BOOK REVIEWS

PROBLEME DER NATURWISSENSCHAFTEN by Paul Niggli

Paul Niggli's Probleme der Naturwissenschaften erläutert am Begriff der Mineralart (Problems of the natural sciences illustrated by means of the conception of a mineral species) is published by Verlag Birkhäuser of Basel, Switzerland and sells for 18.50 Swiss francs. This beautifully printed, cloth-bound book of 240 pages may be regarded as an essay on the natural philosophy of crystallography. Part one, entitled Nature and Science, deals with the goals of natural science, the assumptions underlying the scientific conception of nature, and general methods of scientific research. Under the last heading Niggli defines two methods: the abstract-generalization, atectonic-imperative, factual-explanatory technique and the comparative-systematic, tectonic-normative, idealistic-illustrative technique. It is doubtful that more than a few American mineralogists and crystallographers will expend the time necessary to wade through this morass of abstruse "Germanology."

In part two the author discusses "Individuality, one of the foundations for the concept of species." Here is introduced, among other things, the notion of enteloprot—defined as the smallest unit of or for an individual which still contains the practical, entire individual character.

Parts three to ten are concerned with familiar crystallographic topics grouped under headings designed to emphasize the central theme—that of speciation in crystals. First are listed the fundamental factors in the definition of the crystalline form, such as vectors, symmetry, and zone laws. Thereupon follow descriptions of crystal structure, with NaCl used as an illustrative example, of the relations between structure and growth units, of the differences between ideal and real crystals, and of the notion of species in mineralogy.

Two sections contrast the variability of crystals—"inner" variability as related to the ideal crystallographic blueprint versus variability as a result of external conditions. Under the former belong such topics as isomorphous replacement, exsolution, defect structures, "vagabond" structural elements, adsorption, base exchange, and (growth) twinning. The second part deals, for example, with polymorphism, inversion, zonal structure, and plastic deformation. The book closes with a chapter on the principles governing mineral associations, including the phase rule, and a chapter entitled, "The subject of research determines the character of the science."

Niggli throughout emphasizes the analogy between mineralogy and biology, relating such units as individual, type, species, and assemblage across the two sciences. An interesting juxtaposition is his comparison of oriented mineral overgrowth with symbiosis. He might very well also have symbolized selective mineral alteration as an example of antipathetic symbiosis. By means of this fundamental analogy many "isolated" phenomena of crystal behavior and separately catalogued crystal characteristics may be interrelated in a natural crystallographic ontogeny. The book offers a refreshing approach to advanced mineralogical thought, which too often has been stagnated in the doldrums of indifferent systematology and haphazard presentation. The reviewer has for several years been using a similar analogy between mineralogy and biology, i.e. the separation of mineral characteristics into "environmental" and "hereditary" groups, as a basis for instruction in mineral paragenesis. There is no doubt that the advanced student receives this concept favorably. Niggli's book, which develops this theme in detail, is well worth the attention and appraisal of workers in our science.

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DIE JUNGEN ERUPTIVGESTEINE DES MEDITERRANEN OROGENS. (PART 2) DER CHEMISMUS DER POSTOPHIOLITISCHEN ERUPTIVGESTEINE BY CONRAD BURRI AND PAUL NIGGLI.

This paper-bound volume of 206 pages, which is published by Guggenbühl and Huber, Schweizer Spiegel Verlag of Zürich, Switzerland, stems from the Immanuel Friedlander Institute of Vulcanology of the Mineralogical-Petrographical Institute of the Eidgenossene Technische Hochschule of Zürich. It is a compilation of 2138 chemical analyses of Mediterranean-area igneous rocks, recalculated to the Niggli-Becke projection values—si, al, fm, c, alk, k, mg, ti, and p (see *Am. Mineral.*, **32**, 257–287, 1947). These values are listed, together with the rock name, locality, and magma-type according to Niggli's classification under three geographic sectors—the western, central and eastern Mediterranean. Three outline maps show the location of groups (called "tables") of analyses. A final section summarizes general statistical data derived from the compilation.

No doubt the volume represents an appallingly prodigious expenditure of time and effort in collecting and recalculating the analyses and grouping their projection values. American petrographers, in general, however, have made little use of the Niggli projections, and for them the work probably will be of ephemeral interest. It is unusually unfortunate that the original weight percentages of the rock analyses could not have been retained in the compilation, for such a collection would have served as a valuable source book in chemical petrography. According to the authors this was originally intended but was abandoned owing to increased size of the collection and increased printing costs.

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GEOLOGY AND ECONOMICS OF NEW MEXICO IRON-ORE DEPOSITS BY V. C. KELLEY.

The University of New Mexico recently has issued *Publication in Geology Number 2*—Geology and Economics of New Mexico Iron-Ore Deposits by V. C. Kelley, prepared in cooperation with the U. S. Geological Survey. This paper-bound, 246-page summary of existing knowledge of the economic and potentially economic iron resources of the state appears opportunely, just as western states are in the process of expanding an infant steel industry and as the United States mining industry as a whole is becoming concerned with the discovery and development of adequate iron ore to bolster dwindling reserves of the Lake Superior region. A handsome colored frontispiece showing magnetite and gangue minerals in the Fierro district graces the publication, which is profusely illustrated with 16 other plates and 46 figures, including 10 maps and sections in a rear pocket. The volume may be obtained from The University of New Mexico Press, Albuquerque, New Mexico for $3.00.

From 1906 to 1924 New Mexico ranked as the second largest producer of iron ore in the western states, and ore has been mined from 1889 to date, except for the period of 1932 to 1935. Nearly all production has gone to the Colorado Fuel and Iron Corporation at Pueblo, Colorado. The recorded output is 6,595,184 long tons of which about 18% was manganiferous iron ore. This is conservatively valued at $14,000,000 but represents less than 2% of the value of all other metals mined in the state.

Three main types of iron ore deposits occur: (1) pre-Cambrian iron-bearing quartzites and slates, (2) syngenetic deposits in sedimentary rocks, and (3) replacement deposits in sedimentary rocks. Type 1, or taconite, is of no present commercial interest. Type 2 is exemplified by beds of jaspery chert in the Magdalena group (Pennsylvanian) and oolitic hematite beds in the Bliss sandstone (Upper Cambrian), some of which are as much as 15 feet thick and contain 20–40% iron.

Nearly all production has been secured from pyrometasomatic ores (tactite-type) in

sedimentary rocks (type 3), chiefly limestone or dolomite of Paleozoic age. The associated hypabyssal igneous rocks are intermediate in composition, commonly quartz-monzonitic to granodioritic and are of Tertiary age. Magnetite generally is the dominant ore mineral, occurring intergrown with ordinary hematite or less commonly specularite. Disseminated pyrite and chalcopyrite are common associates. Typical gangue minerals are carbonates, garnet, actinolite, serpentine, tremolite, epidote, wollastonite, phlogopite, and pyroxene. Tabular ore bodies with strongly banded structure parallel with replaced bedding are the rule. Structural features such as projections of sediments into the intrusive body, sharp bends in contacts, and crests and troughs of folds are in some districts responsible for localization of the ore masses.

Analyses of ores from 12 producing districts show an iron range of 48.1 to 58.2%, a phosphorus content of 0.030 to 0.115%, with sulfur varying from a trace to 0.91% and silica between 3.6 and 13.4%. Reserves for 8 southern counties are: (for 35–55% Fe) indicated ore, 24,573,000 long tons, inferred ore, 44,719,000 long tons. The principal reserves of 35–55% Fe ore are in the Fierro-Hanover district, which has produced over 5,000,000 tons of 50–55% ore. Large reserves of 25–35% Fe ore of the sedimentary type occur in the southern part of the Caballos Range in Sierra County.

The main part of the publication is concerned with detailed descriptions of some 30 main districts or groups of deposits. The work is unusually well organized and clearly and competently written. Illustrations are excellent throughout. In many ways the report sets standards of quality, both in the geologic work itself and in its presentation, for future compilations of this type.

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REPORT OF THE COMMITTEE ON THE MEASUREMENT OF GEOLOGIC TIME, 1948–1949.

The Report of the Committee on the Measurement of Geologic Time for 1948–1949 under the direction of John P. Marble, Chairman, has been published by Division of Geology and Geography, National Research Council. It may be obtained by sending a check, draft, or money order for $1.00 drawn in favor of the National Academy of Sciences to the above Division at 2101 Constitution Ave., N. W., Washington 25, D. C. The mimeographed, paper-bound volume of 139 pages presents the Summary Report of the Committee by its chairman and six summary reports (Exhibits A to F): (A) Japanese Analyses of Radioactive Minerals, 1936–1946 (Abstracted from "Chemical Analyses of Japanese Minerals II" by Zyunpei Harada, with comments by J. P. Marble. (B) Late Pleistocene Dates Derived from Radiocarbon Assay, by Richard F. Flint. (Reproduced from *Science*, **109**, 639, June 24, 1949). (C) Present Status of Absolute Age Measurements in Brazil, by John P. Marble. (D) Report to Committee on Measurement of Geologic Time, by L. H. Ahrens. (This deals with the strontium method, the decay constants of K^{40} and the possibility of a calcium age method, and the neighboring isobars, Sn^{115} and In^{115}.) (E) Some Problems of Age Measurements on Eastern North American Magnetites, by P. M. Hurley. (F) Annotated Bibliography of Articles Relating to the Measurement of Geologic Time, compiled by John P. Marble.

The Summary Report by John P. Marble brings together a great many miscellaneous pertinent details and comments, most of which would probably escape publication elsewhere. The annotated bibliography of 55 pages also is of considerable value, for it draws attention to many articles that have appeared in relatively obscure publications or in some not generally available.

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MINERALOGISCHE TABELLEN BY HUGO STRUNZ, second edition, Akademische Verlagsgesellschaft Geest & Portig KG. Leipzig C 1, 1949, pp. xiv+308. Price DM 21.

The first edition of this book (Leipzig 1941, Lithoprinted by Edwards Brothers, Ann Arbor, 1944) was reviewed and warmly praised by Professor Rogers in this journal in 1948. Though the contents as described by Professor Rogers remain much the same the new edition is about 25 pages longer and many improvements have been made.

Two subtitles, "Eine Klassifizierung der Mineralien auf kristallchemischer Grundlage" and "Mit einer Einführung in die Kristallchemie," clarify the aim and content of the book. Between the foreword (Vorwort) and the introduction (Einführung) a preface (Einleitung), ix–xiii, has been inserted. Here the author seeks to justify or explain his procedure in classifying minerals. He refers to his classification as crystallochemical and in summary says (p. xi–xii) that though it may at first glance seem to be purely chemical he has attempted to arrange and order (auszurichten) crystallochemically in every conceivable way.

The preface also contains a statement of the distribution of 1,124 "mineral species" whose symmetry is well established among the several crystal systems. The results, cubic 14.77%, hexagonal 7.83%, hexagonal-rhombohedral 8.99%, tetragonal 7.20%, orthorhombic 25.98%, monoclinic 29.72% and triclinic 5.51%, agree closely with the count made on 701 such "species" by Parker (*Fortschr. Min.*, **14**, 75, 1930). Finally there is in the preface a brief statement about the important matter of the relation of kX to Å units.

A great many changes have been made in the tables. For new data added since 1941 the author and year are mentioned though there are no direct references to original sources. For a few older data where a revised setting or interpretation is involved author and year are also given. All but two of the omissions noted by Rogers have been corrected.

For each mineral listed in the table formula, system, class, space group (both Schoenflies and Hermann-Mauguin symbols), cell dimensions and cell content are given where known. In the absence of cell dimensions morphological elements are given where available. Where needed the reconciliation of morphological and structural elements is indicated. A short statement on the structure or constitution is given for each major group.

Among the mineral groups whose treatment is revised in the new edition is tourmaline. Formerly placed among the nesosilicates (silicates with discrete SiO_4 tetrahedra) it is now found among the sorosilicates (silicates with limited groups of linked SiO_4 tetrahedra) and the formulas are written in conformity with the structure found by Hamburger and Buerger (*Am. Mineral.*, 1948) to whom reference is made.

Combined with the index is a list of the all too numerous obsolete and redundant mineral names. Each of these is elucidated very briefly.

The fragmentary and misleading list of mineralogical museums which appeared at the end of the previous edition has been eliminated. In its place appears a list entitled "Neuere Literatur zur Kristall- und Mineralkunde" in which are enumerated 44 books published since 1936. The selection is very uneven, omitting some important works and including others that are quite unworthy.

Lack of facility in reading German should be no bar to the use of this book. Its value lies in the comprehensive view it gives of the crystallochemical relations of minerals. It should be in the hands of every mineralogist who has any interest in these matters.

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