

BOOK REVIEWS

MINERALS OF THE MONTMORILLONITE GROUP. THEIR ORIGIN AND RELATIONS TO SOILS AND CLAYS. By CLARENCE S. ROSS AND STERLING B. HENDRICKS, *U. S. Geological Survey, Professional Paper 205-B.*, 1945.

Few publications of the U. S. Geological Survey can have been more eagerly awaited by fellow workers than the paper under review. It is now twenty years since the data on the montmorillonite clays were assembled and critically examined, in the classic and much quoted paper by Ross and Shannon (*Trans. Am. Cer. Soc.*, 9, p. 77, 1926). In these twenty years much has happened. The clays have advanced from being a confused and neglected family in the vast concourse of minerals to a stable and indeed eminent position, supported by coherent data and splendidly accoutred with fascinating properties. To this improvement the authors and their associates have greatly contributed. By 1931 Ross and Kerr had rehabilitated the kaolin minerals. (*U. S. Geol. Sur. Prof. Paper 165-E*); by 1934, halloysite and allophane also (*U. S. Geol. Sur. Prof. Paper 185-G*). Since then Ross, Hendricks and other associates have concerned themselves chiefly with the montmorillonite group—elusive in constitution, unique in properties. Their methods have been diverse; *x*-ray, thermal and base exchange studies have been added to the central core of the 1926 work. This consisted of accurate chemical analyses and precise optical constants and has now been very greatly expanded. The results are discussed in the light of contributions from other sources dealing with the planar lattice structure of montmorillonite and its unique characteristic, a variable spacing which increases or decreases according to the pressure of water vapor in its neighborhood. The relationship of base exchange to departures from the idealized composition is strongly emphasized throughout. It is naturally extremely gratifying to the reviewer to find that the deductions he made in 1935 regarding the relationship of the exchange ions to substitutions in the idealized lattice, are so strongly supported.

One of the most pleasing features of this work is the breadth of the mineralogical treatment of the analytical data and the clear demonstration that in the seventy-odd samples on which the main conclusions are based, impurities can have played only a negligible role. The bog of contamination, which appeared to a recent contributor to this journal [W. P. Kelley, *Calculating formulas for fine grained minerals on the basis of chemical analysis' Am. Mineral.*, 30, 1 (1945)] as effectively barring the way to any detailed interpretation of clay analyses, is now seen reduced to its proper size.

The montmorillonite clays, as is now well-known, are structurally similar to pyrophyllite and talc on the one hand and to the micas on the other. What gives them their unique property of one-dimensional expansion is the fact that the negative charge per lattice unit induced by substitutions, falls in an intermediate range. The cations balancing this charge are less numerous than in the case of the micas; hence their cementing action is correspondingly weaker. Dipoles such as water molecules orient themselves around the cations and force the silicate units apart. One important result of the work under review is that fairly definite limits are set to the magnitude of the charge. It varies from 0.5 to 0.8 equivalents per lattice unit of 24 oxygen atoms, with many samples very close to 0.66. Muscovite mica has a corresponding charge of 2.0 equivalents.

The montmorillonite group as a whole is subdivided by the authors into two series. In each are examples of charges arising in two ways; firstly, by the substitution of Al for Si in the silica sheets; secondly, by that of a divalent for a trivalent ion in the alumina sheet or a monovalent for a divalent in a magnesia sheet. The two series differ in the number of atoms in the middle gibbsite-brucite layer. In the montmorillonite-beidellite-nontronite

series it varies from 4 to 4.4 atoms per unit of 24 oxygens atoms; in the saponite-hectorite series it is relatively constant at 6 atoms. The two are thus well separated.

The predominant replacements are as follows: Al for Si in the beidellites, Mg for Al in the montmorillonites, ferric iron for Al in the nontronites. The charge on the latter is most frequently caused by Al for Si, those with the highest replacement being termed aluminian nontronites. Chromium-containing nontronites (volchonskoite) are also known. It should be noted also that a very high charge in the Si layer is generally partially neutralized by a positive charge in the Al layer. In this way the variation in total charge is kept within the narrow limits mentioned above. In the saponite-hectorite series the saponites have a strong replacement of Al for Si. Hectorite shows the unusual replacement of Li for Mg accompanied also by fluorine proxying for hydroxyl. It may be mentioned in passing that while this paper has been in press a new saponite mineral has been described, in which the Mg of the brucite layer is substituted by Zn.

The chemical formulae deduced from the analyses are presented in a novel and effective manner, although the reviewer is not clear why the authors, after giving data for pyrophyllite, talc and the micas on the 24 oxygen atom basis should change to the 12 atom basis in the case of the clays. Formulae employing integral numbers of oxide molecules are also attempted; mainly, one feels, as a polite gesture to the lingering ghost of Berzelius.

The final section of the paper deals with evidence bearing on the mode of origin of the clays. The authors review existing knowledge with especial reference to soils. Their own contribution is well shown in the fine series of photomicrographs illustrating the formation of bentonites by alternation of volcanic glass, and that of several members of the montmorillonite group by alteration in place of the feldspars. They stress the importance of solutions containing magnesium in the synthesis of montmorillonite. Their discussion of clay formation at Magnet Cave, Arkansas, and in the geyser region at Yellowstone will be of especial interest to volcanologists and to geologists generally.

This paper, even more than its predecessors, marks a significant stage in the advance of our knowledge of the clays. It will attract intent and critical readers from varied fields, from geology, mineralogy, ceramics, soil science and colloid chemistry. They will all be richly rewarded.

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REVISED LAPIDARY HANDBOOK by J. HARRY HOWARD. Published by the author, 504 Crescent Avenue, Greenville, South Carolina, 1946. Pp. 220, figs. 50, 5"×8", cloth. Price \$3.00.

The formation of the many mineralogical clubs throughout the country during the past twenty years is evidence of the greater interest in minerals and gems being taken by a rapidly increasing per cent of the general public. The members of these clubs devote much time to the collecting of specimens in the field, preparing them for exhibition or exchange, and in fashioning gem minerals for personal adornment. At present, the number of amateur and professional lapidaries in the United States and Canada is surprisingly large. Accordingly, there is great need for authoritative treatises on the art of cutting, carving, and polishing gem stones.

Revised Lapidary Handbook is a successor to the author's *Handbook for the Amateur Lapidary*, published in 1935. The number of pages has been increased by eighty, the illustrations by six. All phases of gem cutting are discussed in great detail in eighteen chapters. There are also two chapters in which useful information and the sources of lapidaries' sup-

plies are given. All chapters are by the author with the exception of Advanced Facet Cutting, which is by C. G. Waite; Artificial Coloring of Agates, by E. V. Van Amringe; and Cutting Gems by Hand, by C. C. Curtis and J. H. Howard. The Handbook will prove very helpful to all interested in the fashioning of gems.

EDWARD H. KRAUS

NEW MINERAL NAMES

Němecite

JAN VÁCLAV KAŠPAR, A new natural ferric silicate. *Rozpravy České Akad.*, **51**, No. 14, 8 pp. (1941); through *Mineralog. Abs.*, **9**, 186 (1946).

Limonite-like incrustations on pyrrhotite, associated with siderite, cronstedtite, and quartz from Chiuzbaja (Kisbánya), Roumania, gave: SiO₂ 28.79, Fe₂O₃ 40.20, FeO 1.00, S 0.82, H₂O (+240°) 6.97, H₂O (-240°) 22.96; sum 100.74%. The formula is H₄Fe₂Si₂O₉ · 5H₂O, and this is confirmed by the dehydration curve. Sp. gr. = 2.075, H = 2½, isotropic with $n = 1.608$. The mineral is named němecite and is believed to be the crystalline phase of the amorphous hisingerite.

DISCUSSION: Canbyite has the same composition excepting for containing less water. (Canbyite also has lower indices of refraction). X-ray study of these minerals is needed. In the absence of definite proof of a new species, this material should not have been given a new name.

MICHAEL FLEISCHER

Kladnoite

RUDOLF ROST, Supplements to the mineralogy of the burning (coal) heaps in the region of Kladno. *Rozpravy České Akad.*, **52**, no. 25, 4 pp. (1942); through *Mineralog. Abs.*, **9**, 186 (1946).

The name kladnoite is given to the organic compound phthalimide, C₆H₄(CO)₂NH, recorded from the burning heaps at Libušín in the coal basin of Kladno, Bohemia. The monoclinic crystals are of "ruler" habit with predominant {100} and prisms {110}, {230}, {120}. Sp. gr. = 1.47. Indices: $\alpha = 1.501$, $\beta = 1.519$, $\gamma = 1.755$, $\gamma = b$, $\beta : c$ about 16°, melting point 233–235°C.

M.F.