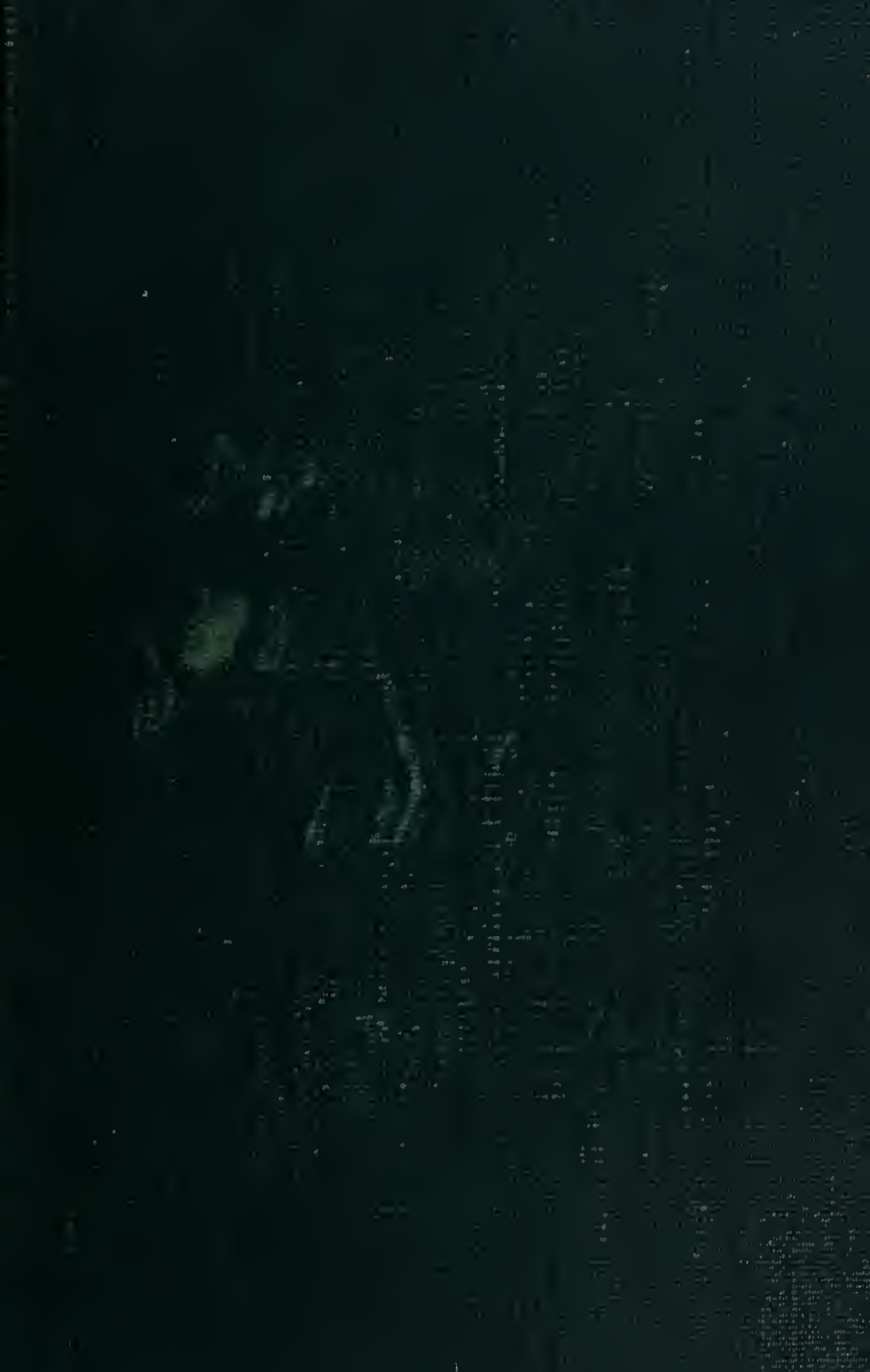

STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION AND EDUCATION
A. M. SHELTON, *Director*

DIVISION OF THE
STATE GEOLOGICAL SURVEY
M. M. LEIGHTON, *Chief*

REPORT OF INVESTIGATIONS - NO. 9

# THE GLENWOOD BEDS AS A HORIZON MARKER AT THE BASE OF THE PLATTEVILLE FORMATION

BY
ARTHUR BEVAN

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# THE GLENWOOD BEDS AS A HORIZON MARKER AT THE BASE OF THE PLATTEVILLE FORMATION

By Arthur Bevan

## OUTLINE



## ILLUSTRATIONS



## TABLE

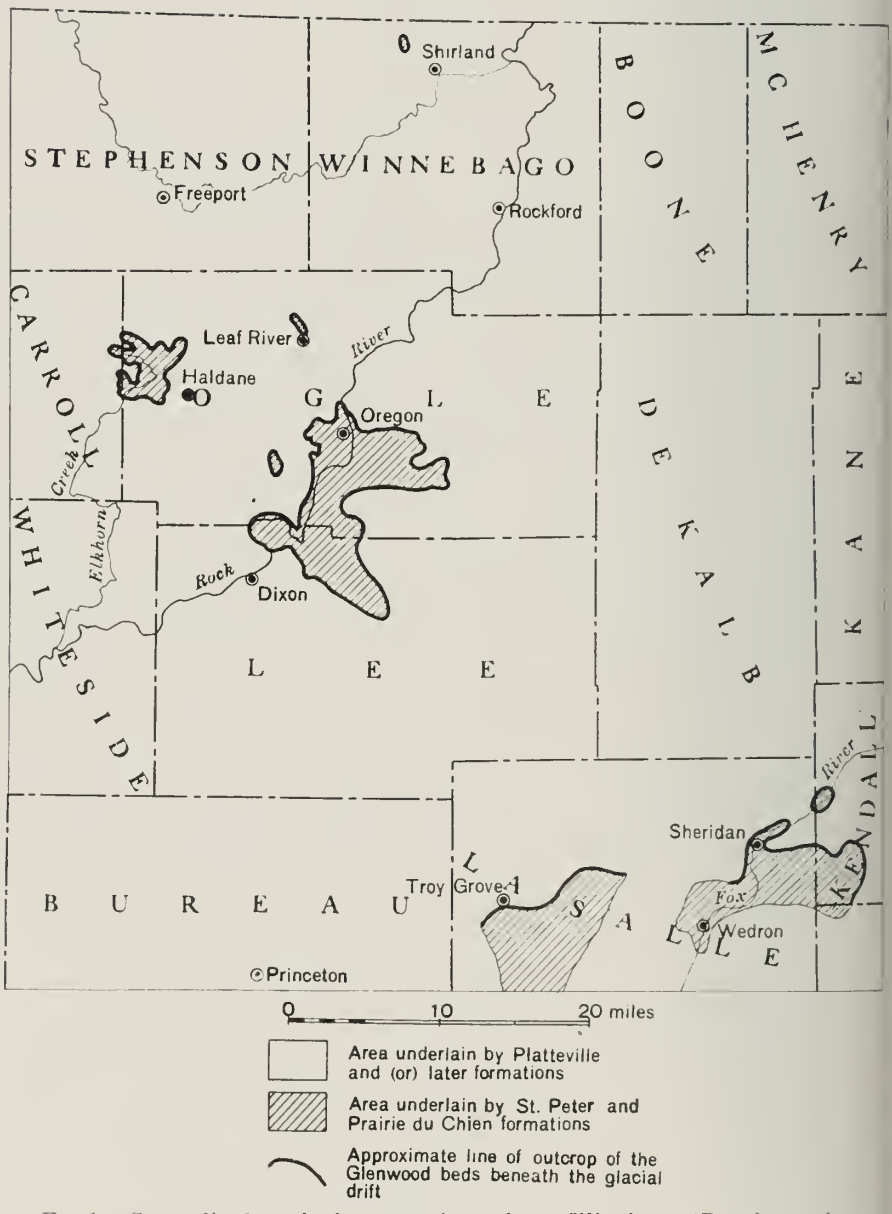


FIG. 1. Generalized geologic map of northern Illinois. (Based on the geologic map of Illinois.)

# INTRODUCTION

## Purpose of the Report

A geologic study of the Oregon quadrangle in the northern part of the State and a review of the pertinent literature of northern Illinois and adjoining states have demonstrated the possibility of establishing the Glenwood beds as a horizon marker between the St. Peter sandstone and the Platteville limestone. The purpose of this report is to present the important characteristics of the Glenwood beds as an aid in their identification in outcrops and in drill cuttings. The formation is described briefly; its value as a stratigraphic key is emphasized, and the geologic conditions under which it was formed are discussed.

## General Statement

The St. Peter sandstone and the overlying Platteville limestone, both of middle Ordovician age (see Table 1), are widely exposed in the upper Mississippi Valley. They crop out in several areas in northern Illinois, southern Wisconsin, northeastern Iowa, and southeastern Minnesota. Their striking features early attracted the attention of geologists working in this general region, and the chief characteristics of each have been described in many publications. In brief, the St. Peter is generally a white to gray

Table 1. *Geologic time divisions of the Paleozoic era and epochs of the Ordovician period*

| Era | Period | Epoch |
|---|---|---|
| Paleozoic | Permian | |
| | Pennsylvanian | |
| | Mississippian | |
| | Devonian | |
| | Silurian | |
| | Ordovician | Cincinnatian (Maquoketa) |
| | | Galena |
| | | Platteville (Trenton) |
| | | Glenwood |
| | | St. Peter |
| | | Prairie du Chien (Lower Magnesian) |
| | Cambrian | |

sandstone composed chiefly of medium to large, fairly well-rounded, frost rather clean, quartz sand grains, which are commonly very loosely cement Its lithology is rather uniform throughout much of this region; but cal reous and shaly beds have been reported from a few horizons at a f localities. The Platteville (the Trenton of early reports) is typically well-bedded, fossiliferous, buff to bluish, somewhat magnesian limesto The two formations are thus in sharp lithologic contrast.

## THE GLENWOOD BEDS

### General Character and Stratigraphic Relations

In the area west and north of Illinois, the St. Peter and the Plat ville are commonly separated by a greenish to bluish shale ranging in thi ness from a few inches to a few feet. This intervening formation is persistent laterally and of such constant character in eastern Iowa that C vin gave it the name of Glenwood shale.[1] In the type locality this sh is 15 feet thick. The lower two-thirds is highly sandy with some thin b of almost pure sand like that in the underlying St. Peter sandstone, where the upper part contains no sand. Elsewhere in Iowa, the Glenwood appe to be a clayey shale, commonly 3 to 6 feet thick. No trace of an unc formity is reported. In Minnesota, the change from the St. Peter to t Platteville is in some places abrupt, but in others sandy shale or calcareo sandstone intervenes. Sardeson described a section of transition beds fr the bluff of Mississippi Valley at Minnehaha, which is 4½ feet thick a consists of alternating thin beds of green clay and shale with thin beds sand. These beds contain Platteville fossils.[2] Green shale is reported fr other localities in Minnesota. Similar beds occur in southwestern Wisc sin, where the shale is more or less sandy and, as a rule, only a few f thick. According to Grant and Burchard, the relations of these strata s gest an emergence after the deposition of the St. Peter sandstone.[3] In eastern part of Wisconsin south of Milwaukee, a "few feet of more less sandy dolomite" intervenes between the typical St. Peter and a 30-f stratum of "rather coarse-grained gray calcareous sandstone" in the ba part of the overlying limestone.[4]

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[1] Calvin, Samuel, Geology of Winneshiek County: Iowa Geol. Survey Vol. X pp. 74-75, 1906.

[2] Sardeson, F. W., U. S. Geol. Survey Geol. Atlas, Minneapolis-St. Paul f (No. 201), p. 6, 1916.

[3] Grant, U. S., and Burchard, E. F., U. S. Geol. Survey Geol. Atlas, Lancast Mineral Point folio (No. 145), p. 4, 1907.

[4] Thwaites, F. T., The Paleozoic rocks found in deep wells in Wisconsin northern Illinois: Jour. Geol., vol. XXXI, p. 540.

## Distribution and Character in Illinois

The Glenwood beds crop out at several places in northern Illinois—in the vicinity of LaSalle, in the Rock River drainage basin between Dixon and Oregon, north of the village of Leaf River, along Elkhorn Creek west of Haldane, and 3 miles northwest of Shirland in northern Winnebago County (fig. 1). The exposure of these beds is a result of the erosion of the crests of anticlines such as the LaSalle anticline. The underlying St. Peter sandstone is also exposed in each one of these areas. In the LaSalle quadrangle Cady reports a few inches of shale in outcrops, and 4 or 5 feet of shale in wells at this horizon.[5] The shale is absent near Troy Grove, north of LaSalle, there being a transition from the St. Peter to the Platteville through a foot of very sandy limestone. The Glenwood in the Dixon quadrangle is a green shale, 2½ to 7 feet thick, whose lower beds are sandy in places.[6] The formation here contains considerable potash.[7] In the Elkhorn Creek area Hershey notes that "there is a six-foot section of light green shale near the top [of the St. Peter], which is persistent throughout the area and is overlain by one or more heavy-bedded, partially lithified strata of white or light gray sandstone, constituting the top of the formation."[8] The lower part of the Platteville is "very sandy and sometimes shaly". In the vicinity of Shirland the Glenwood consists of green sandy shale with sandy limestone at the top.[9] An analysis of the deepest green material shows 0.51 per cent of iron.

As shown by well logs the Glenwood horizon is represented by a few feet of shale at places in northeastern Illinois, although in most of these logs the Platteville limestone is indicated as immediately overlying the St. Peter sandstone.[10] Thin intervening beds are probably present, however, in some of these sections, but have not been reported. In the State Hospital well at Kankakee, 15 feet of pure to sandy magnesian limestone with some green shale is reported as separating the formations.[11] At Woodstock, 41 feet of sandy limestone occurs above the St. Peter.[12] The log of a well at Lake Forest shows that 20 feet of dolomite lies beneath the upper 35 feet of the St. Peter sandstone, but the passage from the latter to the Platte-

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[5] Cady, G. H., The geology and mineral resources of the Hennepin and LaSalle quadrangles, Ill. State Geol. Survey Bull. 37, pp. 39-40, 1919.

[6] Knappen, R. S., oral communication.

[7] Parr, S. W., and Austin, M. M., Potash shales of Illinois Univ. of Ill. Agr. Exp. Sta. Bull. 232, p. 236, 1921.

[8] Hershey, O. H., The Elkhorn Creek area of St. Peter sandstone in northwestern Illinois: Am. Geol., vol. XIV, p. 174, 1894.

[9] Lamar, J. E., oral communication.

[10] Anderson, C. B., Artesian waters of northeastern Illinois: Ill. State Geol. Survey Bull. 34, 1919.

[11] Op. cit., p. 175.

[12] Op. cit., p. 211.

ville is abrupt.[13] A well at Malta, in DeKalb County, shows a series of transition beds which is 45 feet thick, as given in the following section[14]:

*Section of Malta well showing character of transition beds between the St. Peter and Platteville-Galena formations*

| Description of strata | Thickness |
|---|---|
| | *Feet* |
| Limestone (presumably Platteville-Galena) | 210 |
| Limestone, sandy | 2 |
| Sandstone | 18 |
| Shale, sandy | 2 |
| Shale, gray | 23 |
| Sandstone (St. Peter) | 321 |

In some other sections, the beds between the St. Peter and the Platteville resemble those to the north and west; that is, they consist mainly of greenish shale with some sand in the basal portion, and thus constitute rather typical Glenwood shale.

## Character in the Oregon Basin

The upper St. Peter and the basal Platteville crop out in the Oregon quadrangle mainly along the north rim of the Oregon basin. This is a conspicuous depression, resulting from erosion of the crest of a low anticline, which extends east and west through Oregon and for 3 to 4 miles in either direction. Similar outcrops exist in a small area on the west side of Rock River north of Oregon and a few scattered small exposures appear north of the village of Leaf River.

Instead of being a shale as in most other areas, with the exception of some places in northeastern Illinois and southeastern Wisconsin, the Glenwood in the Oregon quadrangle is almost entirely a typical sandstone. Shale forms the greater part of only a single section near the western end of the Oregon basin, where the formation is less than 4 feet thick. Elsewhere it is a bluish-green sandstone composed of a variable mixture of rather fine angular sand and large sand grains of the St. Peter type, with the latter commonly very much in the minority (fig. 2). The sandstone varies somewhat both horizontally and vertically.[15] It ranges in thickness from 2½ to 12 feet.

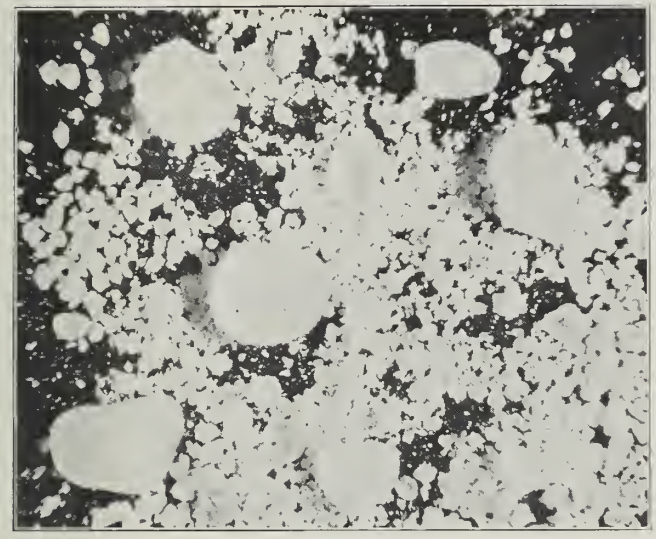
On account of the persistence of the bluish-green color and the characteristic texture, the Glenwood beds are an excellent horizon marker. Even on slopes so mantled with glacial drift that neither the upper St. Peter nor the lower Platteville is exposed, in many places the position of the Glen-

[13] Op. cit., p. 186.

[14] Op. cit., p. 134.

[15] The details of this variation will be presented in the Ill. State Geol. Survey bulletin on the Oregon quadrangle, in course of preparation.

A



B

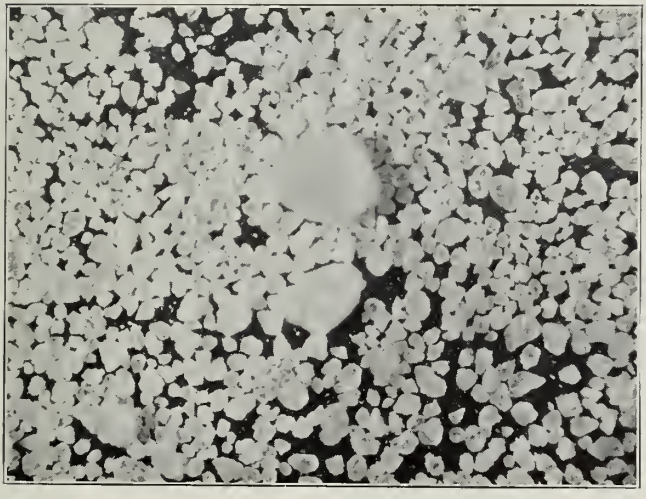


FIG. 2. Microphotographs of Glenwood sandstone in the vicinity of Oregon. (Magnified about 16 times.)

A. On the west slope of Liberty Hill northwest of Oregon, NE. ¼ sec. 4, T. 23 N., R. 10 E. Shows fine angular sand grains of the Glenwood with large rounded grains of the St. Peter type.

B. In head of ravine about 3½ miles east of Oregon, SW. ¼ sec 5, T. 23 N., R. 11 E. Similar to (A) but contains fewer grains of the St. Peter type.

wood can be determined readily by the fragments brought to the surface by burrowing animals. The uniform characteristics of the formation should make it a useful datum plane in well sections, especially in those areas where the boundary between the St. Peter sandstone and the Platteville limestone is not sharply marked.

In places, the Glenwood appears closely related to the St. Peter, and the contact can be determined only by the change in color and the abrupt change from typical St. Peter sand to fine angular sand. Certain sections, however, exhibit a slight unconformity at the base of the Glenwood. On the other hand, it appears to be conformable with the overlying Platteville. This is shown by the parallelism of the Glenwood and Platteville strata without traces of erosion along the contact and also by the transition beds which in places occupy the Glenwood horizon. Although the change to the Platteville is generally abrupt, the basal beds of limestone are locally more or less sandy and even become calcareous sandstone in a few places.

A few miles east of Oregon, the Glenwood sandstone is replaced laterally by a series of transition beds, which on the whole are quite dissimilar to other portions of the formation in this area and unlike most of the reported sections, except a few sections in wells in the northeastern part of the State. Without giving a detailed description of the sections, the chief features of these transitional beds may be summarized briefly. In a ravine in the NW. ¼ SW. ¼ sec. 6, T. 23 N., R. 11 E., about 2½ miles east of Oregon, the St. Peter sandstone is overlain by the following sequence of strata:

*Section of strata overlying the St. Peter sandstone in a ravine 2½ miles east of Oregon*

| Description of strata | Thickness | |
|---|---|---|
| | *Ft.* | *In.* |
| Glacial drift | | |
| Sandstone; rusty, friable mixture of round and angular sand, slightly calcareous | 1 | 0 |
| Shale, argillaceous, greenish to purplish | 3 | 4 |
| Sandstone, light gray to rusty, more or less calcareous to argillaceous, composed of fine angular sand | 13 | 9 |
| Limestone, gray to buff, somewhat magnesian, slightly sandy. Some beds vermicular, and with included angular limestone fragments | 26 | 0 |
| Sandstone, greenish, of fine rounded sand | 1 | 6 |
| St. Peter sandstone | | |

The total thickness of the preserved section of transitional beds is almost 40 feet, but the position of outcrops of Platteville in the vicinity show that its original thickness was slightly greater. The lowest sandstone is the only member of the section that resembles the typical Glenwood in color,

but it lacks the characteristic texture, whereas the other sandstones possess the characteristic texture without the green color.

In another ravine in the NW. ¼ SW. ¼ sec. 5, T. 23 N., R. 11 E., a complete section of the transition beds is exposed. The succession is as follows:

*Section of transition beds between the St. Peter sandstone and the Platteville limestone in a ravine in sec. 5, T. 23 N., R. 11 E.*

| Description of strata | Thickness Ft. | In. |
|---|---|---|
| Platteville limestone | | |
| Shale and clay, bluish-green to yellow-brown, with some limestone fragments | 1 | 8 |
| Sandstone, gray to white, very friable, of round sand scattered through angular sand | 4 | 9 |
| Sandstone and limestone in alternating beds. The sandstone is greenish and very fine-grained; the limestone is gray to buff and magnesian | 8 | 3 |
| Sandstone, greenish | 5 | 6 |
| Limestone, buff, dense | 4 | 0 |
| Concealed | 2 | 0 |
| St. Peter sandstone | | |

The section is about 26 feet thick, and it rather closely resembles the typical Glenwood sandstone except for the limestone beds in its lower part.

The most eastern exposure known in this region is one just beyond the southeastern corner of the Oregon quadrangle where transition beds of thin limestone, sandstone, and bluish-green shale totaling 4½ to 5½ feet in thickness are present between the St. Peter and the Platteville.[16]

## Stratigraphic Relations in Illinois

No break is reported at the top of the St. Peter sandstone in Iowa and in parts of Minnesota, Wisconsin, and northern Illinois. In fact the local occurrence of beds of typical St. Peter sand in the upper portion of the Glenwood, as reported along Elkhorn Creek in northern Illinois, suggests that in some areas deposition was continuous from St. Peter time into Glenwood time. Similar evidence is afforded in places by the alternation of beds of typical St. Peter sandstone and of limestone resembling the Platteville, as well as by the transition beds described in this paper and in other papers to which reference has been made. On the other hand, an erosional unconformity is present above the St. Peter in southwestern Wisconsin and in northern Illinois, as for instance, near Oregon. At Deer Park, south of LaSalle, the contact of the St. Peter and the Platteville is

[16] Bretz, J. H., Geology and mineral resources of the Kings quadrangle: Ill. State Geol. Survey Bull. 43, p. 224, 1923.

an erosional unconformity with a relief of about 2 feet in a short distance (fig. 3). Logs of wells in the northeastern part of the State contain evidence of a break at this horizon.

Similar conditions exist in southwestern Illinois where the Glenwood and the overlying Plattin (or Platteville) limestone rest on the eroded surface of the Joachim limestone in Calhoun County.[17] The absence of the latter formation in the northern part of the State, particularly in view of its considerable thickness in the Ozark region, is further evidence of the extent and nature of the unconformity.

Although the lithologic change from the Glenwood to the Platteville is commonly abrupt, it should be noted that no trace of an unconformity be-

FIG. 3. Unconformity between St. Peter sandstone and Platteville-Galena dolomite at Deer Park. (Reproduced by permission of the University of Chicago Press.)

tween these formations has been reported. They seem entirely conformable in the Oregon quadrangle. They are closely associated in southwestern Wisconsin,[18] and Platteville fossils have been reported by Sardeson from strata at the Glenwood horizon along the upper Mississippi.

## GEOLOGIC HISTORY

The characteristics of the Glenwood beds and their relation to the St. Peter sandstone and the Platteville limestone indicate the geologic conditions in northern Illinois and the upper Mississippi Valley during this portion of the Ordovician period. It has been established that an extensive

[17] Weller, Stuart, oral communication.

[18] Grant, U. S., and Burchard, E. F., U. S. Geol. Survey Geol. Atlas, Lancaster-Mineral Point folio (No. 145), p. 4, 1907.

marine embayment covered this region during St. Peter time.[19] The conditions immediately following the deposition of the St. Peter sands have not been determined conclusively for this entire region, as the evidence given in the literature is meager and indecisive for some areas and even appears somewhat contradictory when different districts are compared.

On the basis of the features described in this paper, the changing geographic conditions during this episode in the Ordovician history of northern Illinois may be interpreted briefly. After a considerable interval of marine submergence during St. Peter time, the sea withdrew from the region, thus permitting slight erosion of the surface of the recently deposited sands. The apparent absence of deep erosion channels in the St. Peter sandstone may indicate that the land remained close to sea level, or that the next sea to invade the region reworked the uppermost beds so completely as to obliterate most of the relief. Rivers and winds probably transported some sand over this land area. After a brief interval the sea again invaded the region with the result that the unconsolidated or loosely cemented St. Peter was reworked by waves and currents and some of it was incorporated in the Glenwood sandstone. Many of the typical rounded and frosted sand grains in the latter may have been derived, however, from the original source of the St. Peter sand. The much smaller size and the angularity of most of the Glenwood sand seem to indicate a new source of detritus during this time. Perhaps streams were transporting sediment from the crystalline rocks of northern Wisconsin or adjoining regions. Much finer sediment was carried into the sea south and west of the Oregon basin. For very brief intervals typical St. Peter conditions of deposition recurred, either because currents were sweeping over the top of the St. Peter sandstone or because winds and streams were deriving sand from exposed St. Peter or other sandstones to the north. From time to time during the Glenwood stage, conditions were favorable for the deposition of calcareous sediments, either organically or biochemically, in protected bays or in barrier-locked areas in the open sea. Shifting currents, oscillating shores, or a fluctuating supply of sediment caused an interbedding of sands and limy muds in some places. Finally, the sea appears to have rapidly submerged much of the Mississippi Valley area, bringing in an abundance and great variety of characteristic lime-secreting invertebrates, so that the Platteville calcareous sediments accumulated to a considerable thickness.

[19] For an excellent discussion and interpretation of the St. Peter sandstone see Dake, C. L., The problem of the St. Peter sandstone: Mo. Bur. Mines and Metall., tech. ser., vol. 6, No. 1, 1921.