BOOK REVIEWS

GESTEINE UND MINERALLAGERSTÄTTEN. II, Exogene Gesteine und Mineral-lagerstätten by PAUL NIGGLI with the collaboration of ERNST NIGGLI. Verlag Birkhäuser, Basel, Switzerland. 557 pp., 181 figures, 67 tables. 1952. 49.40 Swiss francs ($11.48)

This is Volume II of the projected three-volume work on rocks and mineral deposits. Volume I (*Am. Mineral.*, **34**, 128, 1949) presented basic principles of chemical and physical mineralogy; Volume II deals with sedimentary rocks (in the broadest sense) and their mineral deposits (exogenous rocks and deposits). Volume III will be concerned with endogenous rocks (igneous and metamorphic), described as the main research field of the authors. As the first volume, this book, too, is conceived and executed on a grand scale, encompassing considerably more information and delving into much greater detail than one ordinarily expects to encounter in a work on rocks and mineral deposits. So many data, so much information is crammed between the covers that one gains the impression that the authors were sincerely reluctant to omit mention of anything at all pertinent to their subject. Indeed the factual material comes so thick and fast that only the most careful reading can ferret out the critical interpretations of the accumulated data. And to many Americans this careful reading will be a hardship, for the German of Niggli has been remarked upon for its complexity of style and difficulty of disentanglement. Several generations of geology students have already shared this inherited knowledge and have, unfortunately, successively avoided this author's works in attempting to pass their German examinations successfully.

Those, however, who are seeking a most nearly complete and well integrated description of the products of weathering and sedimentation with many rich diversions on their sources, formations and environments will be amply rewarded by a careful reading. The book is for reference and for the further enlightenment of the advanced worker; it will confound the beginner and may well confuse the intermediate. The following summary of the contents may be useful in outlining not only the general scope of the work but also in sampling some of its remarkable detail.

The two major parts are: I, Autochthonous rocks and mineral deposits formed by weathering ("residual sedimentary" rocks and associated deposits); II, Sediments. Discussion of the autochthonous rocks opens with a consideration of weathering under (1) the weathering process: mechanical factors, chemical factors, oxidation, hydration, hydrolysis and silicates formed by weathering; (2) migration of colloidal and dissolved substance in the weathering zone; (3) classification of weathering residua; mineralogical and chemical characterization, profile of weathering, laterite, bauxite, kaolin, etc., silicification and desilicification; and (4) the solutions of weathering. Section two of Part I considers soils under such topics as: their formation, profiles, arid and humid types, soil erosion, soils and man, springs and groundwater.

Part II on the sediments describes them by the groups: *A*, clastic sediments—psephites and psammites; *B*, clayey pelites, sapropelites and humites (including peat, coal, petroleum and natural gas), sulfosapropelites and Fe-Mn-Si-hydrogelites; *C*, carbonate rocks—limestones and dolomites; *D*, phosphatic sediments—guano, insular phosphorite, bone phosphate and bedded phosphorites; *E*, evaporites—sulfates, chlorides, etc.; and *F*, snow and ice. Each rock or deposit type is described chemically, physically, mineralogically, and petrographically. Usually there are also included accounts of textures, structures, sources, transportation, deposition, consolidation, theories of genesis and economically significant characteristics and varieties. The final 14 pages discuss sedimentary petrographic provinces.

From the American viewpoint the chief defect of the book appears to be in the mechanisms and devices adopted for the presentation of data. For example, the unfamiliar Niggli semi-structural formulae of minerals again appear (*Am. Mineral.*, **34**, 128, 1949); all analyses also are computed in terms of the Niggli numbers and chemical changes in weathering are expressed by the Niggli-Grosser ray diagrams. In truth the book contains many Niggli-isms, with which a large number of American petrographers have chosen to remain unfamiliar. The European slant also is evident in the usage of a very large number of varietal rock and mineral names as well as many freshly minted complex textural terms, which must first be learned or deciphered before the textual meaning can be determined.

However, despite these shortcomings, no advanced researcher in sedimentary processes or products can afford to avoid this book. It is outstanding in most every way, and the difficulties attendant the assimilation of its contents should not deter the determined reader.

E. Wm. Heinrich,
University of Michigan, Ann Arbor, Michigan

RADIOCARBON DATING by Willard F. Libby. 124 pp., 11 figures, 2 appendixes; The University of Chicago Press, $3.50, 1952.

Willard F. Libby, who is Professor of Chemistry at the Institute for Nuclear Studies of the University of Chicago, and his associated workers for the last few years have pioneered research leading to the dating of fossil material by means of radiocarbon, or Carbon 14. In this concise work Professor Libby presents the first book on the method and its achievements, bringing under one cover details on principles, sample preparation and measurement and a list of dates obtained by the technique. The book is clearly and carefully written and will do much to advance knowledge of this means of age determination among many branches of science. Chapter I discusses principles fundamental to the method, Chapter II presents data on the worldwide distribution of radiocarbon and Chapter III discusses determination of the half-life of radiocarbon. Techniques are dealt with in Chapter IV, Preparation of the sample for measurement, and Chapter V, Measurement of the sample. Chapter VI is a listing of radiocarbon dates including the sample number of the Institute, a brief description of the type of material, source and location together with any archeological date and reference and finally the age by Carbon 14. The samples are listed by foreign countries and under U.S.A. by groups of states. Many collaborators are enumerated under the various groups in which are included all datings completed prior to September 1951. The last Chapter, Chapter VII—The Significance of the dates for Archeology and Geology has been prepared by Frederick Johnson of the Robert S. Peabody Foundation for Archeology. The work concludes with two appendixes; *A*—Special equipment and chemicals for the C^{14} sample preparation apparatus, giving item and source; *B*—Special materials for screen-wall counter, giving item, source and type. The indexes are three—by subject, name and sample.

Undoubtedly the book will be indispensable to workers in some branches of paleontology and paleobotany, in archeology, geomorphology, glaciology and geochemistry.

E. Wm. Heinrich,
University of Michigan, Ann Arbor, Michigan

THEORETICAL PETROLOGY, A textbook on the origin and the evolution of rocks, by Tom F. W. Barth. John Wiley and Sons. 387 pp., 146 figures, 75 tables. 1952. $6.50.

If *Theoretical Petrology* can be considered representative of Professor Barth's petrological credo and if the reviewer has correctly interpreted it, then it would appear that the au-

thor is both a magmatist as well as a transformationist, that he regards sedimentary rocks and processes to be of subordinate interest to petrologists, that metamorphism is generally metasomatic, and that migmatites are not hybrid rocks but products of metamorphic differentiation. For these and other interesting, if sometimes extreme, views the book is alone worth a careful reading.

The book is in four parts: I, Physics and chemistry of the earth; II, Formation of sedimentary rocks; III, Igneous Rocks; and IV, Metamorphic Rocks. Part I (36 pages) is woven largely of standard materials—origin of the earth, earth heat and strength, earth shells, thermodynamics in calculating earth structure, lithosphere composition and geochemical cycles. Part II on sediments is so short (23 pages) that one is tempted to believe that the author was in a hurry to get it over with and out of the way in order to hasten on to subjects of greater interest (to him). Indeed many petrologists might take exception to the statement p. 37, that, " . . . many of the sedimentological problems are of no general interest for the understanding of the rock-forming processes on the earth."

Part III is subdivided into four sections: *A*, Descriptive classifications; *B*, Physical chemistry of the minerals; *C*, Magmas and their locales; and *D*, Rocks as products of defined processes. Under classification are discussed mineralogical classification, chemical composition (the Daly averages are repeated), Niggli values, and his molecular norm, *C.I.P.W.* norm and Barth's standard cell of a rock. Section *B* includes a statement of the phase rule and reviews the crystal chemistry of the silica minerals, feldspars, feldspathoids, melilites, olivines, pyroxenes and the crystallization history of various combinations of these. Other topics are the reaction principle, crystallization of basaltic magma and the "residua" system of petrogeny. Magmas and their locales has as its chief topics liquid immiscibility, silicate-water systems, vapor phase and hydrothermal differentiation, viscosity and temperature of magmas, pyroclastic rocks and magma tectonics. Section *D* presents a survey of magmatic differentiation, descriptions of variation diagrams and rock series and discussions of the genesis of oceanic basalts, continental basalts, alkalic rocks, calcitic igneous rocks, potassic rocks, pegmatites, monomineralic rocks and granitic rocks.

Part IV on metamorphic rocks describes metamorphic minerals (including many generally of hydrothermal origin), applicable thermodynamic principles, metamorphism of minerals, contact metamorphism, metasomatic processes, structures of metamorphic rocks, recrystallization (illustrated by evaporites), metamorphic diffusion and differentiation, facies, regional metamorphism and finally, migmatites.

Lists of references are given only for Part II, Formation of sedimentary rocks, and for the section on Granite and granitization. Otherwise the sources are embodied in the text (or less commonly in footnotes) and if an article is used more than once, only the author and date are noted, which causes no end of frustration to the persevering reader in his attempts to recover the original citation. The figures and tables, although adequately illustrative, vary considerably in style of preparation and somewhat in quality; e.g., errors in table 35 and figures 16 and 188 and over-reduction in the legend of figure 79. The author, despite a cogent criticism against the overproduction of rock names (p. 1), abets the cause of stockpiling "excess-baggage" nomenclature by using or repeating such terms as phlebite, leptologic, hypermelanic, aorite, holoblast, ectect and entect.

The courses served up in Professor Barth's book make for rich and varied fare, but together they hardly constitute an organized petrologic meal or a well-balanced petrogenetic diet. After concluding that the work is neither sufficiently objective for a textbook nor sufficiently complete for a reference, the reviewer decided the book may perhaps best be classed as a related series of petrogenetic essays, all of which deserve the careful reading of critical petrologists. Obviously much thought has been expended in its preparation and many of its challenging ideas will provoke much further thought and discussion.

E. Wm. Heinrich,
University of Michigan, Ann Arbor, Michigan

INTRODUCTION TO GEOPHYSICAL PROSPECTING, by MILTON P. DOBRIN. McGraw-Hill Book Company, Incorporated: New York, 1952, 1st edition; 435+xi pages.

This book attempts to describe and explain the most commonly used methods of geophysical prospecting to a reader whose knowledge of mathematics is, to quote the preface, no "more advanced than that generally required of students entering upon graduate work in geology." There is also the tacit assumption that the reader has had an elementary college physics course. Dr. Dobrin has succeeded quite admirably.

There are those who maintain that you cannot teach geophysics to students who do not have a stronger background of mathematics and physics than called for above. With this the reviewer agrees. However, there are a great many geologists, both in school and out, who want, and need, to know something about geophysics, and for them this book will be very useful. They and the professors who teach them from this book, must remember, however, that it will not make them geophysicists.

After an introductory chapter the book takes up in order, gravity, magnetic, electric, seismic, and electrical prospecting methods in some 300 pages. The remainder of the book includes a chapter on prospecting for radio-active minerals, a very good chapter on case histories, and chapters on well-logging methods and radio location methods for geophysical surveys. Throughout the treatment is kept at a very consistent level and is put together very smoothly.

Books on physical and mathematical subjects written for non-professionals are likely to contain loosely worded statements that annoy professionals. The reviewer was pleased to find very few of these in this one.

The book is very adequately illustrated with good line drawings and well chosen halftones.

JAMES T. WILSON,
University of Michigan, Ann Arbor, Michigan

IMPERFECTIONS IN NEARLY PERFECT CRYSTALS, prepared by an Editorial Committee, consisting of W. Shockley (chairman), J. H. Hollomon, R. Maurer, and F. Seitz. 1952, John Wiley and Sons, Inc., xii+490 pp. Price $7.50.

Imperfections in Nearly Perfect Crystals is a collection of papers arising from a conference on "Lattice Imperfections" held in 1950, under the sponsorship of the National Research Council and the Office of Naval Research. The book consists of 17 articles by 20 authors.

The book is divided into four parts. Part I is introductory and is concerned with the description of the various kinds of imperfections, namely, phonons (vibrations), electrons and holes, excited atoms, vacancies and displaced atoms, foreign atoms, and dislocations; plus transient imperfections. The article by Seitz defines and classifies the imperfections, and discusses their interactions. Read and Shockley develop the geometry of dislocations, and reduce all dislocations to standard forms or their combinations.

Parts II, III, and IV are reports of experimental data, which are interpreted on the basis of the theoretical foundation laid down in Part I.

Part II discusses the types of dislocations associated with various deformations of crystals. Dislocations due to quenching strains, cold work, and plastic flow are treated. A rather elaborate Fourier analysis of distribution functions for cold-worked metals is given by Warren and Averbach. The effect of impurities on the ease of dislocation is discussed. Koehler computes and measures the dissipation of vibrational energy by dislocations.

Part III deals with diffusion and the mobility of particles and imperfections within the crystal. The dielectric and photoelectric properties of ionic crystals are investigated

and related to defects in the crystal. The diffusion of atoms and vacancies in alloys is examined statistically and thermodynamically.

Part IV is concerned with the properties and effects of surfaces and boundaries in the crystal. Surface and intergrain boundary tensions are discussed by Fisher and Dunn. Read and Shockley continue with a treatment of the geometry of boundaries, and boundary energy. Smith examines interphase energies, and concludes with the topology of interfaces. Mosaics and fine structures are also discussed. The book concludes with a discussion of the properties, physical and chemical, of grain boundaries, and diffusion effects near the boundaries.

On the whole, the book gives a well unified picture of the somewhat heterogeneous knowledge collected to date. A lesser amount of confusion of nomenclature and diversity of belief is evident than might be expected in a collection of essays. Of course, the authors actually worked together at the symposium; the differences of opinion which do exist are included as reproductions of the discussions which took place at the conference.

The book assumes considerably more knowledge of metallurgy and the theory of solids than the average mineralogist possesses. It fails in several small instances where a very slight amount of reorganization or additional information would make the book more understandable.

In the first place, the book looks at crystal imperfections from a different viewpoint from any previously held. The nomenclature and classification of crystal defects is not entirely new, but will be unfamiliar to mineralogists. Principally, the difficulty is that one of the authors assumes another has already explained the unfamiliarity. The term "F-center" is used several times with ominous import; finally about midway through the book it is grudgingly admitted what it is. In another case, we find twice the mention of "holes attached to vacancies." The meaning is obscure, even when one knows what the terms mean.

The paper on geometry is short and difficult, though the geometry of dislocations forms the basis for description of all subsequent distortions in crystals. A system of ill-defined and obscure vector mathematics is used to describe dislocations. The illustrations fail to clarify the text. The chapter is possibly a satisfactory refresher for one versed in the concepts used, but is abstract and unsatisfying for the mineralogist.

The most significant article is the first, by Seitz. His tentative unification of crystallography, metallurgy, and physics into a new science of solids should appeal to most readers. Seitz points to the hazy outline of a unified theory of solids which seems sure to come in the future.

The book presents a concise picture of most of the important experimental and theoretical work done on solids in recent years, and furnishes a wealth of references. The editors cheerfully admit that the experimenters and interpreters have barely started to integrate their findings; the book will be of greatest value if it stimulates others to enter the field. It is highly recommended to all who are interested in crystals and solids.

E. H. POINDEXTER,
University of Michigan, Ann Arbor, Michigan

NEW MINERAL NAMES

Gunnbjarnite

O. B. BØGGILD, Gunnbjarnite, a new mineral from East Greenland. *Medd. om Grønland*, Bd. **142**, No. 8, 1–11 (1951) (in English).

The mineral occurs with calcite in veins cutting a basalt dike at Mt. Steensby. It is dark brown to nearly black, streak very light brown. Luster pearly on the basal cleavage.