A NEW SHALE AND RELATED STRUCTURE IN THE CHICAGO AREA

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A tunnel designated as the Chicago Avenue tunnel, now under construction by the City of Chicago, exposes a sequence of strata and a faulted structure unusual, if not unique, in the Chicago area. This tunnel is eighteen feet in diameter and when completed, will extend from a point three miles out under Lake Michigan west along Chicago Avenue to Harlem Avenue, a total distance of eleven miles. It is situated 180 feet below the surface of the ground at the shore of Lake Michigan, where a shaft to the tunnel passes through 135 feet of glacial drift and 45 feet of bed rock.

The bed rock exposed in the tunnel consists of a dolomite formation overlain by an interbedded shale and dolomite formation. The dolomite in the lower formation is greyish to buff, finely grained, and massively bedded, except near the top where it grades into laminae of agrillaceous dolomite. Grey shale, that represents an impurity, is sufficiently concentrated along the bedding plains to serve as partings. Stylolites are developed in the massive dolomite and they are capped by grey residual clay. The shale in the upper formation is uniformly green and very finely grained although it contains some grains of clear quartz as large as 0.2 mm. in diameter and some secondary pyrite. A few fossils of brachiopods and crinoid stems and arm plates have been found in the shale. The brachiopods have been identified by Dr. T. E. Savage as *Gypidula* n. sp., *Whitfieldella* n. sp., and one comparable to *Spirifer*, probably a new species. The dolomite that is interbedded with the shale is finely grained and nor-porous and occurs in continuous bands as much as 8½ inches thick. Thus, with respect both to character of rock and color of shale there is a marked difference between the formation below and the formation above the contact.

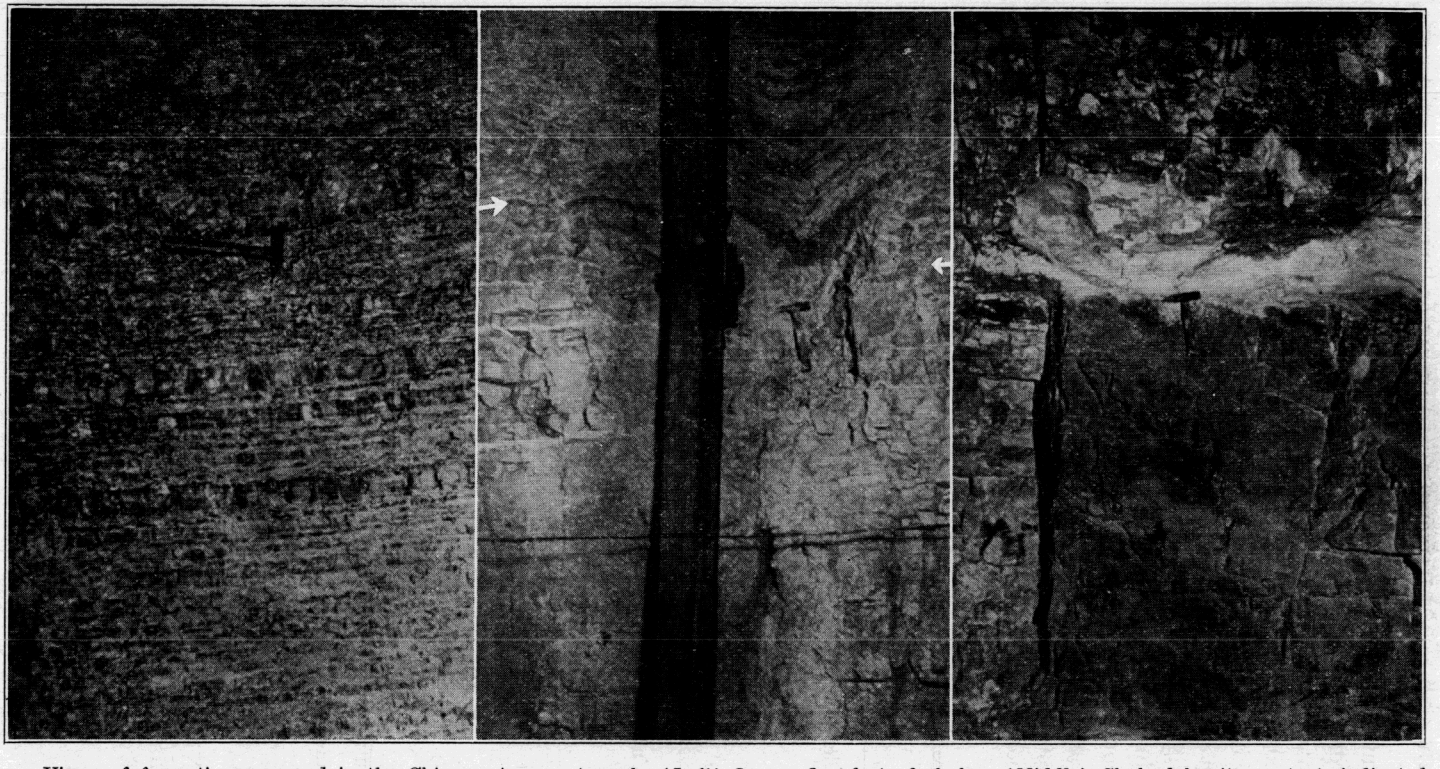
The contact is very even and regular. The thickness of the strata between the contact and key beds both above and below the contact are uniform within one and one-half inches over the 650 feet of exposed shale. All evidences indicate that the strata are conformable.

The shale formation lies in a graben, the total movement of which is estimated to be more than 40 feet. The movement is distributed along six normal faults, which are the major factors in the structure. The direction of movement can be determined by drag along the faults and by relative altitude of key beds. Minor joints and faults cut both the shale and dolomite formation where they are exposed in contact. In the east part of the graben a Y fault having a vertical displacement of eight inches, overlies a three foot opening in the dolomite, which is filled with breccia derived from the overlying shale with a subsequent infilling of the interstices with green shale. Consequently, it is definitely established that the opening was formed after the deposition of the shale, as faulting and brecciation of the shale and dolomite would be impossible while unconsolidated. It is, therefore, further evident that not only the major graben but the minor faults were developed subsequent to the deposition of the shale, and that the shale in the joints in the massive dolomite is derived by downward movement from the overlying green shale.

In the massive dolomite, pockets of green shale are uniformly distributed through the length of the tunnel. Many of these pockets are so large that timbering is required to prevent caving, and at one place, a zone 150 feet in length is so weak that concrete facing is required to retain it. The shale in the pockets is uniformly greenish in color and contains much disseminated pyrite. No bedding or banding is evident, but all of the shale is slickensided. Smoothed fragments of dolomite occur in the pockets in the matrix of shale, and the walls of the pockets are smoothed and horizontally fluted—a result of solution. In that part of the tunnel where the shale is exposed it is possible to trace a connection from the shale in the pockets and joints to the bedded shale above the dolomite as at the Y fault mentioned. In most places no such connection is observable, but it seems logical to assume that in all cases such connection exists. If this is true, the shale has an east-west extension of at least three miles, which is the present length of the tunnel.

It is generally accepted that the bed rock in the Chicago area is massive dolomite belonging to the Racine and Port Byron formations of the Niagaran series.[1] There is a complete conformable sequence of dolomite from the Joliet, the base of the Niagaran,

[1] Savage, T. E., Silurian Rocks of Illinois: Bull. Geol. Soc. Amer., Vol. 37, pp. 513-534, 1926.



Views of formations exposed in the Chicago Avenue tunnel. (*Left*) Lower five feet of shale. (*Middle*) Shale-dolomite contact, indicated by arrows. (*Right*) Shale pocket in dolomite. (*Photos by O. A. Seager.*)

into the Port Byron containing no shale comparable to this occurrence, which precludes that this shale be referred to an earlier horizon than the Port Byron. Dr. T. E. Savage[2] states: "The position of this shaly bed is certainly Niagaran, and it corresponds with the strata at Le Claire which overlie the Port Byron at that place." Accordingly, the massive dolomite in the tunnel is assigned to the Port Byron formation, and the interbedded shale and dolomite represent a post-Port Byron formation, of Niagaran age, conformable with the underlying formation. Because of the isolated occurrence of this shale member, it seems that a separate name should be tentatively given it. The term Chicago is proposed.

COLUMNAR SECTION OF CHICAGO AVENUE SHAFT AND TUNNEL.

	Feet	Inches
Pleistocene*—		
Sand	20	
Plastic clay	30	
Stiff clay	20	
Hard clay, small boulders	17	
Hard clay, large boulders	17	
Clay, sand, water	7	
Sand and water	2	
Clay, boulders, sand, water	19	
Unconformity Niagaran—		
Chicago—		
Interbedded green shale and dolomite	28	
Massive dolomite bed		8½
Interbedded green shale and dolomite	4	4
Massive dolomite bed		5½
Interbedded green shale and dolomite	4	3
Green shale		½
Port Byron—		
Laminated, argillaceous dolomite	3	1
Thin bedded dolomite	7	
Massive dolomite	14 plus	

* Pleistocene from the engineer's log of the shaft at Chicago Avenue and the lake shore.

CONCLUSIONS

1. There are two distinct, but conformable, formations of the Niagaran series exposed in the Chicago Avenue tunnel. The lower formation is designated as the Port Byron, the upper as post-Port Byron.

[2] Personal communication.

2. The present position of the shale formation is due to normal, graben faulting.

3. The shale pockets in the dolomite are filled with green shale derived from the overlying formation.

4. The shale formation is definitely determined to have an east-west extension of at least three miles.

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