

**A HANDBOOK OF ROCKS,
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Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649185160

A handbook of rocks, for use without the microscope by James Furman Kemp

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Cover @ 2017

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BY
JAMES FURMAN KEMP, A.B., E.M.,
PROFESSOR OF GEOLOGY IN THE SCHOOL OF MINES, COLUMBIA UNIVERSITY,
NEW YORK.

WITH A
GLOSSARY OF THE NAMES OF ROCKS
AND OF OTHER
LITHOLOGICAL TERMS.

FOURTH EDITION, REVISED.

NEW YORK:
D. VAN NOSTRAND COMPANY,
23 MURRAY AND 27 WARREN STREETS.
1908.

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THE NEW ERA PRINTING COMPANY
LANCASTER, PA.
PRINTERS, ELECTROTYPERS, BINDERS

PREFACE.

The clear presentation of the subject of rocks to beginners is not an especially simple undertaking. The series of objects is extremely diverse, and many unrelated processes are involved in their production. In order not to confuse and bewilder students, the teacher must emphasize the intelligible points and the recognizable characters, avoiding alike distinctions that have their chief foundations in past misconceptions, such as the time element in the classification of igneous rocks, and that require microscopic study to substantiate them. In the following pages the attempt has been made to avoid these difficulties, and only to mention and emphasize the characters which a beginner, properly equipped with the necessary preliminary training in mineralogy, can observe and grasp.

Some years of annually going over this ground have convinced the writer that for this purpose we are not likely to reach a more serviceable, fundamental classification than the time-honored one of Igneous, Aqueous (or Sedimentary) and Metamorphic rocks. They furnish not alone convenient central groups, but also prepare the student for subsequent geological reading. With the Aqueous have been placed the Eolian as a similar, although very minor division, so that fire, water and air, the ancient elementary agents, are emphasized in their work upon the earth, and the fundamental classification is based, as it should be, on method of origin. The only illogical step involved is the placing of the breccias together with the sediments, but breccias are so subordinate and go so conveniently with conglomerates, that it has been done.

The igneous rocks are the ones which present the greatest difficulties to the learner. In the following pages, after a preliminary exposition of principles, the very minor group of the volcanic glasses is first taken up, because it is the simplest and because it illustrates cooling from fusion most forcibly. Passing then through the felsitic and porphyritic to the granitoid textures, rocks of in-

creasing complexity are one after another attacked. Analyses have been freely used to illustrate the chemical differences of magmas, because in no other way can the varieties be fundamentally described. Within fairly narrow limits the chemical composition of the magma establishes the mineralogy of the rock.

The Aqueous and Eolian rocks are not difficult to understand. The metamorphic are in many respects the most obscure of all, but it is hoped that enough varieties have been selected and emphasized to serve for field use and for the reasonably close determination of the great majority of those that will be met in Nature.

Many names will be encountered in geological reading that are not mentioned in the book proper. To explain them and to avoid confusing the main text with unessential matter, they have been compiled in a Glossary. Practically all the names for rocks will be found there, and some related, geological terms. The chief guide in its preparation has been the index of Zirkel's great *Lehrbuch der Petrographie*, but not a few American terms are introduced, which are not in it nor in Loewinson-Lessing's *Petrographisches Lexikon*, to which the writer is also greatly indebted. Other works, English, French and American, have likewise been at hand. One only needs to compile a glossary to appreciate what numbers of unnecessary and ill-advised names for rocks burden this unfortunate branch of science, and to convince one that the philological petrographer comes near to being the enemy of his kind.

So far as possible, technical words of classical derivation have been avoided in the main work in favor of simple English, and for the rocks described, American types have been especially sought with which to illustrate the different species, because they are more significant and accessible to readers on this side of the ocean. The text, except the glossary, appeared as a series of papers in the *School of Mines Quarterly* during 1895-96. J. F. K.

AUGUST, 1896.

NOTE TO THE SECOND EDITION.

In the preparation of the second edition, but little change has been made in the main text. The Glossary has, however, been rewritten and brought up to date. J. F. K.

DECEMBER, 1899.

PREFACE TO THE THIRD EDITION.

Several important changes have been introduced in the present edition, chiefly in connection with the igneous rocks. The composition of the minerals entering into them has been more fully stated, graphic formulas being employed where they seemed desirable. The ingenious star-shaped diagrams which were first used by W. C. Brøgger for single analyses and subsequently employed by W. H. Hobbs for composite groups, have been adapted to the analyses here selected and have been given under each important division of the igneous rocks. They present characteristic pictures of chemical composition which are well adapted to emphasize this important feature for beginners. Whenever, in an analysis, ferrous iron has not been separately determined, it has been necessary to assume a value for it on the basis of related analyses, but experiments with varying values have shown that within the limits set by the total iron oxides, the variation in the general shape of the figure is scarcely appreciable.

In the description of textures and their development much greater stress is laid than formerly upon the geological occurrence of the rock masses. The several forms, dikes, sheets, laccoliths, etc., have therefore been illustrated by cuts and in the table of classification, p. 23, they have been introduced in a separate column. The igneous rocks have also been treated in a slightly different way. Thus, having established a series of analyses characteristic of a certain group, as for instance the rhyolites and granites, this magma is followed through the several textures from the products of a quick chill to those of slow and deep-seated cooling. In nearly all cases four stages are emphasized and a uniform nomenclature is employed. Thus we have the Rhyolites, Rhyolite-porphyrries, Granite-porphyrries, Granite, and similarly for all the others. The diabases present the one exception to this uniform treatment. In developing the above plan an old and widely employed nomenclature has been used, which experience of some

years in the class-room and laboratory leads the writer to believe, has distinct advantages.

The matter relating to the sedimentary and metamorphic rocks has not been essentially changed. A chapter has been added on the recasting of analyses of igneous rocks, which may serve as an introduction to the Quantitative Classification of Cross, Iddings, Pirsson and Washington, the latter being too complicated for an elementary book. Finally the Glossary has been brought up to date.

The writer is greatly indebted to his colleagues, Dr. Charles P. Berkey for advice and assistance in editing and Professor A. W. Grabau for suggestions regarding the sedimentary rocks.

J. F. K.

APRIL, 1904.

NOTE TO THE FOURTH EDITION.

In the present edition the pages relating to the recasting of rock-analyses (155-158) have been somewhat amplified, and factors for turning molecular proportions into percentages are introduced (pp. 166-167). An appendix to the Glossary brings the rock-names up to 1908.

J. F. K.

APRIL, 1908.

ABBREVIATIONS.

- A. A. A. S., or Proc. Amer. Assoc. Adv. Sci. — Proceedings of the American Association for the Advancement of Science.
- Amer. Geol., or A. G. — American Geologist.
- Amer. Jour. of Sci., or A. J. S. — American Journal of Science, sometimes called Silliman's Journal.
- Bull. Geol. Soc. Amer. — Bulletin of the Geological Society of America.
- Bull. Mus. Comp. Zool. — Bulletin of the Museum of Comparative Zoölogy, Harvard University, Cambridge, Mass.
- Jahrb. d. k. k. g., Reichs. — Jahrbuch der kaiserlichen, königlichen Geologischen Reichsanstalt, Vienna, Austria.
- Jour. of Geol. — Journal of Geology, published at the University of Chicago.
- Neues Jahrb., or N. J. — Neues Jahrbuch für Mineralogie, Geologie und Palaeontologie, Stuttgart, Germany.
- Quar. Jour. Geol. Soc., or Q. J. G. S. — Quarterly Journal of the Geological Society of London.
- Tsch. Mitth. — Tscherniak's Mineralogische und Petrographische Mittheilungen, Vienna, Austria.
- U. S. Geol. Surv. — United States Geological Survey, Washington, The Publications are Bulletins, Monographs, Annual Reports, Folios and Professional Papers.
- Zeits. d. d. g. Ges. — Zeitschrift der deutschen geologischen Gesellschaft, Berlin, Germany.
- Zeits. f. Krys. — Zeitschrift für Krystallographie, Munich, Germany.