was 39.5%; and the per cent Cl^-, found as an average of two determinations, was 60.76%. The theoretical percentages of Na^+ and Cl^- in pure NaCl are 39.32% and 60.68%, respectively.

X-ray diffraction patterns[4] of the Quincy halite and known sodium chloride were identical.

The part of the 85th level where the halite was found in such abundance has not been in use for six years, and the drift is subject to a continuous air current. As the walls, floors, and crevices are covered with halite in a manner similar to the occurrences of calcium carbonate in limestone caves, it is believed that the halite was precipitated by evaporation from waters as they oozed from crevices in the rock or concentrated in small pools on the floor.

[4] Fisher, F.

SOME OCCURRENCES OF KAOLINITE DEPOSITED FROM SOLUTION

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During their recent study of dickite in Missouri,[1] the authors found kaolinite in several localities in which its occurrence gave unmistakable evidence that it had been deposited from solution. These localities were Oronogo Circle mine, Oronogo, Missouri; the National Pigment and Reavis barite mines near Henley, Missouri; and Keokuk, Iowa. Oronogo is in southwestern Missouri; the Henley locality is in central Missouri; and Keokuk is just across the Missouri-Iowa line at the northeastern corner of the state of Missouri. The kaolinite in all these localities is pure white, and occurs in very small crystals. Under a lens, the tiny flakes glisten like snow.

In the Oronogo Circle mine, the kaolinite occurs as thin veins in nearly vertical joints of the Pennsylvanian shales, as well as in cavities and as a replacement mineral. The veins in the shales are simple filled fissures, on the walls of which minute quartz crystals have been deposited, followed by the kaolinite. Some ore specimens show the sulfides, sphalerite and galena, deposited on the quartz with the kaolinite following them. At the Circle mine, some kaolinite occurs in cavities in the rocks, and also replacing coarsely crystalline calcite in cavities or even calcite deposited as veins. The evidence that the kaolinite at the Oronogo Circle mine was deposited from solutions is beyond doubt.

The kaolinite at the National Pigment barite mine was deposited in joints (in Jefferson City dolomite) that had been enlarged by solution. Minute dolomite crystals and pyrite (now limonite) were deposited be-

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[1] Tarr, W. A., and Keller, W. D., Dickite in Missouri: *Am. Mineral.*, vol. **21**, pp. 109–114, 1936.

fore the kaolinite. The veinlets of kaolinite rarely exceed one millimeter in thickness and are not persistent along the joints.

At the Reavis mine, the kaolinite occurs dominantly in solution cavities and along joints in the Jefferson City dolomite. It is patchy in the joints, as well as in the solution cavities, none of which exceed one inch in diameter. Barite, galena, chalcopyrite, pyrite, and marcasite, all occur with the kaolinite, but in small quantities, save the barite. Both this mine and the National Pigment mine are in sink holes.

The kaolinite in the Keokuk, Iowa, area occurs in quartz geodes and small solution cavities in siltstone. The material is most abundant in a prominent siltstone member of the shale series exposed at the north end of the bridge over the Des Moines River, and in quartz geodes in a siltstone exposed near the top of the large quarry at the east end of the Keokuk dam. A few other minor occurrences were noted in Keokuk and to the north of the city. In the siltstone at the bridge, the kaolinite occurs in quartz-lined geodes that are distributed along a well defined zone. A row of smaller cavities occurs near the bottom of the siltstone. Few of the geodes exceed three inches in length. The kaolinite occurs in the lower part of the cavities, showing that after crystallizing it settled downward in a solution. All but a few of these geodial and solution cavities contain pure white, crystalline kaolinite, some being completely filled with it. At the east end of the Keokuk dam, all the kaolinite occurs in quartz (or chalcedony) geodes, some of which are 8–12 inches in diameter. The quartz crystals in the geodes have a radial arrangement. Only traces of sulfides were found. As the outer shell of the geodes is thin, most of the large ones have been crushed. Some geodes occur in the limestone below, but these do not contain kaolinite. It should be noted that dickite has been reported[2] from a geode in this vicinity, but the writers found none in the material they collected. The occurrence of the kaolinite in this area, as in all the others described, points absolutely to deposition by solutions.

The determination of the kaolinite was made by optical methods as far as particle size permitted, and was confirmed by x-ray tests.

The kaolinite from the Oronogo Circle mine averaged about .016 mm. in diameter, and lay in a tightly packed condition in the veins. Consequently, triangular warped books (or sheaves) made of flakes were preserved in the immersion oil suspension. A few crystals showing part of a hexagon were preserved but, in general, anhedral flakes prevailed. Indices on the clay were: $\gamma = 1.566$, $\alpha = 1.561$, $\pm .002$. X-ray patterns made of this material by Professor Paul F. Kerr showed it to be kaolinite.

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[2] Ross, C. S., and Kerr, Paul F., The Kaolin Minerals, *U. S. Geol. Surv., Prof. Paper,* **165 E,** p. 158.

The clay from the National Pigment mine was similar to that from Oronogo in size of flake and tightness of packing. Perhaps a few crystals remained less torn when mounted in oil, but the general appearance of the material was practically the same as that from Oronogo. Indices were: $\alpha = 1.561$ or 1.562, and $\gamma = 1.566$. *X*-ray confirmation of kaolinite was not made because comparison of this sample with known kaolinite and dickite left little doubt in the writers' minds that it was kaolinite.

The Keokuk kaolinite lay rather loose (unpacked) in the protecting geodes and, therefore, could be transferred to a microscope slide with a minimum of crystal breakage. Separation into a suspension in the immersion oil took place readily with the result that the minute kaolinite flakes were fairly well outlined as individuals. Six-sided crystal flakes were uncommonly well developed for kaolinite, but less regularly than is usual with dickite. No doubt, the excellent preservation of the crystals was possible only because of the lack of packing within the geode.

Crystal flakes averaged about .006 mm. in diameter with but little deviation, and this small size made precise index of refraction determination impossible. In oil of 1.566 index the flakes disappeared, but they were visible in oils whose indices were .005 above and below. Gamma is probably close to 1.565. Alpha, and the other optical constants, could not be determined. *X*-ray patterns were run on two samples submitted to Professor Paul F. Kerr, and both specimens were reported by him[3] to be kaolinite.

In summary, we may say that the white powdery material (which has been shown by optical studies and *x*-ray analyses to be kaolinite) found in these three areas is proved by its mode of occurrence and crystalline character to have been deposited by solutions capable of its transportation.

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[3] Personal communication.

Dr. Norman L. Bowen, petrologist at the Geophysical Laboratory of the Carnegie Institution of Washington, D.C., has been appointed first Charles L. Hutchinson distinguished service professor in the department of geology of the University of Chicago. Professor Bowen will succeed Dr. Albert Johannsen who has retired after having served twenty-eight years as professor of petrology. The Charles L. Hutchinson professorship has been established by the Board of Trustees in recognition of the interest taken by the late Mr. Hutchinson in the University, of which he was for many years a trustee and treasurer, and of Mrs. Frances K. Hutchinson.

The Mineralogical Society of America was incorporated under the laws of the District of Columbia on June 17, 1937, by Norman L. Bowen, John Frank Schairer and Waldemar T. Schaller.