BOOK REVIEWS

DIE MINERALIEN DER SCHWEIZERALPEN by P. NIGGLI, J. KOENIGSBERGER and R. L. PARKER, with the collaboration of O. GRÜTTER, F. DE QUERVAIN, F. N. ASHCROFT and F. WEBER. In two volumes: Pp. 661, Pl. 20, Figs. 251. B. Wepf & Co., Basel, **1940**. Price 24 Swiss francs.

Doubtless every reviewer feels that the few paragraphs to which he is usually limited are wholly inadequate to present his subject. That is particularly true in the present instance, so packed with riches are these two volumes. Indeed, even to reproduce the tables of contents would occupy more pages than can be allocated to a book review. Perhaps, therefore, the purpose of this review will be served if it no more than calls attention to the existence of this treasure-house, rather than attempting a detailed digest and concentrate of its rich contents.

The beautifully crystallized transparent quartz crystals from alpine "clefts"[1] were known to the ancient Greeks and from this "ice-stone" has sprung not only the name but much of the science of crystallography. Crystals of quartz, adularia, and many other minerals from these localities are represented in collections all over the world, yet relatively little was known—and this is especially true in America—of the geological relationships, of the mineral parageneses, or of the geographical occurrences, of these classic localities. It was this lack of a comprehensive, up-to-date study of Alpine minerals that provided the impetus for the present work; that, plus a desire on the part of the authors to provide for Switzerland something somewhat equivalent to what Lacroix had done for France in his notable "Minéralogie de la France." That the authors have succeeded brilliantly is apparent to anyone who spends even a short time with these volumes.

The majority of the clefts, it might be explained, are small, flattened, irregularly lens-shaped openings; the length is seldom more than a few meters, and often is less; the height of the opening is commonly measured only in centimeters, although some are a meter or more. A series of clefts frequently exhibits *en échelon* arrangement. The openings are usually transverse to any foliation in the rocks. A feature found in most clefts, with the exception of some in very basic or calcareous rocks, is a band of massive quartz which forms the wall of the cleft against the country rock. The size of this band, as well as of the crystals that project normal from it into the open space of the cleft, is directly proportional to the size, especially the height, of the cleft itself. The minerals that form in a sort of druse on the inside of the quartz layer develop unusually perfect crystal form and include a considerable variety of species, thus permitting exceptionally favorable conditions for paragenetic observations and interpretations. Temperature conditions are estimated by observations on the disappearance of the bubble in fluid inclusions, on the disappearance of color in certain minerals, etc. The age of the clefts is believed to be late-, or post-Oligocene.

Volume I starts with a brief foreword including an historical review by Niggli. Part I (75 pages), by Parker, provides a systematic description of over 200 minerals and a short discussion of the principal rock types. Minerals are arranged as in Niggli's "Lehrbuch." For the less common minerals a paragraph, giving the physical properties and crystal morphology, suffices. More abundant species receive more extended treatment: for example, no less than 16 perspective drawings illustrate the varying crystal habits of anatase. Each mineral is cross-referenced to a locality catalogue. A digest of the major rock types is given: volcanic rocks are few; plutonic rocks are principally granitic, although a wide range

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[1] "Zerrkluft" is not readily translated into English, although the term is perhaps sufficiently onomatopoeic to need no direct translation. "Cleft" is used here in preference to "crevice" because it is short, literal, and implies the "tearing apart under tensional stress" which is responsible for the formation of the "clefts."

is represented; metamorphic rocks are abundant, with gneisses of various types making the majority; sedimentary types are largely calcareous.

Part II (nearly 200 pages), also by Parker, presents a detailed description of almost all known Alpine mineral localities. The major subdivisions are geographic: (*A*) the Northern Calcareous Zone ; (*B*) the Central Massif; (*C*) the Pennines, and eastern and southern Alps; an Appendix describes occurrences in the Jura. *B* and *C* are subdivided into smaller provinces, and these in turn are subdivided on the basis of different parageneses and these into individual localities. Two large panoramic sketches and a map are folded into the back of this volume and provide an index chart and unequalled "collector's guide" to localities discussed in the text. There is also a page index for minerals and rocks.

Volume II begins with a short foreword by Niggli. Part III (190 pages) is a discussion of parageneses by Koenigsberger. By an amusing simile he stresses the importance of a complete and detailed knowledge of the mineral assemblages; the few choice crystals that find their way into museums, and from which most of us have pictured the Alpine clefts are to be considered, he says, as the "film stars" of the mineral world, and are no more to be taken as a guide to the parageneses than are the goings-on of a Hollywood film star to be taken as a guide to the life of the American people! The striking contribution in this part is the demonstration of the close relationship between the minerals of a cleft and the rock in which it occurs. The 113 paragenetic types are grouped under five country rock types: I, predominantly granitic and quartz-dioritic igneous rocks and orthogneisses of similar composition (without hornblende); II, predominantly silica-rich, hornblende-free metamorphic rocks; III, silica-poor, hornblende-bearing, partially metamorphosed rocks; IV-a, sedimentary rocks, more or less metamorphosed, principally Triassic dolomites or lime-mica schists; IV-b, lime-silicate contact rocks; V, sediments that have suffered little or no metamorphism. This broad grouping is broken down into some two dozen petrographic types for the detailed discussion of the deposits. Here the dependence of cleft mineral assemblages on the country rock becomes increasingly clear; for example, adularia and/or potassium zeolites form where potash has been available in the country rock; albite and/or sodium zeolites where soda has been available; the titanium oxides are relatively abundant where titanium-bearing amphiboles are present, they are scant or absent in clefts in hornblende-free rocks; etc. Koenigsberger is careful to point out that the mineralogical and chemical character of the country rock is not alone sufficient to determine the paragenesis. For example, a younger crevice which cross-cuts an older one, even although both are in the same rock, may have a very different paragenesis. The temperature, the rate of cooling, the pressure, the porosity of the rock, the time of opening of the cleft in relation to the stage of metamorphism—all these play a role in determining the paragenesis. A commonly held misconception is that the clefts all contain a rich variety of mineral species. Actually, many clefts contain little but quartz, or quartz and calcite, or quartz and albite. A rich occurrence requires that the cleft be large and that there be a variety of soluble components in the adjoining country rock. A number of diagrams effectively summarize the many features of the clefts. One diagram, for example, generalizes the temperature sequence for all the cleft minerals in non-carbonate rocks. Here it is shown that relatively few minerals (amianth, kyanite, etc.) began to crystallize above 400°C.; quartz is believed to have begun crystallizing about 300° and continued to around 150°; calcite crystallized in tabular habit around 300°, was resorbed with falling temperatures and then crystallized in rhombohedral habit from 250° to 150°, in scalenohedral habit below 150°; zeolites first appeared a little above 100° and continued to separate to as low as 60° (in the case of laumontite). Another diagram presents data on mineral volumes (quartz is the most abundant, followed by chlorite and adularia); another gives data on crystal dimensions (some quartz crystals are over 100 cm., and some calcite crystals nearly as long); another diagram gives mineral associations; still another relates the parageneses to country rock types.

Part IV (105 pages) by Niggli, concerns the origin of the deposits. He emphasizes again the close chemical relationship between cleft minerals and country rock. Many analyses of both minerals and rocks are given, and equations to represent the transformations are presented. The physical chemistry of the falling temperature sequence of crystallization is discussed. He also stresses the relation of the clefts to Alpine tectonics; the clefts are essentially tensional openings developed in arches formed at the time of the major overthrusts. Immediately after formation of the opening, it was filled with hot water and because of the tectonic conditions affecting the rock, diffusion into a zone around the cleft was furthered. Principally within this zone (although more distant contributions are not excluded) the rock was leached of its more soluble constituents, which with lowering temperatures were redeposited within the cleft to give the typical Alpine parageneses. Only lateral secretion, Niggli feels, can explain all the features of these deposits, and he points to the relative scarcity in the clefts of sulphides and of heavy metals, and the relatively wide-spread distribution of titanium minerals as compared with hydrothermal deposits of magmatic derivation. Taken alone, these items are not sufficient to discount magmatic contributions; but taken in conjunction with the mineral-rock relationships, the case for lateral secretion seems rather convincing.

Part V, by Koenigsberger and Niggli, is a short discussion of the literature on these deposits, with a bibliography of nearly 600 titles, going back as far as the year 1546. Only forty references are found in English-language journals, and of these only three have appeared in American publications!

Illustrations are abundant and excellent. It is regrettable, however, that there is no list or index for the many charts, figures, tables and plates, which last include a number of superb reproductions from photos by F. N. Ashcroft. Transparent overlays for these provide a guide to the geographic and locality details.

When peace comes, Switzerland should again be a Mecca not only for winter sports enthusiasts, glaciologists and structural geologists, but also for mineralogists, crystallographers, and collectors, and possibly for "magmaticists" out "gunning for" this lofty stronghold of the lateral secretionists, for all of whom *Die Mineralien der Schweizeralpen* will be a *vade mecum*. And in the meantime, the book—still available through neutral channels—is a "must" for every mineralogical library.

IAN CAMPBELL

GEM TESTING FOR JEWELLERS by B. W. ANDERSON. Octavo, 194 pages with 44 figures. Heywood and Co., Ltd., *London*, **1942.**

During the last two decades the number of useful and authoritative texts on precious stones has increased materially. None, however, emphasizes the methods for the testing and identification of gem stones which might well be used by the jeweler and dealer in gems. The author, Mr. B. W. Anderson, has had long experience in this special field, for he is in charge of The Precious Stone Laboratory of the London Chamber of Commerce, Diamond, Pearl, and Precious Stone Section, and Lecturer in Gemmology at the Chelsea Polytechnic, London, S.W.

After indicating how the book may be of service, the various physical properties of minerals and the instruments that are useful in gem testing are described in six chapters, which include the refractometer; double refraction; color, color filters, dichroscope; specific gravity; microscope; and spectroscope. A chapter of sixteen pages is devoted to the detection of synthetic stones, glass imitation, and doublets. Since the microscope plays an important part in the recognition of these and other gem materials, it would be more logical if this chapter followed the description of the microscope rather than precede it. Sixteen chapters are devoted to the identification of important gems and gem materials. An appendix of thirteen pages includes a glossary, alphabetical summary of gem species, description of the crystal systems, a short bibliography, and tables of specific gravities and refractive indices. There is an excellent index.

The book should prove to be very serviceable to those for whom it is specifically designed, namely, jewelers and dealers in gem stones. EDWARD H. KRAUS

X-RAY CRYSTALLOGRAPHY by R. W. James, Senior Lecturer in Physics in the University of Manchester. *London*, Methuen & Co., Ltd., 1930. vii+88 pages, 29 figures. $4\frac{1}{4}''$ x $6\frac{3}{4}''$. Cloth. Price 2*s*.6*d*. Second edition, **1941**. Price 3*s*.

This excellent book, one of a series of small-sized monographs on physical subjects, gives a concise account of the principles involved in the analysis of crystal structures by means of *x*-rays. *X*-ray crystallography is treated as the descendant of geometrical crystallography, bringing proof of the pre-existing theory of the periodic structure of crystals and the underlying framework of space-lattices, point-groups (crystal classes), and space-groups, and giving the means of finding the absolute lengths of the lattice periods and the actual positions of the atoms in the unit cell. A short chapter on the relation of the crystal form to the crystal lattice shows why crystal faces have rational and preferably simple indices. The following chapter on the crystal lattice as a diffraction grating introduces Bragg's rule and gives an account of the earlier methods of observing *x*-ray diffraction. A chapter on crystal symmetry summarizes the classical geometrical theory, shows how lattice centering and the action of glide-planes and screw-axes give systematic spectral omissions, and explains the calculation of the structure amplitude. The following chapter on the measurement and calculation of the intensities of *x*-ray spectra considers theoretical reflection from perfect and mozaic crystals and the effects of primary and secondary extinction; the calculation of f from the distribution of electrons in the atom, and F from the distribution of atoms in the unit cell; the temperature factor; and the determination of atomic parameters by trial and error and with the help of the Fourier series. In conclusion, some simple structural types are described and a short bibliography and index are given.

In the section on external symmetry rotation-reflexion axes are used whereas rotation-inversion axes are now generally preferred. The groupings of the crystal classes into crystal systems avoids the difficulties that arise when the systems are defined by the typical axial relations, but the recognition of a separate trigonal system leads to formal difficulties. Dr. George Tunell has noted that the diagram representing the space-group D_2^5 (Fig. 20) is incorrect.

By a considered choice and economy of words—recalling the style of the author's chief, Sir W. L. Bragg—Mr. James presents a very readable and illuminating introduction to a complex subject. The concise treatment will appeal particularly to research workers who are commencing a study of structural crystallography. The second edition appears to be an unchanged reprint of the first, on better paper.

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NEW MINERAL NAMES

Meta-alunogen

SAMUEL G. GORDON: Results of the Chilean mineralogical expedition of 1938. Part VII. The crystallography of alunogen, meta-alunogen and pickeringite. *Notulae Naturae Acad. Nat. Sciences Philadelphia*, **101**, 9 pp. (1942).