

BOOK REVIEWS

VERFÄRBUNG UND LUMINESZENZ. BEITRÄGE ZUR MINERALPHYSIK, by KARL PŘIZIBRAM. Vienna, Austria, Springer Verlag (1953). xii+275 pages, 69 figures. Price \$8.25.

After more than 30 years of fruitful research on the effect of radioactive rays on color and luminescence of minerals, Přizibram has written a welcome review of this important field of mineral physics. The field has not been reviewed since the publication in 1910 of Doelter's book, *Das Radium und die Farben*, which consisted of 133 pages dealing with early qualitative observations and contained a bibliography of 160 papers. The great difference between the two reviews, both with respect to the amount and nature of experimental data covered and to the manner of treating the data theoretically, is a measure of the advance that has been made in solid-state physics during the intervening years. Přizibram includes a bibliography of 929 papers.

The book is not a general reference for all types of mineral coloration and luminescence, but rather a specialized monograph on coloration and luminescence induced in minerals by radioactive rays in nature. As has become evident, especially from the work of Přizibram and his colleagues, many minerals show these effects of irradiation.

The book is divided into two parts. Part 1, consisting of nine chapters, deals with techniques of laboratory study of radiation effects on natural and synthetic minerals and with current theoretical interpretations of the phenomena observed. A listing of the chapter headings (freely translated) will suggest the scope of this part: historical review, methods for producing and investigating coloration, experimental data on coloration of alkali halides and other substances, photoelectric effect relative to coloration, theoretical concepts, coloration of glasses, coloration by colloids, theory of color development, and luminescence.

An ever-present difficulty in writing about a borderline field like mineral physics is the fundamental difference in outlook that divides physicists from mineralogists, as discussed by Bragg.¹ Přizibram is exposed to censure from both camps. In part 1 Přizibram gives the physicist's viewpoint and demonstrates the power of modern electronic theory of crystals to explain the major features of radiation coloring and luminescence. His discussion of the role of crystal imperfections—cracks, impurities, and vacant ionic sites—is especially illuminating.

In part 2 he presents a wealth of descriptive information for the mineralogist who cannot brush aside the complexities of natural minerals as tiresome details. The chapter headings of part 2 are: possibilities for coloration in nature, rock salt, other halides, fluorite, oxides and sulfides, carbonates, sulfates, nitrates and phosphates, silicates, diamond, pleochroic halos, and concluding remarks.

Among mineralogists there is increasing interest in radiation-induced fluorescence, phosphorescence, thermoluminescence, and coloration. Přizibram's good coverage and discussion of the literature on minerals will greatly help workers in the field and will encourage others to enter the field.

Of special interest to mineralogists are the sections on radioluminescence, criteria for recognizing radiation coloring, blue halite, fluorite, spodumene, and pleochroic halos. In the last section there is a reminder that the alpha-emitting nucleus that formed a halo indicative of an air equivalent range of 1.74 cm. has not yet been identified.

It is regrettable that Přizibram apparently missed seeing the account of an interesting

¹ Bragg, W. L., Acceptance of the Roebbling Medal of the Mineralogical Society of America: *Am. Mineral.*, **34**, 238-239 (1949).

practical application of his discovery of radiophotoluminescence, namely the paper by Schulman and others² on the development of a radiation dosimeter.

The book is well bound and printed. The index is not adequate but is bolstered by the bibliography, which is also indexed. The book is a *must* for every serious mineralogical library.

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CONVERSATION WITH THE EARTH, by HANS CLOOS (Translated from the German by E. B. Garside; Edited and slightly abridged by Ernst Cloos and Curt Dietz), xxx+413 pp., Alfred A. Knopf, New York, 1953. Price, \$5.75.

When *Gespräch mit der Erde* was first published in 1947 it gained enormous popularity not only as a charming autobiography and travel diary, but also as a fascinating exposition of geological method and of geological processes.

The translation preserves in large measure the interesting style, conciseness, and clarity of the original. The text has been condensed slightly, perhaps 10 percent, and the number of plates reduced from 71 to 52. The plates are smaller and not as well printed or arranged as in the German edition, but 26 explanatory maps and diagrams have been added, which aid a great deal in following descriptions of journeys and of geological processes.

Hans Cloos traveled extensively on four continents. Wherever he went he found, solved, and elucidated major geological problems. When an answer was not forthcoming from field evidence, or where more than one alternative appeared plausible, he set up and carried out intricate and ingenious experiments that usually suggested a definite solution. For example, one series of "time scale" experiments suggested that perhaps grabens like those of the Red Sea and the Rhine Valley may be structural depressions in the crowns of domes which have been produced by vertical upwelling, rather than being down-dropped trenches between two crustal blocks that have been pulled apart by horizontal forces.

These experiments explained many things for which there were previously no explanations. The work of Hans Cloos in experimental tectonics is classic, and most later work in this field is directly or indirectly based upon it.

Equally successful and impressive were the concepts developed primarily from field observations. Ideas concerning the mechanism of intrusion of granitic rocks and the development of their fabric, conceived during early work on the Erongo granite of South Africa and developed by laboratory experimentation and detailed field studies of the granite of the Riesengebirge in Silesia, were later tested on a grand scale by application to the tremendous granodiorite batholith of the Sierra Nevada. Students and followers have applied these ideas with similar success almost the world over.

There is no chapter in the book headed "Experimental Geology" or "Field Methods." It is a delightful account of a marvelously full and rewarding lifetime of field work, experimentation, and reflection woven into as pleasing a story of scientific accomplishment as can be found anywhere. It is not a systematic treatise on geology. It is not a textbook. But one who reads it carefully will come away with a better appreciation of geology, of geological processes, and of geologists than he would gain by reading many, many textbooks.

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² Schulman, J. H., and others, Dosimetry of x-rays and gamma-rays by radiophotoluminescence: *Jour. Applied Physics*, 22, 1479-1487 (1951).

HISTORICAL DEVELOPMENT OF INCLUSION THERMOMETRY, by F. G. SMITH, 149 pp. University of Toronto Press, Toronto, Ontario, 1953. Price, \$4.50.

This little volume is divided essentially into three parts:

(1) *An account of the history of the development of inclusion thermometry (Published Data)*. This section represents an extensive search of the literature for the period 1818-1952. (There is one 1953 reference.) The method of treatment is simply a chronological arrangement of brief abstracts or annotations of all of the references listed in the third part of the book. Most of the abstracts are so short that it is necessary to go back to the original articles for details of procedure and results. There is no connected account of the development of ideas, techniques, theories, or interpretations. Space could have been saved by combining parts one and three and including authors in the index.

(2) *A critical summary of the present state of knowledge*, which includes a summary of the types of inclusions in crystals, their possible modes of formation, and a discussion of the methods of studying them. The discussion is quite good, and careful attention to it will aid a novice in the field in making interpretations and will enable him to avoid many pitfalls.

At least two additional modes of formation of liquid inclusions should be mentioned: (a) Covering of etch-pits on the surfaces of crystals and (b) Covering over of solid reentrant angles between two adjacent or intergrown crystals or parts of crystals. The largest liquid inclusions known in vein minerals form in this manner.

(3) *An excellent bibliography* which will prove very useful to all workers in the field and to others interested in inclusion thermometry.

There are a few points that should be called to the attention of interested readers:

On page 52 in a discussion of Schröer's 1927 paper it is stated that "the critical temperature [of the solution(s)] was found to be somewhat above that of pure water, but the exact difference was not determined." Actually, Schröer gives values of increases in the critical temperature for solutions of alkali halides up to about 5 per cent by weight. All of the results are given to tenths or hundredths of a degree.

On page 70 the "currently accepted" figure for temperature of formation of pegmatite quartz is given as approximately 575° C. This was the accepted figure 30 or 40 years ago, but more than 10 years ago Wright himself, on whose work the figure of 575° was based, recognized that most pegmatite quartz forms below that temperature, and much of it far below.

On page 107 Smith "postulates that carbon dioxide plays a somewhat passive role." That may be true with silicates, but certainly not with quartz itself. The presence of CO₂ reduces the solubility of quartz markedly and causes its precipitation under conditions where it would not form if CO₂ were absent.

In view of the current tendency to accept the idea of important transport of material by diffusion through the lattices of minerals, it is pertinent to mention, as Smith does on page 108, that no experimental data supporting the idea have been published.

Also on page 108 he emphasizes the need for a more systematic comparison of the visual and decrepitation methods of studying liquid inclusions. One of the great needs of geologic thermometry, certainly, is a satisfactory correlation of these two methods.

On page 109 it is suggested that the pressure can be estimated by comparing the temperature obtained from thermoelectric data with temperature of decrepitation. The reviewer suggests that estimates of pressure from geologic data would be more accurate in most cases.

In the second paragraph of page 110 Smith suggests, apparently entirely on theoretical grounds, that the temperature at which glassy or "complex siliceous" inclusions become

homogeneous should approximate the temperature of formation of the enclosing crystal. This might be true of some igneous minerals that have crystallized from an essentially anhydrous magma, but even then only for certain rare cases. It will not be true of vein and other hydrothermal minerals, which are the great bulk of those studied by the inclusion method. The reviewer has heated quartz crystals containing such inclusions to temperatures that were certainly above that at which the quartz grew, yet the inclusions showed no observable change.

The method suggested on page 111, of determining temperature and pressure by varying these factors until a perfect "fit" of crystal inclusions is obtained is ingenious but would be extremely difficult, if not impossible, experimentally.

There is a short index under the heading "Bibliography (Subjects)." Many important subjects, such as "critical phenomena," "supercritical phenomena," and "critical temperature" are omitted entirely. Others are very inadequately treated. For example, there are no individual mineral names in the index. If one wants information on liquid inclusions in quartz he must look up all the references to "Pegmatitic minerals, inclusions in," of which there are 55 and all the references under "Vein minerals, inclusions in," of which there are 82.

The book was produced by the photo offset method from typed copy, but it is on good paper so that it is quite as easy to read as most printing. It is by far the most complete summary that has appeared on inclusions in minerals as clues to their temperatures of formation. It will be the starting point for researchers in this field for years to come.

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NEW MINERAL NAMES

Latiumite

C. E. TILLEY AND N. F. M. HENRY, Latiumite (sulphatic potassium-calcium-aluminum silicate), a new mineral from Albano, Latium, Italy. *Mineralog. Mag.*, **30**, 39-45 (1953).

White to glassy material, massive and in elongated tabular crystals occurred in two ejected blocks of the Alban Hills, associated with hedenbergitic pyroxene, grossularite-andradite, melilite, leucite, haüyne, and in one specimen also with kaliophillite. Sp. gr. = 2.93, H. = 5½-6. Analysis by J. H. Scoon (combination of 2 partial analyses) gave SiO₂ 28.33, Al₂O₃ 24.67, Fe₂O₃ 0.50, FeO 0.55, MnO 0.02, MgO 0.76, CaO 29.41, Na₂O 1.11, K₂O 7.20, H₂O⁻ none, H₂O⁺ 0.27, SO₃ 5.42, CO₂ 1.60, Cl 0.14; sum 99.98 - (O = Cl₂) 0.03 = 99.95%. Further chemical and x-ray data are needed to determine the formula; two possibilities are X₈YZ₁₀O₂₅(SO₄) with X = 5.91 Ca, 0.40 Na, 1.73 K, Y = 0.76 Al, 0.16 Fe, 0.21 Mg, Z = 5.31 Si, 4.69 Al, SO₄ = 0.76, 0.40 CO₃, 0.02 Cl; or X₈Y₄Z₇O₂₅(SO₄) where X and SO₄ are as above, Y = 3.76 Al, 0.16 Fe, 0.21 Mg, and Z = 5.31 Si, 1.69 Al. The first would be a sheet structure, the second perhaps one of mixed groups (SiO₄)(Si₂O₇).

Latiumite is decomposed by weak acids leaving a silica pseudomorph. It fuses before the blowpipe and the resulting glass partly devitrifies at a low red heat to a fine-grained product that gave an x-ray powder photograph similar to that of melilite.

Latiumite is monoclinic. Weissenberg and oscillation photographs gave $a = 12.12$, $b = 5.13$, $c = 10.80$ Å, beta 108°. G. calcd. 2.93. X-ray powder data are given. There is a perfect cleavage (100) and this is also the twin plane. The mineral is variable optically, indices recorded being $\alpha = 1.600$, $\beta = 1.606$, $\gamma = 1.614$, also $\alpha = 1.603$, $\beta = 1.609$, $\gamma = 1.615$. Mottled extinction is characteristic, with $\alpha:c$ ranging from 16° to 28° and 2 V from 83°(+) to 72°(-). Presumably the variation in optical properties is due to variation in composition