Geoscience Wisconsin
Volume 14 1991

# DISTRIBUTION AND AGE OF DOLOMITIC AND HEMATITIC OOLITES NEAR THE ORDOVICIAN-SILURIAN BOUNDARY IN NEBRASKA AND KANSAS

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## ABSTRACT

The upper Maquoketa (Late Ordovician) of Kansas is characteristically a greenish gray dolomitic shale which grades northward across Nebraska into a light gray granular dolomite. In southeastern Nebraska and adjacent areas of Kansas a red shale with oolitic hematite concretions commonly occurs at the top of the Maquoketa and is considered equivalent to the Neda of Iowa. The Silurian consists of dolomite with varied amounts of chert and commonly contains dolomitic oolites near its base. This lower unit is present throughout northeastern Kansas but appears to be overlapped by younger Silurian rocks northward across Nebraska. This oolitic interval has been equated with the Noix (Missouri) and Keel (Oklahoma) oolites which are considered to be Late Ordovician. However in Nebraska the dolomitic oolites are associated with an early late Llandovery fauna (Silurian).

## INTRODUCTION

Two stratigraphic intervals in the subsurface of eastern Nebraska and Kansas contain material which has been characterized as oolitic. The upper interval has been correlated as Silurian and consists of clusters of dolomitic oolites in a dolomite matrix. The lower interval has been correlated as uppermost Ordovician and consists of oolitic hematite concretions in a red to greenish gray shale matrix. Both intervals have been described in a number of wells and seem to have regional stratigraphic significance. Deposition in this region during much of the Middle Paleozoic was centered in southeastern Nebraska and northeastern Kansas in what has been termed the North Kansas Basin. The Basin is defined by depositional thickening of major and minor subdivisions of Middle Ordovician through Mississippian rock. However, regional facies changes in some units suggest that variations occurred in the rate of basin sinking or sediment accumulation which masked the depocenter or both. The configuration of the North Kansas Basin has been obscured by later tectonic activity and erosion of Middle Paleozoic rocks. Current thicknesses of the upper part of the Ordovician rocks in Nebraska and Kansas are illustrated in figure 1. This interval consists of rock termed Maquoketa Formation in the subsurface of these states, but the Maquoketa Formation of Iowa apparently encompasses a thicker stratigraphic interval (Carlson and Berry, 1969). The Maquoketa of Nebraska-Kansas contains both shale and dolomite (fig. 2). In Kansas Lee (1956, p. 42) wrote that "the shales of the Maquoketa range from dark gray and greenish gray to dark green. Most of the shales are dolomitic.... The Maquoketa dolomite is gray to dark gray, grainy, composed of fine crystals set in an argillaceous or silty matrix." The dominant lithology in northern Kansas is greenish gray dolomitic shale. This lithology extends into Nebraska but grades northward into a light to medium gray, dense to granular,

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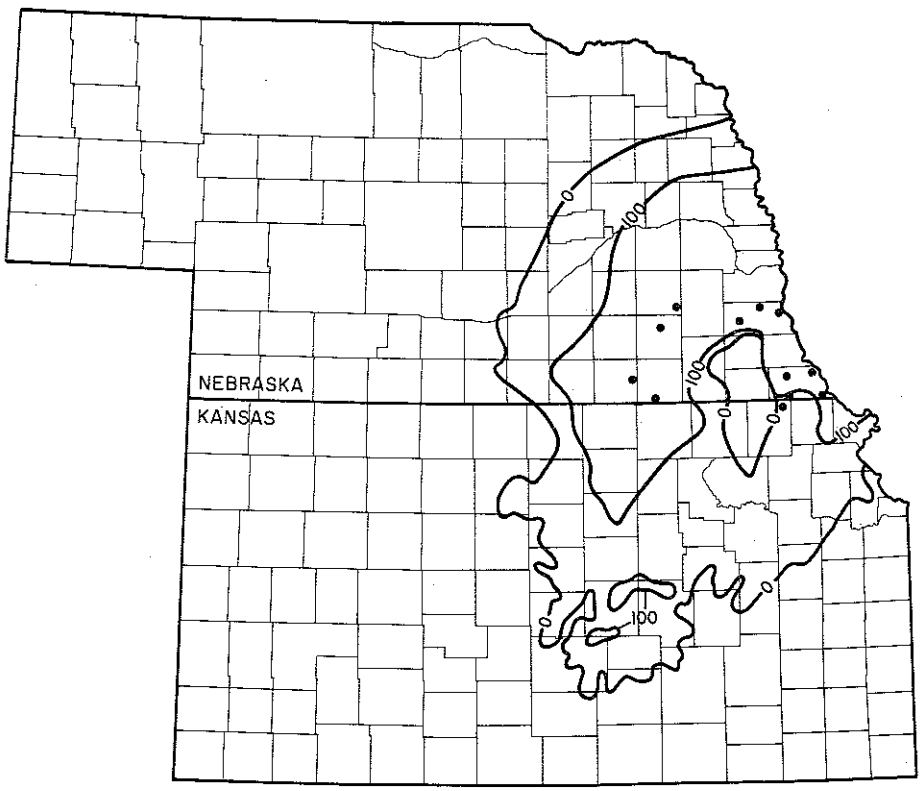


**Figure 1.** Distribution and thickness of upper Ordovician (Maquoketa) of Nebraska and Kansas. Dots indicate location of selected wells penetrating shale containing oolitic hematite in the top of the Maquoketa. 100 feet equals approximately 30 m.

argillaceous dolomite (Carlson, 1969, p. 29). The Maquoketa (fig. 1) is as much as 40 m thick; current thickness was strongly influenced by erosion. In southeastern Nebraska and adjacent areas of neighboring states a dark maroon to red shale containing oolitic hematite concretions commonly occurs in the top of the Maquoketa. Selected wells where these concretions have been described in Nebraska are noted on fig. 1. Published sample descriptions from Kansas and Missouri have not noted this zone, but inspection of available samples indicates that traces of hematite are present in areas adjacent to Nebraska. The shale matrix and flattened hematite concretions (fig. 3) are considered to be equivalent to the Neda as recognized in Iowa. As has been suggested in other areas, this upper Maquoketa unit probably represents a final regressive phase of the Ordovician and may originally have been more widely distributed. Silurian dolomite overlies the Maquoketa in much of this two--state area (fig. 4). The thickening of Silurian rocks to over 175 m reflects the depocenter of the North Kansas Basin; current edges reflect erosion prior to Devonian and during Pennsylvanian time. The dominant lithology in both Kansas and Nebraska is dolomite containing varying amounts of chert (fig. 5). Throughout northeastern Kansas and adjacent areas of Nebraska, the lowermost Silurian is characterized by a crystalline dolomite containing clusters of oolites resembling miniature golf balls (fig. 6). This zone was described by Lee (1956, p. 49) as "the first or oolitic zone, which overlies the Maquoketa, [and] is everywhere composed of sucrose or fine-grained dolomite characterized by dolomitized oolites." The oolites are composed of sucrose dolomite, and their surfaces are roughened by minute crystals of dolomite. In some samples the oolites are touching without matrix. In others they are embedded in the

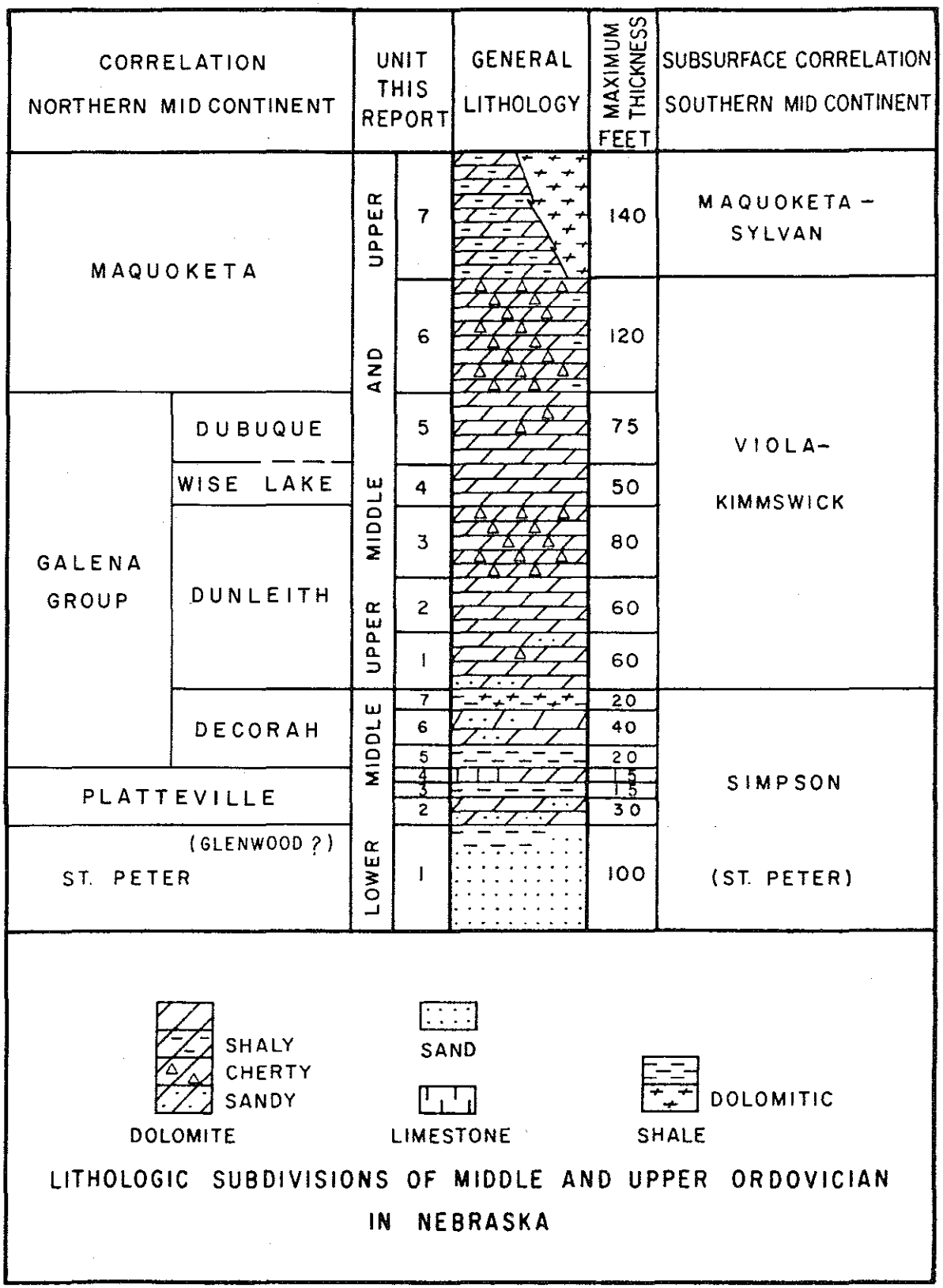


**Figure 2.** Lithology and correlation of the Middle and Upper Ordovician of Nebraska. 10 feet equals approximately 3 m.

**Figure 3.** Oolitic hematite in the Maquoketa shale from a well in sec., 14 T. 1 N., R. 16 E. Richardson County, Nebraska.

matrix, which in some places displays voids left by the removal of fossil fragments. In some wells the oolites resemble grains of soft dolomite worn to roundish surfaces in drilling. The abundance of the oolite is variable, and the variation in thickness of the zone may be due either to poor preservation of the oolites or to their irregular distribution." A core from a well in southeastern Nebraska (sec. 2, T. 2 N., R. 16 E.) contains the oolites (fig. 7) in association with an early late Llandovery fauna (Carlson and Boucot, 1967). This lower Silurian unit was correlated by them with the Kankakee of Iowa but is now (fig. 5) considered equivalent to part of the Hopkinton as described by Bunker and others (1985). The distribution of this oolitic interval in Kansas has been described by Lee (1956, p. 50):, Except for local areas where it is absent, the oolitic zone is coextensive with the Silurian. It reaches its greatest thickness of 60 feet in the northern part of the area (Kansas Salina Basin). The zone thins irregularly toward the south, where it is commonly less than five feet thick or absent. The apparent restriction of the zone in Nebraska (fig. 4) indicates that this lower Silurian unit is overlapped by younger Silurian northward across Nebraska (Carlson and Boucot 1967). A similar overlap was noted in the upper Hopkinton of eastern Iowa by Bunker and others (1985). Both the Ordovician oolitic hematite and the Silurian oolitic dolomites (fig. 8) are present in a sample interval spanning the boundary between the two units from a well in sec. 31, T. 9 N., R. 14 E. Similar occurrences of both units have been noted in wells in sec. 14 and 24, T. 1 N., R.14 E. and sec. 5 and 30, T. 1 N., R. 15 E. These rock units probably were probably formed in a shallow marine environment although post-depositional diagenesis has modified the original structure and mineralogy. The lithology and texture of the hematitic shale in the upper Maquoketa suggest correlation with the Neda and a development over a large area of this shale unit. Time-equivalent, shallow marine environments may have produced the Noix and Keel oolites in the Upper Ordovician carbonate facies to the south in Oklahoma and Missouri. The initial Silurian deposits are also of shallow marine origin including deposition of carbonate oolites in Nebraska and Kansas. The distribution of this basal zone suggests some restriction of initial Silurian deposition. Further Silurian transgression overlapped these basal oolites. The association of these dolomitic oolites with Silurian fauna indicate that this unit is younger than the carbonate oolites of the Noix and Keel.

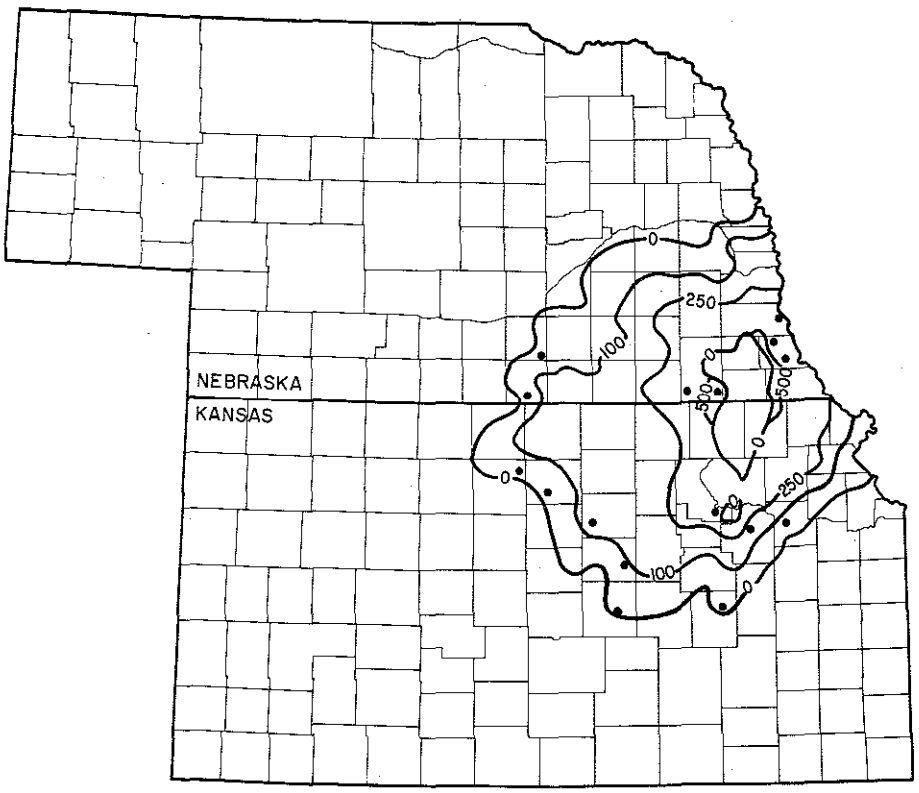


**Figure 4.** Distribution and thickness of Silurian rock in Nebraska and Kansas. Dots indicate location of selected wells penetrating the zone of oolitic dolomite. 100 feet equals approximately 30 m.

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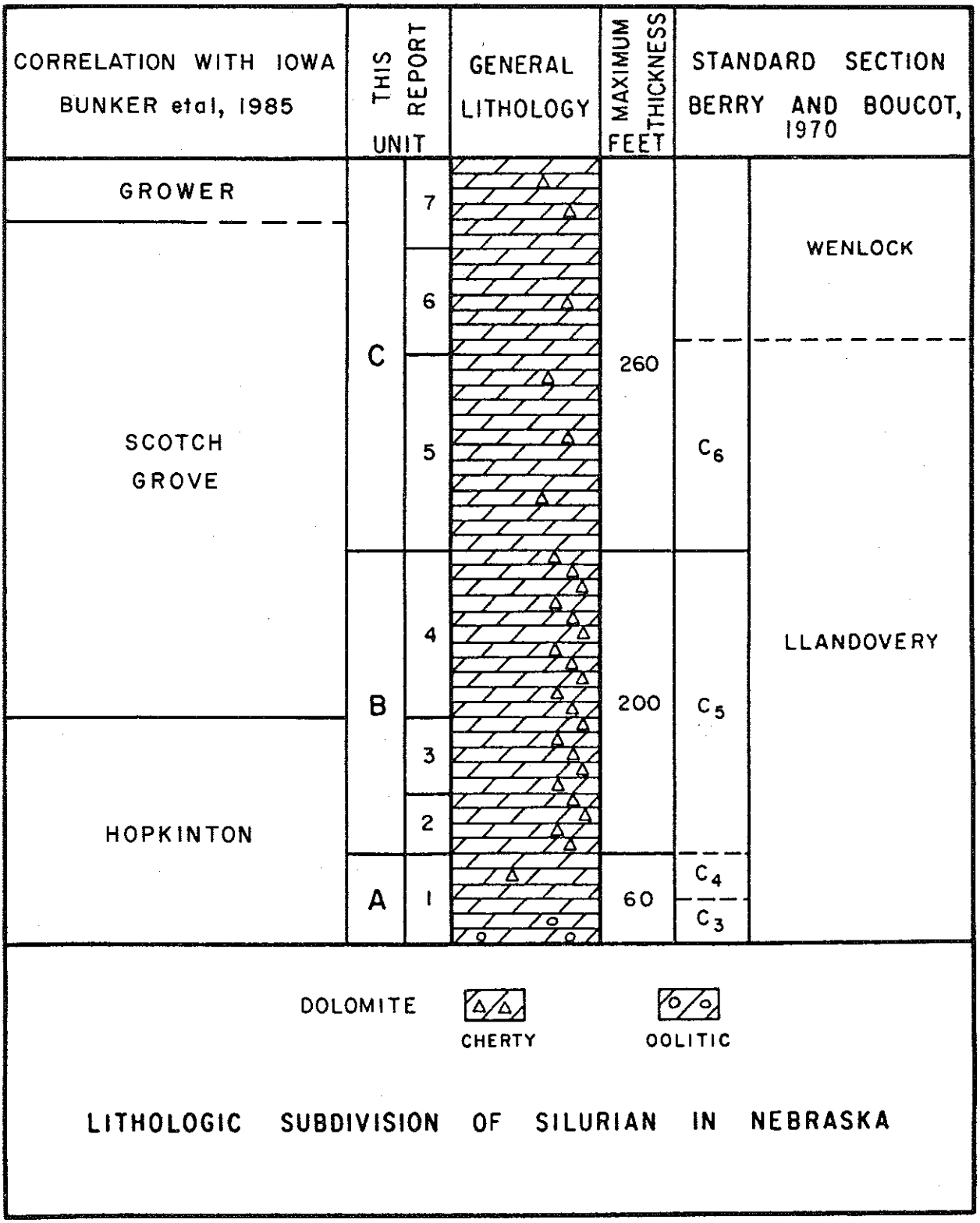


Figure 5. Lithology and correlation of the Silurian in Nebraska. 10 feet equals approximately 3 m.

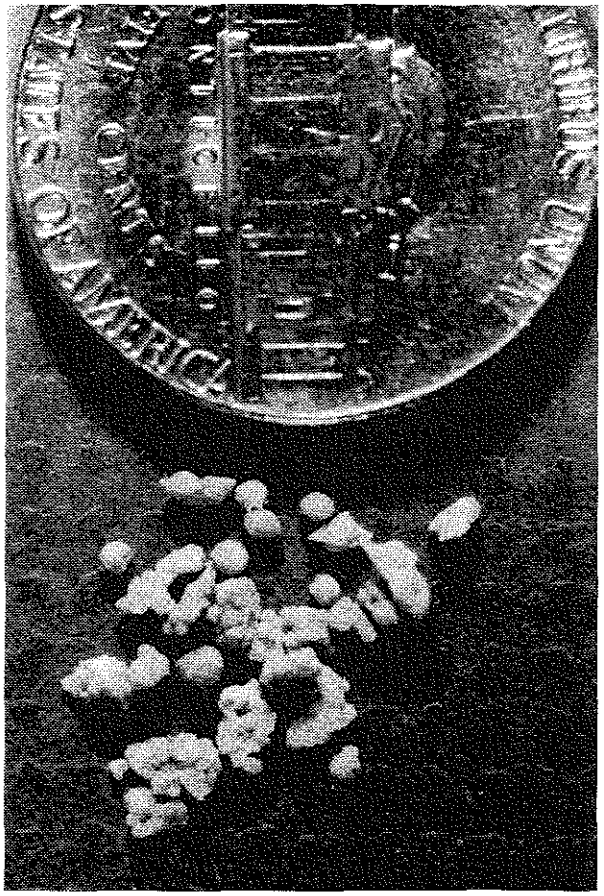

Figure 6. Oolitic dolomite in the Silurian from a well in sec. 14, T. 1 N., R. 6 E. Gage County, Nebraska.

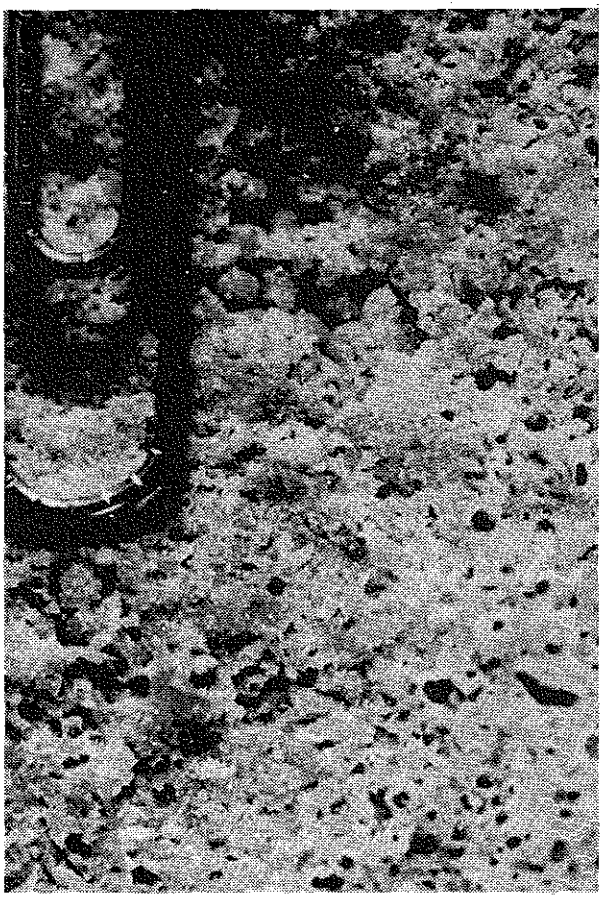

Figure 7. Oolitic dolomite in the Silurian from a cored well in sec. 2, T. 2 N., R. 16 E. Richardson County, Nebraska.

**Figure 8.** Oolitic hematite and oolitic dolomite from a sample interval including Maquoketa shale and Silurian dolomite from a well in sec. 31, T. 9 N., R. 14 E. Otoe County, Nebraska.