

## BOOK REVIEWS

INTRODUCTION TO CRYSTALLOGRAPHY. By DONALD E. SANDS. W. A. Benjamin, Inc., New York and Amsterdam, 1969, xii+165 pages, 83 figures. \$12.50 hardcover, \$4.95 paperback.

Dr. Sands, Ph.D. Cornell 1955, teaches Inorganic Chemistry at the University of Kentucky, in Lexington. He bravely tackles the problem of imparting, in seven short chapters, enough of the language of crystallography "quickly and painlessly to enable the nonspecialist to read and comprehend the crystallographic literature." What he really means is the crystal structure literature. (To this extent the title is a misnomer: it should read, Structural Crystallography.) Dr. Sands' audacious undertaking must have required uncommon courage, for no previous book of comparable size has claimed such an ambitious goal.

In a book written by a chemist for chemists, as part of Walter Kauzmann's "Physical Chemistry Monograph Series", it is no surprise to find Crystallography considered a topic in Physical Chemistry. This approach accounts for the relative weights given to the various chapters in the planning of the book, as well as for the order in which the parts are presented. On both counts the book may seem unusual, but it answers its purpose.

The first four chapters (84 pages) explain *how structures are described*. This is the backbone of the text: chemists obviously consider this material their main stumbling block. The lattice is taken as given to begin with (how it was discovered comes later). Point-group symmetry applied to molecules is explained in both Schoenflies and Hermann-Mauguin notations. A short initiation to group theory suffices to introduce group-multiplication tables, in which the symmetry operations are written in the spectroscopists' symbols. (Although *symmetry operations* are *group elements*, they should not be called *symmetry elements*.) Then come the crystal systems, correctly defined in terms of the restrictions imposed by symmetry on the shape of the cell; the 14 lattice modes; the law of rationality. Included in this chapter is an elegant proof of the existence of rotation axes of order 1,2,3,4, or 6 in a lattice. A very practical discussion of space groups and their use concludes the first part.

A second part, half as long as the first, tells how *structures are determined*. A 29-page summary of X-ray diffraction by crystals, and of the experimental methods of obtaining and processing the data, adequately shows how to determine the cell and possible space groups. Methods to elude the phase problem and get at atomic co-ordinates are adumbrated in five pages—no mean task! Amazing though it may be a number of fundamental concepts do emerge from this ruthless compaction: Patterson maps and their unravelling, heavy atom, isomorphous replacement, inequalities, Sayre's relation, even the general idea of the Hauptman-Karle methods (in 6 lines) and the significance of the residual  $R$ .

The last chapter describes twelve simple crystal structures, admittedly not meant to substantiate the claim made in the introduction. A list of the Hermann-Mauguin space-group symbols is appended. Also relegated in the appendix, here come the reciprocal lattice ("de la moutarde après le souper"!) and the powder method. Some 75 problems, distributed through the book (with answers in the back), effectively increase its coverage. References are made to 25 standard works, many of which will help the instructor more than the students. Most of the 83 figures are excellent; some are particularly striking, like the sequence of five drawings of a wallpaper, which show how—"Pick any point"—to extract the *lattice* from a *structure*; a few did not come off so well (in Table 3-2).

One may differ with Dr. Sands on what is the ideal amount of mathematics to be used. We hope he will, for the 2nd edition, reconsider his decision to leave out vector algebra: so

little of it goes such a long way, and most undergraduates already know it anyway. Is it not inconsistent to adopt trimetric co-ordinates and to shy away from vectors, unrealistic to use Fourier series and to forgo the reciprocal lattice? Granting the author his rightful choice of prerequisites, however, we would be hard put to improve his presentation, except on minor points: A misleading interpretation of crystal morphology (p. 64) could be replaced by a factual statement of the law of Bravais. Bravais' only initial is A. (The M. in front stands for *Monsieur*.) German for body-centered is *innenzentriert* (perhaps the only misspelled word in the whole book). It would be better not to refer to the hexagonal and rhombohedral lattices as "trigonal lattices". The word "identical" should not be used in its everyday sense to mean *equivalent* or *similar*. *Triple cell* is preferable to "triply primitive cell" (for a cell that is nonprimitive). The words *screw-rotation* and *glide-reflection* could be used to uphold the distinction (so clearly made on p. 14) between *symmetry operation* and *symmetry element*, and the ill-defined "symmetry operator" could profitably be discarded.

Crystallography teachers, perusing the book, will not notice these slight imperfections nearly as much as the many skillfully avoided potential pitfalls. Mineralogists should find this chemist's viewpoint stimulating and rewarding. The book making is above reproach, and well it might be at that price.

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CONTEMPORARY CRYSTALLOGRAPHY. By MARTIN J. BUERGER McGraw-Hill, New York, 1970. 364 pages, \$12.50.

The objective of the book is not to be "suitable as a guide to the actual practice and techniques . . . , but rather to outline the general theory and features of the methods so that the student scientist . . . [may] . . . obtain an intelligent grasp of . . . methods, . . . [applications to types of] problems, . . . and . . . data of present day crystallography." This sentence appears on page 105, but essentially the same idea is found in the Preface (p. viii), and elsewhere (*e.g.*, dust jacket, front flap, p. 47). The point is well emphasized, for the book is certainly neither a handbook nor a textbook. Instead, Buerger sets up four objectives: (1) introduce characteristics of crystals; (2) outline current theory and results concerning their basic geometry; (3) analyze modern methods of experimental crystallography; (4) describe the "spirit" of crystallographic results "by sketching the highlights along the route, always keeping in mind the spirit itself." (p. vii).

Burger knows that mineralogists trained in crystallography may have deficiencies in such fields as vector and matrix algebra, and that most other scientists will probably need to study systematic aspects of crystallography. He devotes a chapter to each, with enough material to whet the appetite of the reader. He also cites appropriate references for further study at the ends of most chapters, and includes illuminating "notes on history" in each. The 14 chapters include: Geometrical nature of order in crystals (perhaps mainly for non-mineralogists); Diffraction of X-rays, Reciprocal lattice (mineralogists take note); Routine symmetry determination; Introduction to the use of X-rays in the study of crystals; The less powerful diffraction methods [*i.e.*, powder, Laue, rotation, and oscillation methods]; Weissenberg method; Precession method; Cell contents and their general arrangement; Investigation of the arrangement of atoms in the cell; Fourier synthesis and the phase problem; Patterson function and image theory; Refinement.

There is a long index with about 2200 entries. One notes duplications like "Background fluctuation, 325" and "Fluctuation, background, 325"; also "Layer line, 121, 122, 129," "Layer lines [sic], 121, 123, 129" and "Line, layer, 121, 123, 129," which reduce the real scope of the index. Nevertheless, a thorough indexing, with numerous redundancies, should be welcome and useful. I hope the work will find its place in many libraries, private as well

as institutional, for it can indeed suggest, even if it does not fully explicate, the possibilities of crystallographic study.

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FLUORINE MICAS. By HASKIEL R. SHELL and KENNETH H. IVEY. United States Department of the Interior, Bureau of Mines, Bulletin 647, 1969. Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 291 pages, 86 figures, and 132 tables, \$2.75 (paper cover).

This book has appeared on the basis of the synthetic work of fluorine micas initiated and developed after the World War II to obtain large single crystals or films suitable to replace natural muscovite. Most of the book, therefore, is devoted to detailed data and descriptions on chemical compositions, syntheses, products and uses of fluorine micas, with well-illustrated figures, tables, and pictures. The properties of the fluorine micas, including physical, dielectric, chemical, X-ray, optical, and structural, are well described with many tables.

Because the two methods of synthesis of fluorine micas, internal resistance electric melting and arc resistance electric melting, are now used commercially, they are explained in detail. Among the synthetic micas, fluorophlogopite,  $KMg_2AlSi_3O_{10}F_2$ , is most widely used. Its crystal growth, properties, uses, and impurities are, therefore, precisely described. Although most of the fluorine micas are completely stable in water, some synthetic water-swelling fluorine micas and fluorine montmorillonoids are described, indicating the varieties of synthesis. Other varieties of micas are also described, such as glass-bonded mica, reconstructed sheet from fluorophlogopite, and fluoromica ceramics, all of which are widely used commercially. In appendices, the authors summarize the U. S. patents on synthetic fluorine micas and list of the reports of the Bureau of Mines.

The authors have done a remarkable job of presenting a well-written summary and account of the latest developments in the field of technology of mica synthesis. This monograph will be appreciated in the mineralogical and ceramic laboratories as well as in the centers of material industry.

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AUSTRALIAN ROCKS, MINERALS AND GEMSTONES. By R. O. CHALMERS. American Elsevier Publishing Company, Inc., New York, 1968. 398 pages, \$17.50.

The first five chapters of this book provide a concise and comprehensive introduction to mineralogy and petrology, well designed to meet the needs of the amateur collector with little or no previous exposure to these subjects. Chapter 6 gives brief but adequate descriptions of nearly 300 mineral species, which certainly cover practically all the minerals that an Australian amateur collector is likely to acquire, and some that he is not (for example, twelve sulphosalts are described, including such rarities as lillianite and wittichenite). The Australian localities are given for only a few species (locality data are given in Chapter 8); in a second edition it would be convenient if this were extended to all but the very common minerals.

For the non-Australian, the most useful and instructive part of the book is Chapters 8, 9, and 10, which provide an excellent regional mineralogy of Australia, full of information not readily available in any form. The author's forty years of experience at the Australian Museum and his extensive travels have provided him with an unequalled knowledge of the mineralogy of this fascinating continent, and he has distilled this knowledge into an eminently readable and instructive account. My only criticism is the absence of a map, or

preferably two maps, one showing the principal mineral localities and the other showing the broad geological features of the continent. These maps would graphically illustrate the vast areas of flat-lying sedimentary rocks or of desert deposits of little interest to the mineral collector, and could appropriately form the end papers of the book.

The book is completed with a useful bibliography and excellent indexes, both locality and subject. The book is well illustrated with both black and white and color plates.

This book was published in 1967 by the firm of Angus and Robertson in Australia at the retail price of \$A10.75. The review copy appears to be identical with the Australian edition, except for the title page, which reads "American edition published in 1968 by American Elsevier Publishing Company, Inc."; it retails at \$17.50. Even allowing for the fact that \$A1.00 = \$US1.12, the mark-up to the American purchaser seems excessive.

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THE POLARIZING MICROSCOPE, 3RD ED. By A. F. HALLIMOND. Vickers, Ltd., Vickers Instruments, York, England, 1970. 302 pages, \$14.00.

This final edition of Dr. Hallimond's book summarizes the knowledge and experience accumulated during the many years he spent in the development of polarizing microscopes and related instruments and in their application to the microscopy of both transparent and absorbing materials. Like the preceding volumes, the third edition centers around the elements of polarizing microscope systems, their functions in the determination of optical properties of crystals, the optical relations involved, and problems encountered in the practice of microscopy. The book is written with particular reference to the Vickers line of instruments (successors to those of Cooke, Troughton, and Simms, Ltd.). These have been completely redesigned since the second edition appeared. As before, however, these instruments are merely a vehicle for the discussion of optical relations and techniques for measuring optical properties, and the book is therefore valuable to the users of all makes of microscopes.

The book has been greatly expanded, and certain sections have been substantially revised to bring them abreast of recent developments in the more quantitative aspects of microscopy. There are new chapters on the interference microscope and on the basic principles of crystal optics. Revisions and additions are found in the chapters on measurement of anisotropism, both in transmitted and in reflected light, on microphotometry, microhardness, and polishing and grinding methods. The chapter on microphotometry reflects the shift from visual photometry to use of electronic equipment embodying the photomultiplier, and several makes of instruments of this type are described. The discussion of polishing methods summarizes the author's lengthy experiments with techniques involving diamond abrasives.

This work was never intended as a textbook. Rather, it is a volume that will aid anyone who works with polarized light to achieve better understanding and more effective use of polarizing microscope systems. Largely this is because the author was aware, through many years of contact with both manufacturers and users of polarizing microscopes, of points that need to be emphasized, relationships that can easily be unclear, and specific problems that arise in the practice of microscopy. He had a broad perspective of polarized light microscopy that is readily apparent in this edition. The practicing microscopist will find the work a valuable addition to his working library.

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PRACTICAL X-RAY SPECTROMETRY (2nd Edition). By R. JENKINS and J. L. DeVRIES. Springer-Verlag, New York, Inc., 1970. 190 pages, \$7.80.

As a petrologist applying X-ray spectrography to geologic problems (and teaching such applications to students), this reviewer has found that many of the pitfalls of imprecise and inaccurate analytical results can be avoided by a reasonably thorough knowledge of the practical physics of X-ray generation and detection. The first edition of Jenkins and DeVries' book, published in 1967, provided a well-balanced, highly readable, and relatively error-free discussion of these topics in a concise form. Their book is certainly one of the best on this subject and, in my opinion, superior to several other books (and parts of books) on analytical methods written by earth scientists for earth scientists (Jenkins and DeVries are chemists with much instrumental application and teaching experience). As in the first edition, the second is divided into the following topics: Physics of X-rays; Dispersion; Detection; Pulse Height Selection; Counting Statistics; Matrix Effects; Quantitative Analysis; Sample Preparation; and Trace Analysis. Compared to the first edition, the second has a new section on dead time, and revisions in the sections on quantitative analysis, correction procedures, and pulse-height selection. None of the value of the first edition to mineralogists and petrologists interested in X-ray spectrography has been lost in the second edition.

My principal criticism of the second edition stems from the authors' claim (preface): "We have taken the opportunity to revise the text thoroughly to bring it entirely up-to-date with the latest developments in this field." Except for the specific revision noted above, this claim has not been met. One example: The first edition minimizes (presented identically in the second edition) the importance of non-dispersive detection systems, citing the relatively poor resolution and inefficiency in the light element region. Tremendous technology gains have been made here since 1967, and this technique now merits serious consideration by anyone using X-ray spectrography. The most recent reference given in the second edition on this subject is a 1966 paper. Another example: Granting that dispersive systems are *now* the most commonly used (and most commonly available in commercial instruments) why not provide the most modern information on dispersive analyzing crystals? Not mentioned, but of particular importance in light element analyses, is the polycrystalline graphite "crystal" ( $2d=6.70 \text{ \AA}$ ) which provides an order of magnitude increase in signal intensities for phosphorus and sulfur K-alpha over the EDDT and PET crystals. Also worthy of note are the newer RAP (rubidium acid phtalate,  $2d=26.12 \text{ \AA}$ ) and SHA (orbital hexaacetate,  $2d=13.98 \text{ \AA}$ ) crystals. The latter has the potential for truly practical sodium analysis (for the first time) using commercially available sealed X-ray sources in a flat-crystal spectrometer. In this part of the second edition on dispersion, the most recent reference given is a 1965 paper.

Despite these revisional shortcomings, the book *is* a valuable source of basic information; owners of the first edition, though, may question the need for another \$7.80 outlay.

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VOLCANIC HISTORY OF HONDURAS. By HOWEL WILLIAMS and A. R. MCBIRNEY, with chemical analyses by KEN-ICHIRO AOKI. University of California Publications in Geological Sciences, Berkeley, 1969. 101 pp., 2 maps, \$3.50.

This slender volume will be the last of an outstanding series of reports on Central American geology and volcanology, representing twenty years of work by Howel Williams and A. R. McBirney. The series of reports, which includes some classics of volcanology, has appeared in the University of California Press beginning in 1952. Perhaps the most

meaningful comment I can make on the series is to note that several of the volumes are among the most dog-eared on my shelf.

Central American geologists in particular and volcanologists in general owe a great debt to the thorough field work, painstaking description, and thoughtful discussions of Williams and McBirney. Rugged, inaccessible, and, until recently, almost unmapped topographically northern Central America is still poorly known geologically. Until the Second World War, Central American geology was more poorly known than southern California at the turn of the century. The authors have played a major role in the essential reconnaissance stage in the present development of understanding of Central American geology and volcanology. Their works, and this work in particular, must be regarded as reconnaissance reports—but with far more detail and flair than one generally associates with the term.

The report—as is the case of most of its predecessors, treats both the geological framework of the area (Western Honduras and adjacent Guatemala and El Salvador) and the late Tertiary to Recent volcanic activity there. Most of the text consists of a rather intricate series of brief field relationships and rock descriptions which a person not already familiar with Central American geology will not readily follow. Few of these brief descriptive notes are developed or even explained in detail—a fact which tends to provide abundant small tantalizing reactions. Only a member of the “in-group”, for example, would react to the casual mention of the occurrence of Tactic schists in central Honduras. The failure of the authors to elucidate some of these seemingly trivial points is perhaps only a slight annoyance in the face of the abundant really useful observational data presented here. A more general objection—which applies to previous works in this series—is that there are no outcrop sketches or photos, nor are there any detailed descriptions of some of the key outcrops referred to in the text.

Fifty-four new chemical analyses of volcanic and plutonic rocks by Dr. Aoki are one of the most important parts of the text. Unfortunately, the abundant petrographic descriptions of rocks contain little quantitative mineralogical data, and only a few of the analyzed rocks are described. The thin-section sketches are well done but many readers would prefer to have photomicrographs in their place.

An intriguing discussion of the origin of Central American ignimbrites forms a part of this volume. The authors use major element, strontium isotope (some unpublished) and oxygen isotope data, and a few results from melting experiments on basement metamorphic rocks. Their conclusions that these ignimbrites are not simply anatectic melts, though they could have equilibrated with metamorphic basement rocks, is not unreasonable, but this volume is probably not the appropriate place to develop such an argument.

In their introduction the authors express the hope that their report “will provide a useful guide and incentive to more detailed studies.” In this context this work and its predecessors have few equals in the geologic literature.

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A PETROGRAPHY OF AUSTRALIAN IGNEOUS ROCKS. By GERMAINE A. JOPLIN  
American Elsevier Publishing Company, Inc., New York, 1968, 214 pages, \$8.50.

A new edition of Dr. Joplin's book on igneous petrography, which first appeared in 1964, provides a useful reference to the petrographic and chemical character of Australian rocks. It has an added interest in that it takes a new approach to petrography and the systematic classification of igneous rocks.

In several ways, the book marks an important improvement over previous works in this field. It considers igneous rocks in relation to their petrologic associations and provides a wealth of analytical data and excellent microdrawing of typical examples from geologically

distinct suites. The genetic grouping of rocks according to their occurrence is one that I personally have found useful in teaching and one that I believe will logically replace the classical systems in which rocks of widely differing origins have been lumped together because of certain petrographic or mineralogic similarities. Once students have mastered the techniques of optical mineralogy and can identify common minerals and textures, they are prepared to deal with rocks in terms of simple petrologic and geologic principles, as this book proposes. The only question is how far one can go in this direction, and it is interesting to observe where Dr. Joplin has chosen to draw a line.

The book avoids the matter of phase equilibria and does not refer to experimentally determined relations of any kind. The rocks are discussed, however, in terms of concepts, such as reaction relations, that are based on such systems. Similarly, there are no tables of norms for the many chemical analyses, but rocks are described as being saturated or undersaturated and as having various normative minerals. There are no geologic diagrams, maps, sections or illustrations of outcrop relations, but geologic occurrence is stressed throughout the text.

Dr. Joplin's approach to petrography is a qualitative one, to say the least. Close to two hundred rocks are described without a single volumetric percentage of constituent minerals. Minerals are defined and described but chemical formulas are systematically avoided. Anyone who tries to derive any quantitative comparison of the rocks in different suites or the individual minerals in a given rock will be totally frustrated.

A major section of the text is devoted to the author's proposed shoshonitic magma, which is given equal rank with orogenic and non-orogenic types. It is difficult to weight the merits of this scheme, because of the difficulty posed by imprecise definitions and bewildering inconsistencies. I found it impossible to determine exactly what a shoshonitic magma might be or how I would recognize a rock belonging to the suite. It is said that shoshonites are typically higher in potassium than sodium and that they are rich in alumina and CaO, but an illustrative table of seven undifferentiated shoshonitic rocks includes four that have more sodium than potassium, and in other tables one finds rocks with  $Al_2O_3$  contents down to 9.31 percent.

While agreeing with the logic of earlier workers who have made repeated pleas to abandon the all-but-meaningless names trachybasalt and trachandesite, Dr. Joplin has decided to retain them and adds to the morass of definitions several of her own which are not even consistent from one page to the next. For example, trachybasalts are said to contain labradorite and orthoclase on page 60, but on page 91 it is stated that shoshonites differ from trachybasalts in that the former contain labradorite while the latter have oligoclase. Intermediate intrusive shoshonitic rocks are said to have all the petrographic and chemical features of monzonites but because they occur in a different geologic setting—one in which the crust is being stabilized—she resurrects the deservedly forgotten name banatite (in one place 'banakite') for rocks in this category without defining the chemical or mineralogic limits of such a rock. A banatite of Mt. Dromedary (page 98) contains too much quartz to be called quartz syenite, but on the next page another is described that is equivalent to syenite porphyry with rare quartz. Then in subsequent descriptions of intermediate intrusive shoshonites the same rocks are called monzonites or the products of monzonitic magma. As if this were not confusing enough, the term monzonitic is used to denote a texture, so that one encounters sentences, such as 'the monzonite porphyry also contains phenocrysts of plagioclase and, although the minerals of the groundmass are those common to the monzonite, the texture is finer and essentially granular thus differing from the groundmass of the porphyritic monzonite which is monzonitic.'

The foregoing problems are not likely to concern more than a few American readers, since they deal with a group of rocks which is already notorious for its chaotic nomen-

clature. The descriptions of andesites, however, will be of interest to geologists who are familiar with the Circum-Pacific region. According to Dr. Joplin, andesites never have a pilotaxitic groundmass and contain less augite than hypersthene and hornblende. The late Professor Kuno would be interested to know that pigeonite has never been positively identified as a ground mass mineral in 'true' andesites. I have been told that he devoted seven years to hand picking a sample for analysis of this mineral from the andesites of Hakone volcano. If the intent is to exclude from 'true' andesites the iron-rich and alumina-poor intermediate differentiates of tholeiitic magmas found in certain oceanic and non-orogenic regions, it may be justified, but it appears that the purpose is to equate 'true' andesites with Australian andesites, regardless of what the rocks are called elsewhere.

Despite these minor problems, Dr. Joplin's book can be taken as a model reference to the rocks of a very important continental assemblage. One can only wish that there were similar references for other regions. With the growing interest in global relations of igneous rocks to tectonic environments and large-scale geochemical processes, compilations of this type will prove increasingly valuable.

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A PETROLOGICAL-MINERALOGICAL CODE FOR COMPUTER USE. Edited by R. K. HARRISON and P. A. SABINE, Institute of Geological Sciences, Rept. 70/6. London, 1970, 134 pages.

The use of computers to store and retrieve petrological and mineralogical data has raised perplexing problems regarding the encoding of mineral and rock names—should they be spelled out in full, assigned a cryptic alphanumeric code, or should a compromise be struck? This publication will assist many gatherers of data in this regard. To my knowledge, it is the first to present a set of specific codes for general use, in contrast to the many publications containing codes designed for particular files and purposes.

The codes each consist of 4 alphanumeric digits with a hierarchic, fixed-format structure. Depending on the information available, the hierarchy allows one to distinguish, for example, an "igneous rock" (1000), a "granite" (1A00), and a "quartz felsite" (1ABI). About 2,800 codes are given for igneous, metamorphic, clastic sedimentary, and chemical-biochemical sedimentary rocks; soils and residual cumuloose deposits; mixed mineral assemblages; minerals, and extra-terrestrial materials. Although obviously not comprehensive, all the basic names appear to be present and the coding system allows for limited expansion and modification as required. The codes are presented in two forms, as a "hierarchical display" and as an alphabetically listed "thesaurus". The latter is mainly a lexicon with only some "use" and "used for" relationships given. However, in the Introduction, the application of "use/used for" references is confusing and described erroneously.

Although there is no such animal as an all-purpose code, this one may find many users in the fields of petrology and mineralogy where there is need for a fixed-length, hierarchical code. It should be borne in mind that in many data files, codes for mineral and rock names are neither necessary nor desirable from the scientist's point of view and the fundamental question to be answered in compiling computer-based files is not "what code should I use?", but "what observations should I record?". Given that certain rock and mineral names are to be recorded, use of this code has the advantages of being orderly and searchable without implying commitment to rigid classifications, and of being moderately flexible (some fields, unfortunately, are filled already). On the other hand, the codes themselves are cryptic (*e.g.* apatite=7J51) and they are not at present comprehensive. If adopted nationally or internationally, new editions would be required to control the coding of new names. Hopefully, the merits of such a possibility, among others, will be discussed and decided upon in



the near future by the COGEO DATA committee of the International Union of Geological Sciences.

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GEOCHEMISTRY OF SEDIMENTARY ROCKS. I. PETROGRAPHY AND CHEMISTRY OF ARENACEOUS ROCKS. Report No. 69/1, Inst. Geol. Sci. By P. A. SABINE, E. M. GUPPY, and G. A. SERGEANT. Her Majesty's Stationery Office, London, 1969. 9s Od. 69 pages.

This report brings together analyses of arenaceous rocks from Great Britain made in the laboratories or under the auspices of the Institute of Geological Sciences. As such it is an addition to the already published reports of the Geological Survey of Great Britain concerned with the chemistry of igneous and metamorphic rocks and minerals and will be followed by further reports on other types of sedimentary rocks from the British Isles. Ultimately all reports will be revised into one memoir.

One hundred and forty partial (45) and complete (95) chemical analyses are given for arenaceous rocks of Precambrian to Recent age. The complete analyses include the constituents:  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{FeO}$ ,  $\text{MgO}$ ,  $\text{CaO}$ ,  $\text{Na}_2\text{O}$ ,  $\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}+$ ,  $\text{TiO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $\text{MnO}$ ,  $\text{CO}_2$ ,  $\text{ZrO}_2$ ,  $\text{FeS}_2$ , and C. Minor and trace analyses are provided for a number of the samples. Unfortunately, there are scant analyses of matrix-rich sandstones.

Locality and age information is given for each rock analyzed and a lithic description, density, effective porosity, and the publication reference in which the rock was initially described are provided for each complete analysis. In some cases availability of petrographic and X-ray determinations are also noted. Sixteen photomicrographs, apparently selected to portray visually the petrographic variability of British Isle arenaceous rocks, are illustrated in four plates. Chemical means have been computed for Dalradian, Cambrian, Devonian, Carboniferous, and Jurassic age arenaceous rocks. Notes on nomenclature and chemical methods are also provided.

This report will probably be of most value to researchers interested in historical geology as deduced from the chemistry and mineralogy of sediments. As such it forms a fine addition to the compilation of Pettijohn in the revised *Data of Geochemistry* [*U. S. Geol. Surv. Prof. Pap.* 400S 1963]] and to Vinogradov and Ronov's [*Geochemistry* 6, 523-559 (1956)] excellent work on the Russian Platform. Although the British data are somewhat inconclusive, the  $\text{Na}_2\text{O}/\text{K}_2\text{O}$  ratio of British Isle post-Paleozoic sandstones tends to be higher than that for older rocks, thus confirming a chemical trend observed in sandstones from other parts of the world. If rock specimens and petrographic slides could be obtained, the report could also be used in a class in sedimentary petrology to provide students with complete descriptions and analyses of rock types studied.

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