references are given to other works on the various subjects in most of the chapters, and yet, in many ways, the volume is not self-sufficient.

The book, however, contains many very practical hints and suggestions that were obviously born out of the experiences of the author and his collaborators. The chapters on "Target considerations" and "Prelaunching and launching" are particularly significant in this regard. The book also gives many examples of economic considerations, such as Chapters 15, 19, and 20, all of which are so necessary to guide our young and brilliant engineers in this highly important field.

In general, the book provides a valuable aid for advanced courses in universities, either as source material or as an advanced part-time text in specialized courses. Its primary value, however, is that it provides source material and refresher material to engineers who must perform daily tasks as advanced systems designers in both civilian and military establishments in this highly complicated field.

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**Astrophysical Quantities.** C. W. Allen. Athlone Press, London, 1955 (distributed in the United States by John de Graff, Inc., New York 10). xi + 263 pp. $10.

Here is a volume that every teacher and research worker in astronomy and its allied sciences will want handy for quick reference. A large number of physical constants and quantities are tabulated, in addition to what the author considers to be the best available data on the earth's atmosphere and interior, the sun, stars, planets, nebulae, and galaxies. Great care has been taken to give clearly the units of every quantity that is tabulated, and numerous conversion formulas are included. Copious references provide the reader with the sources from which much of the information is drawn. The judgments by which the author derived the tabulated values are not given.

The material embraced in this compilation runs over such a wide range of subject matter that it is scarcely to be expected that all topics would be covered to the same degree of thoroughness and reliability. More data pertaining to radio astronomy might have been included advantageously. In a number of instances, better data than those quoted exist in the literature. The temperatures quoted for the interior of the earth seem improbable. The failure to distinguish between the Rosseland and Chandrasekhar mean absorption coefficients in section 65 is unfortunate. Section 95 does not do justice to the various three-color systems such as those of Becker, Johnson, and Morgan, which appear to be of increasing importance in photometric work. The table of line emissions in planetary nebulae would have been much better if it had contained the actual data for some particular nebulae. The table of partition functions is somewhat inadequate.

Various minor shortcomings are manyfold offset by the great service that has been rendered in putting together in a concise fashion so much of the basic useful quantitative data in astrophysics.

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**Principles of Physical Metallurgy.** Morton C. Smith. Harper, New York, 1956. 417 pp. Illus. $6.

This book is the first of a two-volume series. The second book, *Alloy Series in Physical Metallurgy* was not available for this review. The author's expressed purpose is to ". . . assist the thoughtful metallurgist . . . in achieving a fundamental understanding of metal behavior." Smith recognizes the difficulty in pleasing both the scientist and the engineer in one book, but, unfortunately, it appears that his efforts please neither one.

A little less than the first half of the book is devoted to elementary atomic physics, crystallography, crystal types, polymorphism, and crystal imperfections. This last subject includes such diverse topics as freezing of metals, dislocations, Hume-Rothery rules, and ordering. A brief chapter on magnetic and electrical properties completes the first section. The organization and method of presentation are neither bad nor distinguished; in essence, the author has boiled down the well-known books of Seitz, Cottrell, and Barrett. The coverage of topics is broad rather than deep, and tends to vary in emphasis. Four pages are devoted to the amorphous "Beilby layer," and somewhat less space is given to dislocations, although the latter are subsequently reintroduced. Dislocations, lineage, and mosaic structure are treated successively with no attempt at interrelation.

The greater part of the book concerns deformation of metals, effects of deformation and temperature, and fracture. The subjects are treated in a rather loosely knit fashion. Descriptions of the various properties are usually general with occasional references to specific alloy systems. Little use is made of the theories developed in the first half of the book. Although about 20 pages are devoted to creep, experimental work and theory of the last 10 years are largely ignored.

A great many (apparent) statements of fact are open to question; for instance, Smith states that second-stage and third-stage creep do not occur in compression, although it is well known that they do. In another example, he states that mechanical polishing of copper results in mechanical twinning. Unfortunately, there are very few references, so that one cannot trace some of the author's unusual conclusions to their sources.

Attempting to educate the engineering metallurgist, as the author intends, is a worthy and much-needed endeavor, but in a book of this size it is difficult to give more than superficial coverage of many important topics; the author has done no more. Furthermore, the lack of references and the use of books for most references (thereby causing much material to be out of date) decrease the usefulness of the book if it should whet the interest of the reader.

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**Structural Geology for Petroleum Geologists.** William L. Russell. McGraw-Hill, New York, 1955. x + 427 pp. Illus. $7.50.

Russell's new textbook on *Structural Geology for Petroleum Geologists* has been prepared with an objective that, to my knowledge, is new, original, and so worthy that I wonder why it had not been thought of before. As the title indicates, it is neither a textbook on petroleum geology nor a textbook on structural geology, although it includes and combines subject matter ordinarily treated in each of these, omitting parts of the other subjects that do not bear on the new objective.

In the subject of petroleum geology, it thus omits such matters as chemistry of hydrocarbons, the hydrology of petroleum deposits, and the origin, migration, and accumulation of petroleum; in the subject of structural geology, it omits structural features of metamorphic and igneous rocks, neither of which ordinarily contains petroleum deposits. The text is, however, not merely a treatment of the structure of known oil and gas reservoirs, for the petroleum geologist is less a developer of proved deposits than he is an explorer for deposits yet un-

known and undeveloped. His field is therefore that of regional geology and all sedimentary rocks. Thus, a text on structural geology for petroleum geologists must also be a text on the structural geology of sedimentary rocks in general.

This viewpoint is indicated by the subject matter of the chapters of the present book, which includes treatment of folds, faults, joints and fractures, unconformities, salt domes, buried hills, sedimentary features, regional structures, superficial structures, and continental shelves. The book concludes, however, with two chapters of more practical application to petroleum geology on classification of traps for oil and gas accumulation and on structural factors in petroleum prospecting.

With these objectives, the book may well find its place as a textbook in a structural geology course in those schools of the country where the surrounding terrain is made up dominantly of sedimentary rocks, or where the study of geology is primarily in preparation for entrance of the student into the various professions of the petroleum industry.

In assemblying his book, Russell has covered a vast amount of original source material, largely contained in articles in the technical journals, and in the various state and federal publication series. One of the most useful feaures of the book for the professional geologist, in fact, is the careful documentation of most topics, both in footnote references and in the lists of "additional references" at the ends of the chapters. The professional geologist will find these citations an up-to-date survey of numerous topics of interest.

In a work with objectives as novel as this, a first attempt may not prove to be as well rounded as later ones, by the same author or others; in the present book, I feel that this is to some extent the case. Thus, some of the chapters seem to be largely revisions of chapters in the author's previous *Principles of Petroleum Geology*; they cover essentially the same subject matter with only slight change in emphasis. This is notably true of the chapters on salt domes in the two books, and to a lesser extent of the chapters on sedimentary structures, structure of the continental shelves, and classification of oil and gas reservoirs; the two books, instead of being mutually supplementary, partly duplicate each other.

Also, in this first attempt, treatment of the subject matter appears uneven. Some chapters, such as those on faults and sedimentary structures, are largely statements of definitions and general principles, little fortified by examples or indications of how the principles might apply to petroleum geology. On the other hand, some topics, such as salt domes and buried hills, are rather exhaustively covered and well supported by examples.

Some areas with special problems are also given an interesting summary treatment—for example, the problem of the cherts of the Ouachita facies (pp. 268–270)—and I wish that more of these summaries could have been included. I would like to see a treatment in one place of the assemblage of related structural features that characterize the Gulf Coastal Plain, to which some geologists have given the term "homoclinal tectonics"; many of the individual features are mentioned throughout the text, but their relationships to each other in bringing about a peculiar structural style in the region is not made evident. The chapter on faults contains little mention of faults with large components of transcurrent movement of the type of the San Andreas fault in California, although some of them, such as the San Gabriel fault north of Los Angeles, pass through productive oil territory. It is also disappointing to find no mention of the problems of "gravity tectonics" in the chapter on superficial structures, although structures resulting from this process are important in the oil fields of Iran and northwestern Peru, and the area where they are most spectacularly developed, in the northern Apennines of Italy, is currently being prospected for petroleum. Some of these features may seem odd or exceptional, yet they may be more common than realized, and the petroleum geologist should make himself aware of them.

On the other hand, I am puzzled at the inclusion, and in some cases the rather full discussion, of some items that seem to have little bearing on petroleum geology, such as erratic blocks (pp. 287–288) and cryptovolcanic structures (pp. 329–332).

It seems to me, however, that the greatest opportunity for improvement of the book is in the text figures. Many of these are simply outline sketches illustrating general principles such as an instructor customarily puts on the blackboard to demonstrate some item to his classs. A printed book, in contrast to an oral lecture, provides an opportunity for more elaborate demonstration from actual examples. Such demonstration would appear to be desirable, for most of the students who will use the book will have little notion of how the principles illustrated in the sketches apply in field problems or in the occurrence of petroleum. Even some of the general discussions in the text might well have been tied to cross-sections or maps showing specific structures, rather than to theoretical diagrams.

For example, under faulting, reverse drag shown in Figs. 5–1 and 5–12 might have been illustrated by a cross-section of a fault with reverse drag in the Coastal Plain area; thrust faults shown in Figs. 5–9 and 5–13 could have been illustrated by sections in the Ventura Basin, Calif., the Anadarko Basin, Okla., and Turner Valley, Alberta; and fensters in a thrust fault shown in Fig. 5–14 could have been illustrated by a section of the Rose Hill oil field, Va. One misses, too, maps showing the interesting and significant relation between faults and oil-bearing anticlines, such as those in the Kettleman Hills field, Calif., and various anticlinal fields of Wyoming.

Examples of this sort are in proved oil territory; many of them involve producing oil fields; all are supported by abundant drilling data that indicate the structure for many thousands of feet below the surface. They would emphasize to the student that the structures discussed in the text are not merely theoretical concepts of whose application he is uncertain, but genuine features of the sort with which he will have to deal in his work as a professional petroleum geologist. It is true, of course, that the examples are in developed territory, whereas much of the student's professional work will be as an explorer in areas where these have not been deciphered and have not been proved by drilling, but they will demonstrate to him the types of structure he must consider in planning for the drilling of promising localities.

In summary, in these days when efforts are so often duplicated by different authors, so that the purchaser of technical books is more often puzzled to make a choice between several works on the same subject, rather than to locate the unique book for his purpose, Russell is to be congratulated for discovering a well-known subject on which no specific book has been prepared. Opinions will probably differ from one reader to another about how fully the objectives of the book have been met, but I feel that this worthy undertaking could be further amplified and improved. This may well be Russell's intention as he continues to gather material on the subject and to teach it to his classes. In the meantime, the book as now published is a useful and much needed source book on an important and neglected subject.

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**New Zealand Geomorphology.** Reprint of selected papers 1912–1925. C. A. Cotton. New Zealand University Press, Wellington, 1955. 281 pp. Illus. + plates. 42s.

Those who are familiar with the students of geomorphology need no introduction to C. A. Cotton. Indeed, all the older students have already read these chapters in the various learned journals,