PLATE 1.

3

2

6

5

4

1

For explanation see page 1.

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GLAUBERITE CRYSTAL CAVITIES IN THE TRIASSIC ROCKS IN THE VICINITY OF GETTYSBURG, PA.[1]

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Among the specimens of Triassic rocks collected during the survey of the Fairfield and Gettysburg quadrangles, Pennsylvania, for folio publication, certain dark shales and hardened altered shales with molds of crystals were obtained, and were sent with specimens of metamorphosed sediments and igneous rocks to Prof. J. Volney Lewis for petrographic study. In a letter dated May 24, 1915, Professor Lewis wrote:

"The casts [molds] of crystals . . . suggest very strongly the mineral glauberite and my conception of the climatic conditions under which these sediments accumulated would make this mineral entirely possible, even probable, in the muds and 'alkali' marshes. I happen to have some crystals that almost exactly fit the cavities, conforming in size and shape."

"I wish to add, as a matter of simple justice, that the first suggestion of glauberite as the original mineral of these cavities was made by Mr. W. S. Valiant, Curator of the Geological Museum of Rutgers College, who observed the striking resemblance while unpacking the specimens, or very soon afterward, before I began my studies of them. Later when I compared the molds and wax casts of some of them with crystals of glauberite, their essential identity was quickly established."

EXPLANATION OF FRONTISPIECE

Molds of glauberite crystals in Triassic shales from vicinity of Gettysburg and crystals of glauberite from San Bernardino County, Cal. Photographed by J. Volney Lewis. Natural scale.

No. 1. From locality 1 (see Fig. 1.); shows mold of rhombic face of crystal with characteristic parallel growth striations.

No. 2. From locality 1; shows molds of rhombic face of crystal and characteristic aggregates of crystals.

No. 3. From locality 2; shows wedge-shaped (or lozenge-shaped) cross sections of cavities.

Nos. 4, 5, 6. Crystals of glauberite from San Bernardino County, Cal. Nos. 4 and 5 show the rhombic faces that correspond to the impressions in Nos. 1 and 2, and No. 6 shows aggregates of crystals which correspond to the molds in No. 3.

[1] Published by permission of the Director of the U. S. Geological Survey.

This was the first intimation I had of the significance of these cavities. Since then two articles by Dr. Edgar T. Wherry[2] have been published in which the mineral which formed similar

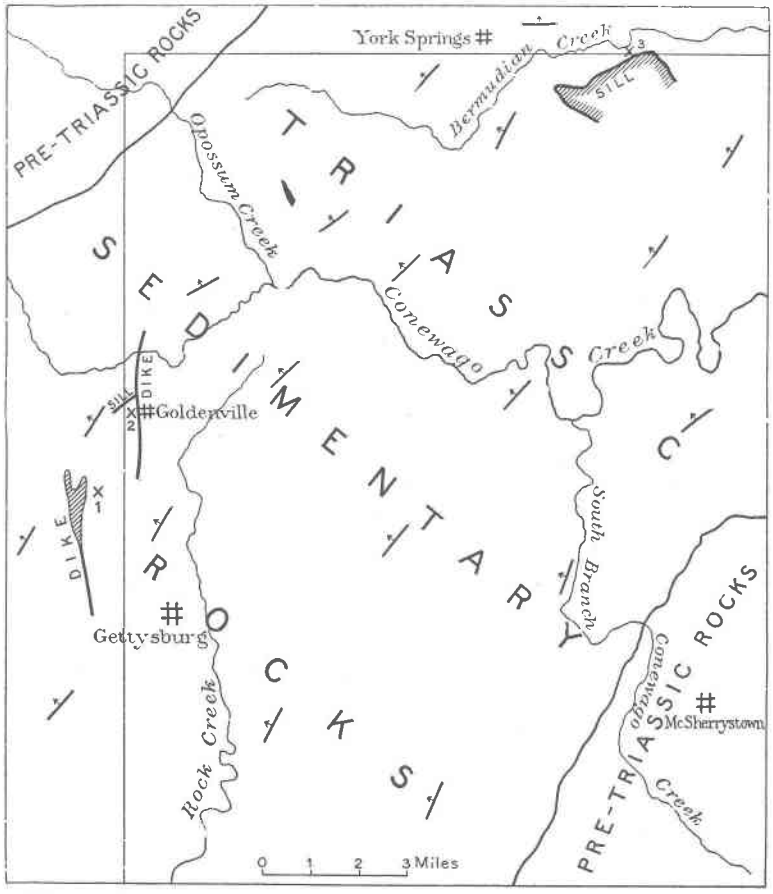

FIG. 1. Sketch map of the Gettysburg quadrangle, Pa., and immediately adjoining area on the west and north, showing localities where molds of glauberite crystals were obtained and adjacent diabase sills and dikes. The direction of dip of the Triassic rocks is shown by arrows. Locality 1. 3 miles northwest of Gettysburg. Best specimens; rock little altered. Loc. 2. 4½ miles north of Gettysburg, just west of Goldenville. Good specimen; rock hardened. Loc. 3. North edge of the Gettysburg quadrangle, 3 miles east of York Springs. Rock much altered.

[2] The lozenge-shaped cavities in the First Watchung Mountain zeolite deposits; *J. Wash. Acad. Sci.*, **6**, 181–184, 1916. Glauberite crystal cavities in the Triassic rocks of eastern Pennsylvania; *Am. Min.*, **1**, 37–43, 1916.

molds, in the Triassic rocks at several localities lying 100 miles or more further east, is shown to be glauberite.

In the Gettysburg quadrangle and adjoining areas specimens of the crystal cavities were obtained at three places, shown on the sketch map herewith, Fig. 1. The holes which compare most favorably with crystals of glauberite in the possession of Professor Lewis were photographed by him and are presented in the frontispiece. The fact that the glauberite crystals and the molds in this photograph are almost identical in shape and size supports the conclusion presented by Dr. Wherry in his papers referred to above.

Glauberite is a sodium-calcium sulfate, $Na_2Ca(SO_4)_2$, found in nature in rock salt deposits and on alkali flats in various parts of the world. It is evidently the product of slow desiccation of alkaline water in arid regions. The occurrence of this mineral in the Triassic sediments is probably to be explained, therefore, by deposition under similar climatic conditions, *i. e.*, in ponded water in an arid climate (playa basins).

The Triassic sediments of the Gettysburg district, which is part of a belt that extends from New York to Virginia, are believed to have been deposited in an elongated continental basin into which streams from the adjacent highlands to the east brought an abundance of rock waste. The climate was arid and the rains were accordingly spasmodic and torrential, so that flooding of the basin by the streams during times of torrential rains in the mountains alternated with times of drought and evaporation of the ponded water. The coarser sands and arkoses were largely deposited as thin sheets of alluvium in flat, wide-spreading, coalescing alluvial fans by the flood waters as they first spread out over the lowland plain, whereas the finer sediments were in large part laid down in ponded water after the inflow had ceased. Nearly all the beds, therefore, have a normal sedimentary habit. Numerous ripple marks, animal trails, rain prints, rills, and sun cracks on the surfaces of the beds bear evidence of frequent drying up of the lakes and exposure of the freshly deposited sediments in mud flats. The prevailing warm arid climate is indicated by the red color of most of the sediments, the rocks on the higher land having been deeply weathered and thoroly oxidized before being washed into the basin. There was not sufficient organic matter deposited with these red sediments to transform the brilliantly colored

ferric oxide to the dull gray ferrous carbonate. During the droughts, when the standing water was entirely or nearly evaporated, the dissolved salts were concentrated to the point of saturation, and crystals of the minerals in solution were formed on the shores and possibly on the bottom of the ponds, which at such times were probably reduced to alkali swamps or even to dry encrusted playa flats. Glauberite and perhaps other allied minerals crystallized out, altho molds of salt crystals have not been observed in this region. The crystals that were formed in the saturated muds, and others that were quickly covered by sediment during the next influx of water into the basin, became inclosed in the sands and clays and preserved in the strata.

The fact that in at least two and possibly all three occurrences in the Gettysburg area the rocks which contain the molds are somewhat altered and hardened by the action of heated waters given off from the dikes or sills of diabase, whose proximity to the localities where the cavities were found is shown in figure 1, may perhaps be regarded as indicating that the glauberite crystals were still present in these clays and sands at the time when the igneous rocks intruded them and the sediments were hardened around the crystals, so that when they were subsequently dissolved by circulating waters their molds were preserved sharp and clear, as shown in the photographs (frontispiece).

It is probable, therefore, that glauberite crystallized out of ponded waters at various times during the Triassic epoch; and the crystals were inclosed at many horizons thruout the Triassic section, altho thus far clearly defined molds of the mineral have been found in this area only in beds which have been somewhat hardened by the metamorphic action of the intrusive diabase.

BARITE FROM GREAT NOTCH, N. J. ERNEST H. WILSON. *Caldwell, N. J.*—Some years ago the writer obtained at the Great Notch trap quarry a 5 x 10 cm. specimen showing an aggregate of small crystals of a dull white color, on a fragment of trap rock. This has recently been submitted to Mr. H. P. Whitlock, of the American Museum of Natural History, who has identified it by blowpipe tests as barite. Altho this mineral is not infrequently associated with trap rocks, and has been found under such circumstances at several other localities in New Jersey, this appears to be the first report of it from this place. At one end of the specimen are a number of very small calcite crystals and a couple of globular crystals of prehnite, but the barite rests directly upon the trap, suggesting that it was one of the earliest minerals to form.