CONCRETIONARY FORMS IN THE GREENFIELD LIMESTONE.*

CHARLES W. NAPPER, Greenfield, Ohio.

The locality of this study is at Greenfield, in southwestern Ohio. The workings are the Rucker Quarries. The rock is a Silurian dolomite, the quarry face above and below water-level measuring sixty (60) feet. Characteristic features divide the exposure into two parts, called the Gray Stone for the lower twenty(20) feet and the Buff Stone for the upper forty (40) feet.

In this paper the term "concretionary force" is employed in the sense and with the idea of the aggregation of rock material into various forms which are distinctly different from the surrounding stratification.

THE GRAY STONE—THE ISOLITH.

Herein the concretionary force is manifested in one single form. This stone is very evenly bedded, the ledges maintaining horizontal regularity unless there is interference from large, irregular, unstratified masses over which they bend.

The quarrymen call these masses "horsebacks" or "blisters" and this has caused the writer to search for possibly a better name. While producing a disturbance somewhat similar, the terms *laccolith* and *batholith* can not be used for they refer to conditions produced by the intrusion of one kind of rock, igneous, into another, hence two kinds of rock material are involved. In our instance, the masses causing disturbance and the strata disturbed are of one and the same rock material. Therefore I suggest and have used the term "isolith" for them.

*This paper, accompanied by lantern slide views and an exhibit of forms described, read before the Geological Section of the Ohio Academy of Science, meeting in Columbus, at the Ohio State University, April 7, 1917.

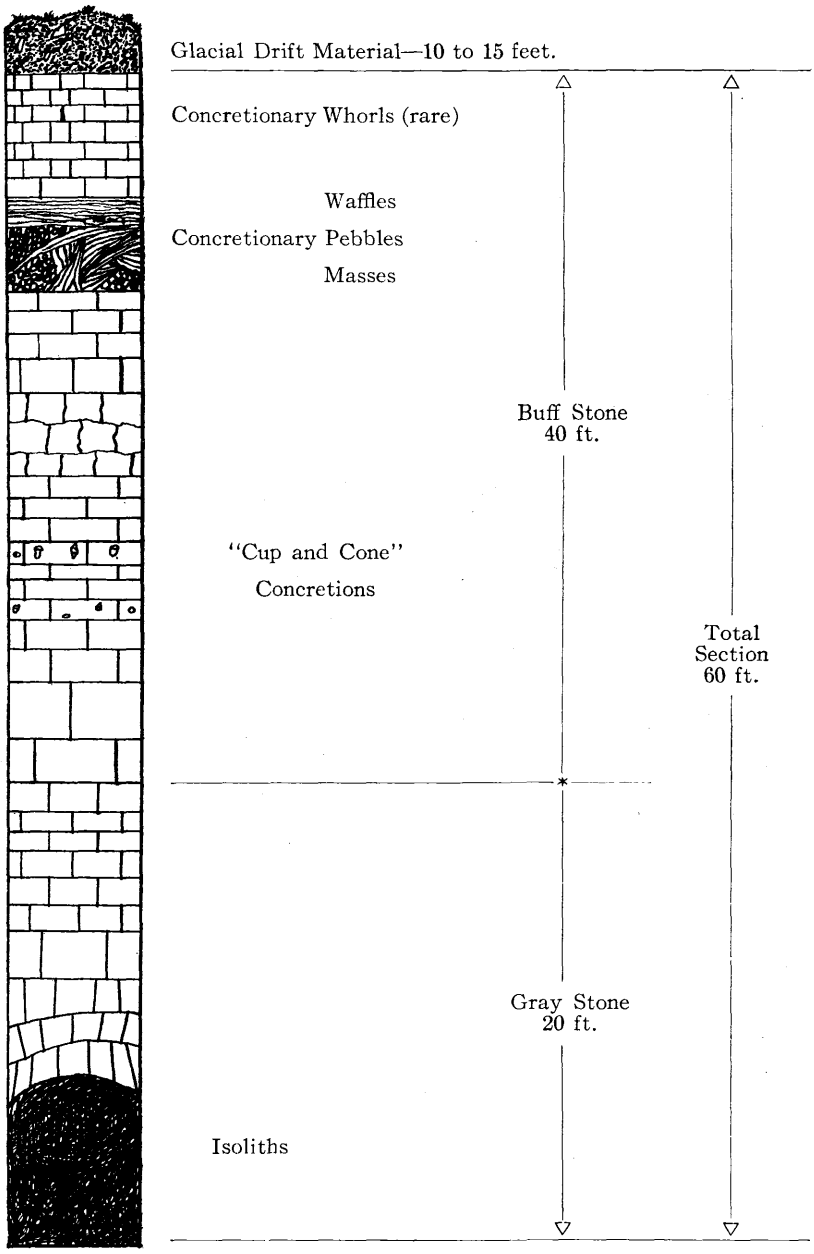
These isoliths have 8 x 10 x 12 feet as average dimensions and appear as large ovals. They are a hindrance to quarrying, being difficult to break up and causing uneveness in adjacent ledges. Operations downward usually cease when they are reached.

The first isoliths studied were of solid texture and not fossiliferous, and I was then disposed to regard them as a form separate and distinct from the brecciation well known as occurring

Fig. 1. An Isolith. Curving Strata Clearly Shown.

in the Monroe formation, of which the Greenfield Limestone is the basal member. But later finding isoliths of brecciated structure and fossilferous, and unable to observe the resumption of stratification beneath, I am now rather of the opinion that both forms, to some degree, are manifestations of the same force of aggregation. Why then I continue to mention isoliths among concretionary forms, will appear in the correlation I shall present further on in this paper.

Isoliths afford us two interesting features—ledges can often be traced through them and come out on the other side—they sometime contain a fauna not characteristic of the immediately surrounding ledges.



Section at Rucker Quarries, showing position of Concretionary Forms.

THE BUFF STONE.

The largest number of concretionary forms are found in the Buff Stone—the lower fifteen (15) feet containing "cup and cone" concretions, and the upper twenty-five (25) feet having the concretionary "masses, pebbles, waffles, and whorls."

The "Cup and Cone" Concretions.—In the lower ledges of the Buff Stone, especially in two or three strata, these forms are found plentifully and continue so horizontally throughout their zone.

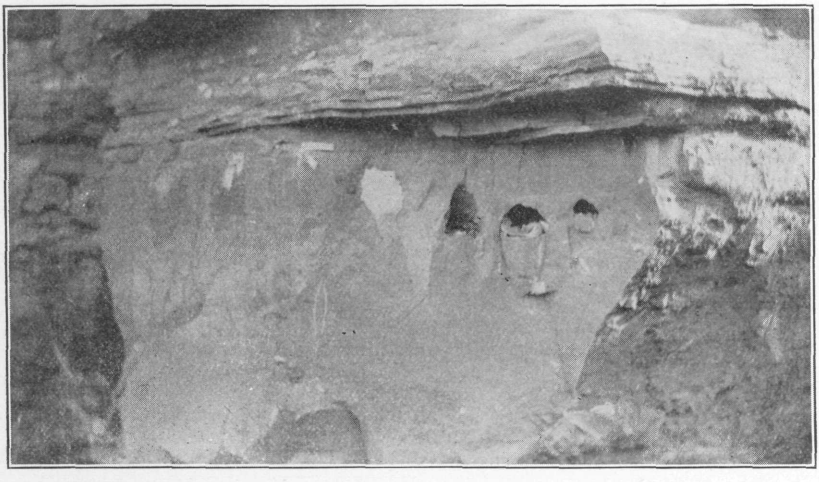


Fig. 2. "Cup and Cone" Concretion in Position in Buff Stone Ledge.

As a standard form, the "cup and cone concretion" consists of a cap, a cone, a cavity and its filling. From this we find every possible variation by the irregular combination of these parts. Additionally we have the "double" variety, two cones with one common cavity. The accompanying drawings show a perfect form and the variations. In length they are one to ten inches and one to five inches in diameter at the largest part. Usually stems or cones are round in cross section, although frequently found oval.

The filling of the cavity presents an interesting study and may be—the cavity partly or tightly filled with small lenticular pieces of the same rock material appearing as crushed and pressed into it—partly or completely filled with "rock tar,"

the result of carbonaceous material draining in and solidifying—lined or filled with quartz crystals, through which sphalerite may be disseminated—containing well formed crystals of sphalerite—or filled with a brownish, carbonaceous clay. These last two are very rare forms. These cavities are objectionable in building stone.

We now pass to the concretionary forms found in the upper ledges of the Buff Stone.

Concretionary "Masses".—Usually these forms appear as a distinct, continuous ledge five to thirty inches thick and two to five in number. They rarely disturb adjacent layers, therefore "contorted ledges" is a term more suggestive of their structure.

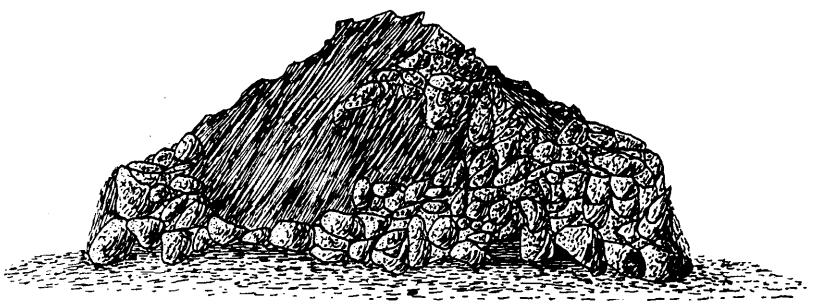


Fig. 3. "Concretionary Pebbles."
Sketched from a piece 5 x 12 x 3 inches.

Concretionary "Pebbles."—Frequently within the "contorted ledges" are found bunches or clusters resembling a conglomerate of rather large pebbles. These pebbles are usually round, about one inch in diameter and other sizes and shapes occur. When broken for cross section, they reveal a ring around ring structure somewhat similar to that of an onion.

Concretionary "Whorls."—A rare form in the Rucker Quarries, but frequently found in other exposures of the thin-bedded upper Greenfield Limestone. They appear as fine lines drawn around a center then joining into one another. May prove to be a fossiliferous form.

How could rock material aggregate into these various forms, especially in strata so evenly bedded? How could this occur while all forms and strata are of the same rock material? How

were the ledges arched and the space filled in? Or are the forms contemporaneous with their surrounding strata? Why out of the six forms only two are frequently found in other exposures of the same limestone in the same locality?

The "cup and cone" concretions with their cavities often filled with rock pieces crushed in, suggest pressure as a cause. But then why are they not found in the lower Gray Stone where pressure would be greatest? Why do they occur most frequently in a few ledges near the middle of the exposure? Always being vertical, seldom inclined and never horizontal, has this definite position any importance? The lithological differences between the Gray and Buff stones, have they any bearing on the problems involved? These important questions I desire to submit for further, careful consideration.

CORRELATION.

I have found specimens which are suggestive that there may be a relationship between these and other concretionary forms. If this can be sustained, then we have made quite an advance towards the explanation of the common force which has operated, what it is and how it has operated.

At the center of an unbrecciated, unfossiliferous isolith which had been bisected, I found a large mass of sphalerite, well crystallized and weighing thirty (30) pounds. Its position was suggestive that it had been the nucleus of the isolith's aggregation, a striking similarity to where concretions are formed with fish bones, leaves, etc., as nuclei.

Embedded in a fossiliferous, unbrecciated isolith I have found concretionary "pebbles" with characteristic ring around ring structure in cross section. This seemingly joins my lowest and next to highest forms as the result of a common force.

The stem of the "cup and cone" concretion sometimes has a structure somewhat similar to the "cone in cone" form. As pressure is now regarded the probable cause of the latter, any relationship that can be established with the former is evidence of some corroborative character for the pressure theory. The crushed-in particles in the cavity are ever strongly suggestive of pressure.

In the disturbed ledges near the contact with the isolith, I have found smoothed, grooved portions. This is evidence

of pressure and movement, either the isolith upward or the ledge downward. Can such occurrence be of use and value to the pressure theory?

The arches of the concretionary "waffles" sometimes become so high, large and shaped, as to be suggestive of a transition into the "pebble" form.

In the gorge of the Cuyahoga River near Akron, just below the electric power-house dam, in the bluish sandstone, I found two ordinary and familiar round concretions about eight (8) inches each in diameter and not requiring more than twenty (20) inches of space in length over all. Midway between these, I found a concretion very similar to the "cup and cone" type. It has a cap, a stem or cone and an oval end suggestive of a cavity. If this similarity has merit, then we have joined an additional form to the series.

These observations are presented in the hope that they will be found to be clews of some value and assistance in arriving at a full and complete understanding of the concretionary force and the forms resulting from its operation.

We now see that the Greenfield Limestone has features of intense interest which its usual regularity would seem to preclude.