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BOOK REVIEWS

THE INFRARED SPECTRA OF MINERALS. Edited by V. C. Farmer. Mineralogical Society Monograph 4, 1974. Mineralogical Society, 41 Queen's Gate, London SW7 5HR. x + 539 pages £16.00, $38.00.

It is something of a curiosity of science that despite several decades of fruitful work it is still not possible to go to a mineralogical handbook and find useful information on the infrared spectra of the described species. *The Infrared Spectra of Minerals* therefore fills what has long been a conspicuous gap in the mineralogical literature. There are 21 chapters written by 13 authors. The larger part of the book consists of a number of authoritative and often penetrating reviews of the infrared spectra of major mineral groups—oxides, hydroxides, borates, carbonates, phosphates, sulfates, and the different structural groups of silicates. Introductory chapters cover the theory and practice of vibrational spectroscopy as applied to minerals, and the book concludes with sections on the mineralogically related fields of cements, ceramics, and glasses.

Although there are many absorption band frequency tabulations and illustrative spectra, it has not been designed as a handbook of mineral identification. In the discussion of each mineral group emphasis has been placed upon understanding the origin of the vibrational spectra and how they may be applied to characterizing those minerals and their reactions. Where insufficient data exists for this type of treatment, species are dealt with briefly or not at all. However, even where no extended discussion is included, a lead into the recent literature is usually available from the extensive lists of references.

The ambitious conception of this book has enabled proper space to be given to introductory aspects without which it would have been too narrowly specialized. The section on instruments and techniques by J. D. Russell, which gives a distillation of the experience of many years of practical infrared mineral research at the Macaulay Institute, will be read with profit even by experienced workers. V. C. Farmer and A. N. Lazarev give a clear exposition of the method of determining the number and nature of vibrations characteristic of a mineral with the aid of new tables. A good introduction to the Raman spectroscopy of minerals by W. L. Griffith, with references complete to 1970, is unfortunately well out of date, a testimony to the recent revolution in vibrational spectroscopy caused by the proliferation of relatively inexpensive Raman instruments.

Like the previous volumes in the Mineralogical Society's monograph series, the book provides such an obvious access to the subject that it will be widely used not only by specialists but also by workers in other fields of mineralogy and by a generation of graduate students. It is a pity that in such an invaluable addition to the literature the lack of uniformity in reproducing the infrared spectra mars an otherwise pleasing presentation. For inexperienced readers the spectra will often be obscure and sometimes misleading. They have been drawn in all possible orientations even within one chapter—normal, upside down, or reversed—when convention calls for long wavelength to the right. There are many cases where the intensity axis is unlabelled, and in a few cases where the spectrum consists only of broad bands it is scarcely possible to decide which are the absorption bands and which are the transmission regions. On the other hand it might be argued that, if anyone is going to explore the infrared literature, he might as well get used to the chaotic state of spectral presentation which basically reflects not only the type of instrument used to record the spectrum but also national, individual, and editorial predilections.

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Corrigenda

p. 519, last line: read C_s^a for C^a
p. 522, Table D_{6h} in column headed D'_{3h} read A'_2 for A'
p. 522, Table D_{6h} in column headed C_{6h}: read E_{1u} for E_u

CONTRIBUTIONS TO CLAY MINERALOGY: *Dedicated to Professor Toshio Sudo, on the Occasion of his Retirement.* From Festschrift Committee, Geological and Mineralogical Institute, Tokyo University of Education, Otsuka 3-29-1, Bunkyo-ku, Tokyo, Japan, 1975. xix + 261 pages.

This nicely printed volume, prefaced by a photograph of Professor Sudo, contains 46 contributions (24 in Japanese with English abstracts) by his associates and former students, distributed over the following topics: clay mineral structures (7), interstratified clay minerals (7), occurrence and properties of clay minerals (17), clay-organic compounds (2), volcanic ash and soil clay minerals (7), landslide clay (3), and general topics (3). This wide range of topics reflects the broad interests of Professor Sudo who, in the period 1935-1974, has published more than 200 papers. All who are interested in the science and technology of clays and layer silicates will certainly find much that is of interest in this volume. I select the following (which of course reflects my own bias): the distortion of Si(Al) tetrahedra in sheet silicates (Y. Takeuchi), diffuse scattering of X-rays and electrons by mica-like minerals (H. Kodama), divalent cation substitutions in tetrahedral and octahedral sites of micas (H. Tateyama), oblique texture diffraction patterns of some interstratified minerals (T. Nishiyama), X-ray and infrared studies of sudoite and tosudite (S. Shimoda) (both these minerals are named after Professor Sudo), studies of a nickeliferous laterite profile (A. Satsumo and K. Harada), clay minerals and petroleum hydrocarbon formation (A. Shimoyama and W. D. Johns), spherical halloysite from Japan (H. Minato). (In most cases, these titles are abbreviated versions of the original ones; all these articles are in English). Probably everyone interested in clays and clay minerals could pick out another half-dozen titles reflecting his particular bias.

This volume worthily honors Professor Sudo on the occasion of his retirement after 20 years as Professor of Mineralogy in the Tokyo University of Education, but I hope he will continue to contribute to this subject to which he has already contributed so much.

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CRYSTALLINE SOLIDS. By Duncan McKie and Christine McKie. Published in Great Britain by Thomas Nelson and Sons; in USA by Halsted Press, Wiley, New York, 1974. x + 628 pages. $17.75.

Both authors are lecturers in mineralogy and petrology at the University of Cambridge. The book comprises two parts. Part I attempts to cover a broad field, which encompasses nearly all of crystallography *sensu vasto*. Part II, only one-fourth as long, deals with unrelated material pertaining to thermodynamics, phase diagrams, and experimental methods of analysis and synthesis (It is being reviewed separately by Dr. R. F. Martin). This text is intended for mineralogists and like-minded scientists: its aim is to "provide a physical understanding rather than a rigorous development." After reading some 400 pages I am impressed by the elegance of the language, but stunned by the large number of misprints, inaccuracies, errors, and points to which I must take exception.

On the plus side can be noted: two departures from the British tradition in discarding the Miller rhombohedral axes in favor of the Bravais-Miller hexagonal axes and accepting the concept of symmetry directions in a lattice, a useful innovation in Weber symbolism $[UV\dagger W] = [uvtw]$, skilful and extensive use of the stereographic projection (particularly to describe X-ray methods), the introduction of the concept of space group of a lattice, a courageous stand for the *b*-unique setting of monoclinic crystals, the quality of the last three chapters in Part I (Crystal chemistry, Crystal physics, Crystal optics), good line drawings and excellent half-tone reproductions, and—this too must be acknowledged— a valiant attempt at integrating all of crystallography in a single volume.

The text, however, is poorly organized, repetitious, conveying its message—one might say—by successive approximations. It is chatty, diluted, and padded. Lengthy figure legends rehash textual explanations. The coverage, meant to be elementary, often lapses into the superficial—what with the authors continually pointing out the many topics they consider "outside the scope," flippantly announcing "we do not propose to work laboriously through the derivation" or superciliously avoiding "tedious detail." Main shortcomings are the following: failure to recognize crystal morphology, lukewarm endorsement of the reciprocal lattice, shunning of vector algebra, faulty logic, clumsy terminology, conflicting symbolisms and—particularly deplorable in a text intended for students—no historical perspective.

The book also suffers from a lack of feel for basic concepts: observations, assumptions, definitions, principle, law of nature. These terms are used in a very disturbing way (on p. 461): "assumptions known as laws," "the laws of thermodynamics being empirical assumptions," "the zeroth law . . . is an important principle." Mistaking a definition for a principle is not a novel phenomenon; "Neumann's Principle" is the most notorious example. Like the so-called "law of symmetry," it was exploded as early as 1911 in G. Friedel's *Leçons de Cristallographie* (p. 31), but it is still taken seriouly in some books, including the one under review (p. 365).

The book was printed in Great Britain; typography and bookmaking are up to the best standards. The jacket offers a puzzle in symmetry: twelve brightly colored circles on the front are reflected on similarly colored circles on the back. The mirror exists for color only. These circles randomly carry stereograms either of the symmetry elements or of the general form in six out of the seven holohedries: only the triclinic is left out. (Not bad for people who boast of not being interested in morphology!) If the text did not quite come off, it was a good try. The authors should take comfort in the reviewer's expressed hope that future editions will get closer to his high expectations.

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Part II

In part II of the book *Crystalline Solids*, the authors have focused on topics of relevance to the mineralogist and the material scientist, "whose interests are generally similar." The four chapters cover the thermodynamic basis of mineral equilibrium, the interpretation of phase diagrams, the determination of composition of phases, and the experimental methods of synthesis and of testing for the attainment of equilibrium. The authors endeavor to cover these broad fields succinctly, presenting only the essentials of the matter. They succeed particularly well in their "no-frills" presentation of the thermodynamic basis of phase equilibria. The interplay between thermodynamic and structural properties is well brought out, as in the discussion of polymorphism between diamond and graphite. Few typographical errors have crept into these chapters; the most serious involve the definition of specific heat at constant volume (p. 471) and the formulation of an equation for the combustion of graphite (p. 478). More bothersome, however, is the uneven treatment given many topics. For example, the authors illustrate solution calorimetry by discussing in detail one very specific case, in which "the calorimeter is filled with 856.0 g 20.1 percent (wt percent) HF" (p. 468). Similarly, a discussion of mineral separation and silicate-analysis techniques (p. 558-560) is presented in terms that are overly specific to the examples chosen. In contrast, very few applications are provided where theoretical binary or ternary phase diagrams are discussed. The discussion of order-disorder involves no reference to a mineralogical example. Polymorphism is treated in a one-component system, without the complications that arise in nature, where the coexisting phases very often do not possess identical compositions. Liquid immiscibility is dismissed as it is "not nowadays considered to have frequently exerted any significant influence on the crystallization of minerals from melts in nature" (p. 533). Students of the petrogenesis of carbonate, oxide, and sulfide liquids might contest this evaluation.

The authors simply leave out other topics of direct interest to the earth scientist. The need to consider independent variables other than P and T, in replacement processes, for example, is not covered. Open systems, so common in many geological situations, are not treated either. Possibility of metastable growth of diamond and other high pressure phases outside their field of stability in nature is not properly evaluated. Liquids are said to crystallize at the liquidus, where an infinitesimal amount of solid appears; no mention is made of the supercooling necessary to induce nucleation and growth, or of the importance of diffusion and non-equilibrium processes attending growth in the interface region. Partition coefficients governing distribution of trace elements among solids and applications to geothermometry should have been covered briefly in a book of this type. These modifications of part II would increase the relevance of the text, at least for students of natural processes. As it stands, the book tells the student how pure crystalline solids should behave in the laboratory, without giving him enough of a foretaste of the complexities imposed by Nature.

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