Optically the material presents the characters of a metacolloid but gives fair data. It is optically negative with $2V$ medium. The refractive indices are $\alpha = 1.561$, $\beta = 1.567$, $\gamma = 1.568$. These data bring the mineral very close to bowlingite and antigorite in Larsen's tables which should have identified it as a serpentine had it not been for its unusual appearance and manganese reaction.

The writers' thanks are due Colonel Roebling for the privilege of investigating the material.

GEODE CONCRETIONS FROM THE BLACK HILLS, SOUTH DAKOTA

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INTRODUCTION

In 1921, while on field work in the Black Hills with a class, the writer found a number of rather unique geode concretions, in some cases lined with amethystine quartz and various other minerals. In the spring of 1924, the spot was revisited during the annual field trip of the Department of Geology of the University of Minnesota. The occurrence seemed so unusual that the exposure was examined in detail and the concretions studied in the laboratory with the results noted. With the aid of the students several hundred concretions were obtained from the shale and the slopes below. These were broken and the best examples of each type retained for study.

GEOLOGIC OCCURRENCE

The Black Hills represent the farthest east outliers of the Rocky Mountain system. They were formed by a domical uplift at the end of the Cretaceous which exposed all of the earlier formations from the granites and schists of the pre-Cambrian to the thick series of Cretaceous sediments. The concretions were found in the shale, which forms the lower part of the Englewood formation (Mississippian), on a bluff of the canyon of Whitewood Creek in the northwest quarter of Section 7, T. 5 N., R. 4 E. This is about three miles below Deadwood and nearly a mile east of the point where the creek bends away from the tracks of the Chicago and Northwestern railroad.

The following section was measured on the cliff:

Mississippian { Pahasapa limestone 80 feet. Massive white limestone.
Englewood formation 64 feet, 32 feet of concretion shale with buff limestone above.

Ordovician—Whitewood formation 85 feet; very massive buff dolomite.

The concretions were limited to the shale of the Englewood formation and a detailed section showing their distribution is as follows:

13 feet, chocolate colored to reddish shale. Many concretions and the shale itself has a concretionary structure at places.
6 feet, gray, sandy, thin-bedded shale with many concretions.
10 feet, very thin-bedded chocolate colored paper shale. Few concretions.
3 feet, yellow sandy shale. No concretions.

Aside from the exposure described above, the concretions were noted at one other place which was on the north side of Whitewood Creek in the same vicinity. They are evidently local, as neither Darton,[1] Irving,[2] nor Darton and Paige[3] mention them, and they are not present at other exposures of the shale seen by the writer.

The concretions are irregularly distributed in the shale both horizontally and vertically. At places they occur more or less in groups or nests but for the most part are found singly. It seems from the manner in which they are embedded in the shale that they originated after the deposition of the mud, but before induration, as there is no evidence of a cracking or breaking of the shale layers.

Description of the Concretions

The concretions vary from half an inch to fully 6 inches in diameter, but most of them are from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches. (See Fig. 1.) Practically all of them have a similar shape, that of a somewhat flattened sphere with an irregular knobby surface. They are gray in color and the outside is apparently chalcedony with a concretionary or concentric structure. Many, especially the larger ones, are hollow and the vugs are lined with colorless or amethystine quartz, or calcite crystals with lesser amounts of other minerals noted below. A small percentage of them are solid and the interior is filled with quartz, calcite, ankerite, siderite, limonite

[1] Darton, N. H., Geology and water resources of the northern portion of the Black Hills: *U. S. Geol. Survey Prof. Paper* **65,** (1909).

[2] Irving, J. D., Economic resources of the northern Black Hills: *U. S. Geological Survey Prof. Paper* **26,** (1904).

[3] Darton, N. H., and Paige, Sidney, *U. S. Geol. Survey Folio* **219,** (1925).

and hematite. Rarely entire concretions are composed of marcasite and its oxidization products.

A study of thin sections of several typical concretions confirmed the identification of the several minerals made in hand specimens and brought out several other facts. The major part of most of the concretions is silica in the form of coarse crystals of quartz. There was originally a large amount of chalcedony, but much of this has recrystallized to quartz. Some still retain the radiating

Fig. 1. Photograph of several concretions showing form and variation in size. The three on the lower right hand side have been broken and show the coarse crystals more or less completely filling the interior. *One-half natural size.*

and spherulitic forms characteristic of chalcedonic material. One of the most conspicuous features is the multitude of inclusions which occur in an interior zone of many of the quartz crystals, whereas the exteriors of the crystals are perfectly clear. Most of the inclusions seem to be sericite. This is a feature of practically all of the slides examined. Many specimens contain greater or less amounts of pyrite mixed with the quartz, calcite, ankerite, or siderite which lines the vugs or completely fills the interior. In practically all cases the exterior of the concretions is chalcedony grading to coarser quartz on the interior.

In general the concretions are unusual for the variety of minerals composing them and for their structure. They are certainly concretionary forms as is clearly indicated by their structure and mode of occurrence in a limited area and horizon of the shale. An explanation of the mode of origin does not readily appear.

It has been suggested that the original concretions were formed before induration of the shale. The geode structure and numerous minerals indicate a change from the original material as concretions normally consist of but one or two minerals, and grow from the center outward. Perhaps the original concretions consisted of some soluble mineral which was dissolved and various minerals substituted, notably quartz. This would account for the partly filled centers of many of the concretions. The solutions which accomplished this result may very well have been of hydrothermal nature, as the surrounding country is invaded by numerous porphyry sills, dikes, and laccoliths. The presence of much sericite in the quartz would be a further indication of hydrothermal action.

THE IDENTITY OF NEWTONITE WITH ALUNITE

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In 1891 Brackett and Williams[2] described two new clay minerals from Arkansas. One occurring as soft white masses at Sneeds Creek in Newton County was named *newtonite* after the locality. This locality has recently been revisited and described by E. T. Wherry.[3]

Newtonite, as described by Brackett and Williams, is found in nodular masses of a pure white color embedded in a soft clay. Microscopic examination showed it to be a remarkably pure substance. The characteristic feature of this mineral is its occurrence in minute rhomb-shaped crystals clearly distinguishable under the higher powers of the microscope. An analysis of this mineral yielded the following:

[1] Published with the permission of the Secretary of the Smithsonian Institution.
[2] Am. J. Sci., **42**, 11, 1891.
[3] Am. Mineral., **10**, 350-351, 1925.