BOOK REVIEWS

STRUCTURAL PETROLOGY OF DEFORMED ROCKS by H. W. FAIRBAIRN, Assistant Professor of Petrology, Massachusetts Institute of Technology. Addison-Wesley Press, Inc., Kendall Square Building, Cambridge, Mass. 1942. Price, $5.00.

The main reason given by Fairbairn for bringing out a new edition of his text on structural petrology at this time is that, "As much new work has been done recently, a need exists for an up-to-date compilation of facts . . . ." Two previous editions, as mimeographed books, were published by Queen's University in 1935 and 1937. The announced purpose of bringing the factual summary up to date has been accomplished as far as papers published in this country are concerned. At least 25% of the 140 papers in the bibliography have appeared since 1937.

Another reason for bringing out a new edition is the belief that there is a need for a treatment of the subject in which facts and interpretation are not merely plainly distinguished in the discussion, but actually separated into different parts of the volume. There are several ways in which such a separation may be treated, ranging from giving the interpretation of each bit of data as it is given, to the other extreme of presenting all the observed data in one section and all discussion of interpretation in another.

It appears to the reviewer that a middle course is probably the best, to present a moderate amount of data followed by a discussion of interpretation, perhaps the known facts of orientation for one mineral, followed by possible interpretations of those facts. Fairbairn elects to go to the extreme of complete separation, which is not desirable for a text or reference book. It is not possible for a student to hold in mind all the facts presented in Part I while reading the theoretical discussions of Part II. Shuttling back and forth from one part of the book to another is likely to be confusing to a student, as well as inconvenient. This same shuttling back and forth is necessary if the book is used for reference, because there is not a single measured orientation diagram in the entire section on interpretation; for all references to diagrams one must turn back to Part I. This could have been eliminated, at least in part, by using some examples in the interpretive section not already given in the factual section, which would have had the added advantage of giving a somewhat broader view of the work that has already been done.

There is some question whether there is a pressing need for such a volume just now, but certainly the need is not great enough to justify all the shortcomings that evidently are due to rushing into print. These shortcomings range from misinterpretation of previous work, through the style of the book, to simple typographical errors.

For example, on p. 28, in discussing a paper on inclusions in albite metacrysts Fairbairn says, "The cleavages are parallel to the *s*-surfaces of the rock." One of the main points of the paper that he is discussing is that the cleavages are *not* parallel to the *s*-surfaces of the rock, a fact which helped to prove that the mica inclusions in the albite crystals are not relict structures. Then, Fig. 152 on p. 108 shows an apparatus for orienting hand specimens as "about natural size," but the picture is actually about one-sixth natural size, which is far too small to be of any use for orienting hand specimens.

It no doubt would have been possible, by waiting a while to publish it, to have had a more convenient sized printed volume rather than the large ($9\frac{1}{2} \times 11$ in.) loose leaf photographic offset book. However, the print is easy to read and most of the illustrations are clear and well done. The frontispiece is particularly effective. It illustrates graphically the important but little-grasped fact that structural petrology is not concerned alone with grain orientation, but with all spatial relations from the lattice of individual crystals to the largest mountain structures. The index is sketchy and inaccurate. There are numerous errors in references, cross references, etc. For example, on p. 47 there is mentioned a paper as having been written by Adams and Osborne, which was written by Osborne and Lowther.

On p. 63 there is a reference to Figures 11–14, which should be Figures 31–34. There are far too many such errors to be included in a review.

The component pictures of Figs. 92 and 115 are referred to in the text and legend by letters. These letters are omitted from the figures, probably intentionally, but their omission does not help the readability. A large percentage of the orientation diagrams are taken from Sander's *Gefügekunde der Gesteine.* As there are 245 such diagrams in Sander's book, it would have helped greatly in reference if Sander's diagram numbers had been given.

Fairbairn continues to use some definitions and conceptions that are at variance with accepted usage, and introduces a few new deviations in the new edition. This is likely to confuse beginners and to irritate those who are more or less familiar with current usage in structural petrology. For example; *vectorial* is used as synonymous with *directional; dimensional orientation* is substituted for *preferred orientation,* although any crystal has a dimensional orientation whether it shows any preferential attitude toward the fabric axes or not; a *superindividual* is defined as an aggregate of crystals that acts as a single unit, with no mention of the relation of the orientation of the crystals of the superindividual to each other or to the surrounding crystals, which is the fundamental concept in the original definition of *superindividual.*

Fairbairn appears to miss completely, or in part, some of the fundamental concepts on which structural petrology rests. One looks in vain for a suggestion that it is a study of rocks based on kinematics rather than on dynamics. In his discussion of symmetry no mention is made of the symmetry of motion. The symmetry of a diagram reflects the symmetry of the motion that produced the grain orientation and when the motion is lost sight of, the symmetry of the diagram loses its meaning, except for descriptive and comparative purposes. In his classification, therefore, Fairbairn loses sight of the third dimension entirely. For example, some diagrams are referred to as bisymmetrical (e.g., Fig. 24), when the plane of the projection is a third symmetry plane. This failure to think in three dimensions leads to the absurdity of classifying one diagram as bisymmetrical and another from the same specimen as monosymmetrical (Figs. 16 and 17). Diagrams from all three principal sections of a tectonite must show identical symmetry with respect to the fabric axes, if the fabric is homogeneous.

It is gratifying to find such an extensive treatment of the subject of recrystallization, although some of the processes described are open to question. It is astonishing to find on p. 80, for example, that " 'annealing recrystallization' might be expected under higher stress conditions than load recrystallization." In the first place, this leaves the impression that static stress is not a stress. Secondly, in metallurgy, from which presumably the term was taken, annealing recrystallization relieves stresses developed by deformation, which is quite the reverse of the rôle ascribed to it by Fairbairn on p. 54 when he says that "annealing recrystallization may be important in the formation of tectonites."

Many will not agree with the categorical statement that all deformation in calcite is brought about by twinning. In this instance fact and theory have not been separated. This idea causes Fairbairn to label some calcite diagrams taken from Sander as diagrams of twinning planes, when Sander cautiously called them lamellae diagrams.

Part III on Methods is on the whole very well done. Inclusion of the description of x-ray equipment and technique makes it the most complete discussion of methods available in English. Some of the equipment suggested is credited to Americans, when the same things were in use in Innsbruck several years ago; for example, the template shown in Fig. 177. There is no discussion of the "blind spot" in some types of measurements that makes it necessary to have two or more sections from a given specimen before a representative diagram can be prepared.

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MINERALS OF NEW MEXICO by STUART A. NORTHROP. The University of New Mexico Bulletin, whole number 379, Geological Series, volume 6, No. 1 (1942), Albuquerque, New Mexico. 387 pages. Paper bound edition, $1.00; de luxe cloth bound edition, $1.75.

Earlier reports on the mines and minerals of New Mexico appeared in 1904, 1910, 1933 and 1937. The present bulletin, however, is the first comprehensive report on 320 minerals recording both the physical properties and records of occurrence. It represents mainly a compilation of the literature although some previously unpublished material is included.

Part I includes a summary of some interesting facts on the history of mineralogy and mining in New Mexico. Also in this section may be found a discussion of some economic phases of the State's mineral industry, a list of minerals recently discovered in New Mexico, a list of 63 minerals constituting museum specimens and the districts furnishing them.

Part II is devoted to brief descriptions of the minerals and records of occurrence, arranged alphabetically by counties. While the descriptions are on a whole brief, but adequate, because of the unusual interest attached to turquois the author has given this mineral a more extended treatment, including a discussion on such aspects as archaeology, prehistoric mining, folklore, and technology.

A map showing the location of 156 mining districts accompanies the bulletin.

W. F. H.

REPORT OF THE COMMITTEE ON THE MEASUREMENT OF GEOLOGIC TIME, 1941–1942. 68 pages issued in bound mimeographed form. Alfred C. Lane, Chairman; John Putnam Marble, Vice-Chairman.

This Report is now ready and may be purchased for 50¢ from the Division of Geology and Geography, National Research Council, 2101 Constitution Ave., Washington, D. C.

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PROCEEDINGS OF SOCIETIES

PHILADELPHIA MINERALOGICAL SOCIETY

Academy of Natural Sciences of Philadelphia.

September meeting

The September meeting, which was attended by fifty members and visitors, was devoted to reports on summer trips and activities of the members of the Society. Those

participating in the discussion included Dr. Oldach and Messrs. Knabe, Cochran, Cope, Arndt, Wilson, Toothaker and Hesse.

October meeting

The fiftieth anniversary meeting of the Society, held on Oct. 1, 1942, was preceded by a dinner in commemoration of the event. Following the dinner the Society met in regular session with Dr. W. Hersey Thomas presiding. Sixty-six members and forty-three visitors were present.

Mr. Charles M. B. Cadwalader, President of the Academy, gave the address of welcome and reviewed a number of interesting incidents relating to the past history of the Academy. The anniversary address on "Mineralogists, Where Now?" was given by Dr. John Schairer of the Geophysical Laboratory. Dr. Schairer dwelt on the important place the science of mineralogy has had in the past in the development of other sciences, such as chemistry, physics, radio transmission, and even astronomy. He reviewed some of the methods used in the Geophysical Laboratory in its researches and mentioned field trips to active volcanoes to study vulcanism and its relation to chemical changes caused by water, sulfides, and the halogens when subjected to high temperatures and pressures. Dr. Schairer also indicated that great strides would be made in the next fifty years in the synthesis of minerals.

The following officers were elected:

President: Dr. W. Hersey Thomas
Vice President: Charles Toothaker
Treasurer: H. W. Trudell
Secretary: J. S. Frankenfield
Councilor: Robert Hesse

A number of guests presented personal congratulations to the Society. These included Professors Buddington, Miller, Sampson, Dr. Pough and Messrs. Weidhaus and Manchester. Among the older members of the Society who spoke briefly were Edgar T. Wherry, John Vanartsdalen, Harry W. Trudell and Samuel G. Gordon. Mr. Henry Clay Borden, the only surviving member of the three founders of the Society, read the minutes of the first meeting and reviewed several interesting incidents in the Society's history.

November meeting

The November meeting was held on November 5 with Dr. Thomas presiding. Seventy-five members and visitors were present. The speaker of the evening was Dr. Edward Sampson of Princeton University who spoke on "Mineralogical and Geological Sources of Some Important War Metals." Professor Sampson in his general survey spoke of the importance of tin, iron, copper, lead and zinc, and the characteristics of the main metal producing regions. Attention was also called to the numerous and important by-products from the Sudbury, Ontario, ores. Dr. Sampson also discussed the vanadium deposits of Rhodesia and south-west Colorado, and its recovery from phosphate rocks of Idaho.

Following the main address Dr. Gillson spoke briefly on some of the non-metallic minerals in our war economy. Fluorite was mentioned and an estimate given that the demand for this mineral would be about 500,000 tons in 1943. Reference was made to an unusual occurrence of celestite in a dried lake bed in the Mohave Desert of California and Nevada. It is probably of volcanic origin with the dust falling in strongly sulphatic waters of what was then a lake bed.

J. S. FRANKENFIELD, *Secretary*