well have been included. Telemetering and automatic computing machines are not mentioned, although, with the rapid progress engineers are bringing about here, some well-deserved future edition may alter the statement that "In most communication systems the source of the information is a human being."

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The Earth Sciences

Mathematische Grundlagen der höheren Geodäsie und Kartographie: Das Erdsphäroid und seine konformen Abbildungen, Vol. I. R. König and K. H. Weise. West Berlin: Springer-Verlag, 1951. 522 pp. Cloth DM 49.60; paper DM 46.

In the field of theoretical geodesy and cartography, the Germans have enjoyed an enviable position from the time of the mathematician C. F. Gauss, whose fundamental work on conformal representation of surfaces upon planes and other surfaces might properly be called the beginning of modern geodesy. His papers on cartography gave the rigorous mathematical formulation of projections already envisioned 50 years earlier by J. H. Lambert. The two-volume treatise by F. R. Helmert, *Die mathematischen und physikalischen Theorieen der höheren Geodäsie,* has been the bible of geodesists through the years, although important and outstanding contributions have appeared in recent years—notably C. F. Baeschlin's *Textbook of Geodesy.* But the present work of König and Weise is that once-in-a-century type of outstanding classic in a field.

Part I, Chapters 1 through 10, under the general title "The Earth-spheroid and its Conformal Projection," with which this review is concerned, is the first volume of an extensive, but compact, two-volume treatise. Parts II through IV, Chapters 11 through 22, under the general title "The Fundamental Problem of Higher Geodesy," will appear as the second volume.

The following remarks seem apropos concerning the general format of Volume I. Immediately after the table of contents there is a most useful summary explanation of the mathematical symbols and notations used in the text. Some of the notations, such as those used for geographical latitude and longitude, are not those commonly used, but this is a minor point and in no way detracts from the masterful treatment. Throughout the volume, figures are plentiful and many are done in two colors for clarity; the bibliography includes all the important extant works in the fields of geodesy and cartography. A useful index concludes the volume.

In Chapter 1 are found the constants of the oblate ellipsoid of revolution (spheroid); numerical values of the constants for the Bessel and International Spheroids; parametric representation of the meridian ellipse by means of the geographical latitude; arc element of the meridian; curvatures associated with the spheroid; trigonometric developments and power series expansions for the various curvatures and associated functions; the meridian arc, complex representation and power series developments in terms of geographical latitude; geographical latitude as a function of meridional arc; the parallel arc element; the surface element and evaluations. The chapter concludes with a summary of the power series developments obtained, including middle latitude formulas.

Chapter 2 includes the parametric representation of a revolute by means of geographical latitude and longitude, with the specializations to the sphere and the spheroid; the linear element of the spheroid; the isometric latitude for the sphere and spheroid; the isothermal parameters; three complex fundamental surface variables by means of which the conformal projections are characterized; relationships between these three complex fundamental variables for the sphere and spheroid; the transverse Mercator projection of the sphere; Gauss-Krüger projection of the spheroid; summary of complex variables for points, curves, and fields.

Chapter 3 deals with the conformal projection of one plane upon another by means of the analytic function of a complex variable; the curvature of plane curves; specific determination and continuation of the projection on a large scale; examples of conformal projections by means of elementary functions; conformal projections by means of elliptic functions of elliptic integrals; conformal projections by means of algebraic functions and integrals.

In Chapter 4 are found the geometric relations between the three fundamental complex variables for characterizing the conformal projections (originally defined in Chap. 2); application to the particular case of the sphere; projection of the spheroid by means of exponential functions and their linear transformations; a summary of the results obtained. In Chapter 5 the analytic developments in series are presented for the relationships between the three fundamental variables and their exponential functions; the conformal projection of the spheroid upon the sphere; a summary of the series developments; summary of the singular points of the various projections discussed; numerical examples of the computation of the fundamental variables.

Chapter 6 develops the conformal projections of the spheroid upon a plane (Mercator, transverse Mercator, Gauss-Krüger); the spheroid upon a sphere; the spheroid upon a second spheroid. A summary of the projections discussed is given at the end of the chapter, and numerical examples of these projections are presented.

The stereographic projection (in its various forms, polar, equatorial, etc.); spherical projection; and the general projection by elemental arcs for spheroids form the subject matter of Chapter 7. A summary of the important projections is followed by numerical examples. The transformations of isothermal coordinate systems is the subject of Chapter 8; they are discussed with respect to the Gauss-Krüger system, the Lambert spherical projection, etc. Chapter 9 is concerned with some of the already established projections of the reference ellipsoid upon the plane, upon the sphere, or upon a second spheroid.

Chapter 10 is called "Aids from Analysis." It treats of complex numbers and elementary functions; differentiation of a product (the product formula of Leibnitz); differentiation of a function of a function (composite function); general analytic functions and their representations; exponential series; general ordering theorems; general exponential series (Weierstrass-Laurent series); the particular case of trigonometric series; trig-

onometric functions from general exponential series, in particular from trigonometric series; the combination of two general exponential series, particularly of two trigonometric series; reversion from general exponential series, especially from trigonometric series; exponential series in two variables, reversion of series; two-dimensional interpolation.

This chapter-by-chapter account of the contents of Volume I only implies the systematic, skillful development of the theory. By defining three fundamental parameters early in Chapter 2, by means of which the conformal projections may be generated, various relations among them are established and the necessary power series expansions, etc., developed for the characterization and computation of the conformal projections—thus giving a logical and systematic development of the theory of conformal projection of the spheroid on a plane, a sphere, or another spheroid.

This monumental work is a "must" for anyone interested in the mathematical theory of geodesy and cartography.

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***The System of Mineralogy* (*Dana's*)**, Vol. II. 7th ed. Charles Palache, Harry Berman, and Clifford Frondel. New York: Wiley; London: Chapman & Hall, 1951. 1124 pp. $15.00.

Since 1837, when the first edition appeared, *Dana's System of Mineralogy* has been in constant use the world over as an authoritative reference work. It has long been characterized as the mineralogist's bible.

The sixth edition appeared in 1892, and 52 years elapsed before Volume I of the seventh edition was issued in 1944 under the authorship of Charles Palache, Harry Berman, and Clifford Frondel, of Harvard University. Shortly afterward Dr. Berman met a tragic death in an airplane crash at Prestwick, Scotland. Because of the many advances made in mineralogy and related sciences since the sixth edition, it was necessary to introduce significant changes in the new edition. These changes are discussed in detail in the preface and introduction to Volume I, which also includes an extensive bibliography of 37 pages.

Volume I contains descriptions of the elements, sulfides, sulfosalts, oxides, and related minerals. In Volume II, the halides, carbonates, nitrates, iodates, borates, sulfates, selenates, tellurates, chromates, phosphates, arsenates, vanadates, antimonates, vanadium oxysalts, molybdates, tungstates, and related minerals, as well as organic compounds, are described.

The descriptions of the individual minerals have been uniformly well prepared. In each case there is a comprehensive bibliography, so that the original sources can be readily consulted. Being encyclopedic in scope, the volume describes many substances with doubtful status as minerals. This is well indicated by such statements as "probably identical with ———," "is a mixture of ——— and ———," "needs further verification," and the like.

Many minerals have been reclassified and their crystallographic orientation has been changed, as a result of the new data obtained by the use of modern x-ray methods and new chemical analyses. The crystallographic data are given in terms of measurements with the two-circle goniometer, making it difficult for those not familiar with this type of goniometry to use the tables of angles readily.

Volume II is a noteworthy addition to scientific literature and will be widely used by all interested in minerals. The authors are to be congratulated on the thorough way in which a stupendous task has been accomplished. It is hoped that the third and final volume of this monumental work, which will describe silica and the silicates, may be issued before long.

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The Formation of Mineral Deposits. Alan M. Bateman. New York: Wiley; London: Chapman & Hall, 1951. 371 pp. $5.50.

This volume aims to acquaint the reader who may lack a basic knowledge of geology and mineralogy with the way deposits of industrially important metals and minerals occur in nature and how they have been formed. Certainly there is need for a work with such an objective. Public interest in mineral resources is growing as the result of more general realization that metals and minerals are the basis of modern industrial development. This interest is mixed with concern over the alarming consumption of mineral resources and the consequent necessity of searching for new occurrences to replenish supplies being depleted.

The author's manner of treatment, as stated in the preface, is designed to serve the scientist, the engineer, the industrialist, the student, and the general reader interested in mineral substances. This is a difficult task with a subject as complex as mineral deposits. To be effective the treatment must be sound and authoritative, cover the essentials, yet not presuppose too great a knowledge of geology and mineralogy. Professor Bateman's volume measures up very well indeed.

It could not have been written by a person with a more appropriate background—a teacher of the subject, a professional economic geologist of world-wide experience, a government servant with broad responsibilities in development of mineral supplies and mineral procurement, the editor of an international magazine devoted to economic geology, and the author of a leading textbook in the field. As the result of following closely the plan of treatment of equivalent material in the author's text *Economic Mineral Deposits* (1950), the book is sound, more comprehensive, and better balanced than one would normally expect. Bateman has resisted the temptation to interest the casual reader by undue emphasis of the sensational at the expense of providing a complete, balanced picture. It follows, then, that the volume is not easy reading for the person without serious interest. Of

course, a basic knowledge of geology and mineralogy on the part of the reader would contribute to the ease of understanding and appreciation of the subject matter. However, throughout the book a conscious attempt is made to develop the knowledge of geology and mineralogy required for an adequate understanding of the formation of mineral deposits. Technical words are held to a minimum, and a brief glossary is appended to explain the technical terms used.

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The Tectonics of Middle North America: Middle North America East of the Cordilleran System. Philip B. King. Princeton, N. J.: Princeton Univ. Press, 1951. 203 pp. $3.75.

This book is a progress edition of a larger work on the "Tectonics of North America," which the author hopes to complete later. Because of press of other duties, he has deemed it best to make available the portions already prepared. These are: "Southern Portion of the Canadian Shield," "The United States East of the Rocky Mountains," and adjacent parts of northern Mexico.

The text is supplemented by 52 cross sections, maps, and diagrams, most of them edited and modified from publications of other authors, and all especially redrafted. The source of each and, generally, the nature of the modifications are given in a special list at the end. The large regional maps planned for the final work could not be included, and the reader is referred to the American Geographical Society *Map of the Americas,* the American Association of Petroleum Geologists *Tectonic Map of the United States,* and the Geological Society of America *Tectonic Map of Canada.*

The treatment is arranged under three major headings: "The Central Stable Region" ("The Interior Lowlands," 39 pp.; "The Canadian Shield," 23 pp.); "Paleozoic Structure Southeast and South of the Central Stable Region" (92 pp.); and "The Coastal Plains" (24 pp.).

The free use of structure sections and the assembly and digest of the literature of the various regions make this an extremely useful book for the student of continental tectonics. Each section is accompanied by a bibliography which, though it makes no pretense of being complete, contains most of the recent pertinent references and is full enough to serve as a starting point for more detailed studies. The print is good, and the line drawings are remarkably clear and distinct.

The foreword states that the work was prepared to fill a need "for a modern description of the tectonic features of the United States for class-room use and as an explanation of the Tectonic Map of the United States." In the main, the work is just that, and it is a very important contribution.

As a descriptive work for classroom use, it seems to this reviewer to be marred by the author's adoption and inclusion of certain controversial concepts of tectonics and of sedimentation. These, being taken more or less for granted, will inevitably have the effect of orienting the thinking of the generation of students who use the text in the direction of those concepts. In a book designed mainly as a descriptive text on the tectonics of a region, controversial ideas, with their related classifications, should not be used in the body of the text as if they were established concepts of tectonics and sedimentation—for example, the concept of the tectogene; the idea that orogeny acting on mobile belts results in consolidation of the disturbed regions so that they resist further compression; or the concept that carbonates and clean-washed sandstones are miogeosynclinal, whereas slates, shales, arkoses, and graywackes are eugeosynclinal. Such ideas might entirely properly and better be discussed in a separate chapter dealing with theoretical considerations.

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Theoretical Petrology: A Textbook on the Origin and the Evolution of Rocks. Tom F. W. Barth. New York: Wiley; London: Chapman & Hall, 1952. 387 pp. $6.50.

Petrologists of every hue, from magmatists to transformists, have looked forward to the appearance of this volume by Barth—for he has recently shown notable leanings toward transformist views and many have wondered whether he would now go the whole way. There will be disappointment in the ranks of the extreme transformists, if we may take as representative of their attitude the statement of D. L. Reynolds: "Magmatists, adopting a defeatist attitude, have begun to conceive of petrology as a restricted branch of physical chemistry." Far from rejecting physical chemistry, Barth says in his preface, "Now that experimental methods have led to the synthesis of minerals and rocks and the determination of their thermodynamical constants, petrology has become physico-chemistry applied to the crust of the earth." Yet there will be disappointment among magmatists, too. Barth again expresses and apparently still adheres to his view that granites may be formed by condensation of a cloud of ions!

This presentation of extremist views, often without distinct indication of choice, is characteristic of the book and may, perhaps, be regarded as its strength, if it is to be used principally for teaching purposes and in the hands of a discriminating teacher. Without proper guidance a student is likely to find it rather bewildering.

The book begins with a brief discussion of the earth as a whole, its origin and development, and then passes to a consideration of the rocks of the crust. In a decidedly unorthodox arrangement, the sedimentary rocks are considered first in spite of their derivative character. There is just enough consideration of mineral substances in the preliminary discussion of the whole earth, however, to render this

arrangement reasonably satisfactory. Only about 20 pages are devoted to sediments, so that the book must be regarded as dealing almost exclusively with igneous and metamorphic types. It is principally with their problems that the author has been concerned throughout his career in the field and in the laboratory.

In introducing the igneous rocks he points to lavas as the only indubitably igneous or once-molten rocks. For certain deep-seated types that have usually been classed as igneous, he suggests that some doubts should be entertained, and the implication is strong that he himself thinks that very large masses (batholiths), and therefore most granites, are not of igneous origin—a view much in vogue in these times and one with which this reviewer has little sympathy.

In his treatment of the igneous rocks the author discusses the laboratory studies of silicate melts and the equilibrium diagrams that have resulted therefrom, making good use of these in describing the crystallization of magmas. He leans strongly toward the view that the diversity of igneous rocks has arisen largely through fractional crystallization of magmas, although he does not exclude the other processes involving selective transfer of material. Here the reviewer finds himself in complete agreement, and also regards as excellent the author's discussion of the manner of occurence and natural relationships of igneous rock types.

With the metamorphic rocks we reach varieties on which our knowledge is much more limited. They therefore present a major challenge and are at the moment the object of much investigation, both on the theoretical side and in the field and laboratory. The possible effects of pressure and stress become of equal importance with those of temperature, which is the principal consideration with the igneous rocks.

Barth discusses, as fully as possible in this small volume, the present state of knowledge and conjecture in this varied approach to the problems of metamorphism. Possible mineral assemblages under different conditions of temperature and pressure are treated in considerable detail. It is often not sufficiently emphasized how uncertain is our knowledge. For example, in a diagram on page 255 and again in the text on page 269, a rising-temperature inversion of triclinic microcline to monoclinic orthoclase near 700° is presented as if it were an established fact. Actually nothing is known of the temperature of this change. Indeed, no less an authority on rock minerals than Eskola has recently raised the question whether microcline may not be the high-temperature modification of potash feldspar.

It should be realized, however, that such a wealth and variety of interpretation are presented that the author could not hope to discuss all the pros and cons in one small volume. It is well, therefore, to end on the note already struck, that in the hands of a discriminating teacher the book will be a valuable addition to petrologic literature.

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