ON THE GEOLOGY OF CHAMPAIGN COUNTY

BY

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Champaign is one of the few counties in Illinois in which not a single exposure of hard rock is known. Consequently, our knowledge of these rocks is obtained from well records and other drillings in this and neighboring areas. From these sources we know that each of the systems of the Paleozoic group is represented in Champaign County, except the Permian. Here, as elsewhere, the Paleozoic strata rest upon metamorphic rocks of Proterozoic age.

CAMBRIAN SYSTEM

The presence of the Cambrian rocks is inferred from their known occurrence in adjacent regions. Their character is presumably similar to that of the rocks of this age in other parts of the state, where they consist mostly of sandstone and sandy shale. Their thickness farther north in Wisconsin ranges up to nearly 1000 feet. The thickness is probably somewhat less in this area, but it is doubtless as much as 700 or 800 feet. This sandstone is an important water bearing formation in Chicago, and other places in northern Illinois, but in Champaign County abundant water is obtained from shallow wells.

ORDOVICIAN SYSTEM

The record of a well put down a short distance east of the Power Plant, in Champaign, some years ago showed a thickness of more than 1,250 feet of Ordovician strata. Of these rocks, a thickness of more than 700 feet belongs to the lowest division of the Ordovician, the so-called Lower Magnesian limestone. Above this limestone or dolomite there occurs 75 feet of clean, rounded sand called the St. Peter sandstone. This sandstone is exposed in the canyons in Starved Rock Park and Deer Park. It furnishes an abundant supply of water to many towns in the northern part of the state. Overlying this sandstone is a thickness of more than 380 feet of limestone and dolomite which is commonly known as the Galena-Trenton limestone. The Galena dolomite is the source of the lead and zinc ores in the northwestern part of Illinois, and adjacent portions of Iowa and Wisconsin. The uppermost

division of the Ordovician in this region consists of a thickness of about 80 feet or more of shale and shaly limestone which is called the Maquoketa formation.

Silurian System

The rocks of the Silurian system in this part of Illinois are mostly yellowish or brown dolomite, 75 feet or more thick. In some places a sandstone, of variable thickness occurs at the very base of the Silurian. This is the Hoing sand, which is the oil sand of the Colmar field in MacDonough County. The Silurian dolomite is quarried extensively for road material and other purposes in the vicinity of Kankakee and Joliet. The lower part of the Silurian in those areas is known as the Alexandrian

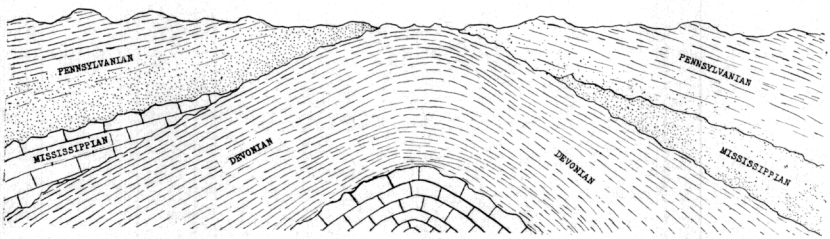

Fig. 1. Sketch showing the relations of the strata to the LaSalle anticline beneath the mantle rock, in the northern part of Champaign County. Horizontal scale about 2 inches to the mile. Vertical scale about 50 feet to the inch.

series, while the upper part is called the Niagaran series from the fact that these rocks are about the same age as the strata over which the water of the river drops at Niagara Falls.

Devonian System

The Devonian rocks in this part of the state consist of an upper, shale formation which presumably represents about the same time of deposition as the New Albany shale of southern Indiana. Below this shale is a nondolomitized limestone of Devonian age the thickness of which can not be certainly determined because of the difficulty of distinguishing the boundary between the Devonian and the Silurian limestones from the well records in this region. The combined thickness of these two limestones indicated in the Champaign well is about 164 feet. Farther east, at Danville Junction, the combined thickness of these limestones is about 600 feet.

Mississippian System

No rocks of Mississippian age appear to be present in the record of the well at Champaign, or in the test borings near Mahomet. This is doubtless because these places are located so near the crest of the LaSalle anticline. Several miles farther east, at Danville, the Mississippian rocks have a thickness of about 400 feet. In the latter locality they consist mostly of shales, with a little sandstone and limestone. West of the LaSalle anticline the Mississippian strata are more commonly limestones. The thickness of these rocks increases both towards the east and the west from the LaSalle anticline in this region.

Pennsylvanian System

A thickness of 75 or 80 feet of shale and sandstone is shown in the record of the Champaign well between the top of the dark upper Devonian shale and the unconsolidated deposits of the Pleistocene. In the logs of the test borings near Mahomet, which are more nearly on the crest of the LaSalle anticline than is the Champaign well, no Pennsylvanian or Mississippian strata are present between the upper Devonian, Sporangites-bearing shale and the Pleistocene deposits. No coal was reported in the Champaign well record, but the log of a well drilled in Urbana showed a coal bed a few feet thick. Like the Mississippian strata, the Pennsylvanian rocks become thicker both towards the east and the west of the LaSalle anticline, and within a few miles in both directions one or more coal beds appear in the Pennsylvanian section. A maximum thickness of 400 to 600 feet of Pennsylvanian strata are present in some places in Champaign County, at a distance from the LaSalle anticline.

Structure of the Strata

The rock structure in Champaign County is dominated by the LaSalle anticline, as described above. This explains why there is no coal in the Pennsylvanian strata beneath Champaign and Urbana. The crest of this arch extends in a general northwest-southeast direction nearly beneath Mahomet, and a short distance west of Champaign. On the west side of this arch the strata dip towards the west or southwest, and on the east side they are inclined generally towards the east. During the greater part of the Pennsylvanian time the crest of this arch was so high in this region that not much sediment was deposited upon it. Minor irregularities of structure are present in a number of places, but these do not modify in any important way the control of the structure by the LaSalle anticline.

Age of the Sporangites-Bearing Shale

Important evidence of an indirect nature concerning the age of the dark Sporangites-bearing shale is furnished by the relation of the Mississippian rocks and associated strata to the LaSalle anticline. The dark Sporangites-bearing shale is present over the crest of this arch, and is similar on the east and west sides of the anticline. The Mississippian strata, on the contrary, are absent from the crest of this arch, and these sediments are quite different adjacent to the anticline from the usual limestones of which they commonly consist over the greater part of the State. Moreover, at a distance from this arch the Mississippian strata are quite different on the east side of the anticline, where they consist mostly of shales and sandstone, from what they are on the west side of the arch, where they are made up largely of limestones. These differences indicate that an important upward movement of this anticline occurred in this region after the dark Sporangites-bearing shale was deposited, and before the first of the Mississippian strata were laid down. Such movements are commonly interpreted as indicating the end of a period, and as marking the boundary between the preceding period and the one that followed. Consistent with this interpretation, it is thought that the dark Sporangites-bearing shale which was deposited before the movement above mentioned, belongs to the Devonian system, and that the earliest sediments that were laid down after this movement represent the beginning of the Mississippian deposition in this region.

Post-Pennsylvanian Conditions

The last great period of deposition in this region durmg the Paleozoic era was the Pennsylvanian, after which time this region was permanently elevated above the sea accompanied by a further uplight of the LaSalle anticline. For a very long time after this uplift the area of Champaign County was subjected to the processes of weathering and erosion, as land areas always are.

Because this region was of rather low elevation and quite a distance from the sea, no very great thickness of rocks was removed from the surface notwithstanding the very long time during which such denudation was taking place. This interval was millions of years in duration. It included all of the Mesozoic era and much the greater part of the Cenozoic. The small amount of denudation is indicated by the fact that alluvial deposits which were laid down on a floodplain of a Permian stream are now exposed in a few places in Vermillion County,

not far east of Champaign County, at nearly the same level as the flood-plains of the present streams in this region to-day.

During Pliocene time it is thought that an uplift occurred that rejuvenated the streams, and permitted them to trench their channels to a greater depth. As a result of this general uplift and the quickened erosion, the streams developed on the surface of this region a topography more rugged than that of the present. The pre-Pleistocene relief of Champaign County was comparable with that of the southern part of Illinois today. The preglacial relief of this region exceeded 160 feet.

Preglacial Drainage and Bed Rock Surface

The difference in the elevation of the surface of bed rock in different places in Champaign County indicates the presence of a wide preglacial valley 160 or more feet deep, which may have been tributary to the preglacial Illinois River valley. This valley probably extended in a more or less easterly direction from the preglacial Illinois River nearly to the eastern boundary of the state. The lowest elevation of this valley known in Champaign County is about one mile south of Mt. Olive cemetery where rock was reported at an elevation of 403 feet above sea level, which is 287 feet below the present surface. Several different wells in Champaign and Urbana found rock at about 440 feet above sea level. At Thomasboro the elevation of the bed rock surface is about 436 feet. North of Champaign County, at Paxton, bed rock is reported at an altitude of 343 feet. At Delavan, in Tazewell County, rock was found at an elevation of 288 feet, and at Pekin the elevation of bed rock is 208 feet.

East of Champaign County a preglacial upland is shown by the rocks that outcrop along Salt Fork and Vermilion River at an elevation considerably higher than the rock surface over the greater part of this county. Farther south, bed rock is reached at Sidney at an elevation of 565 feet, and at about the same altitude at Homer. At Mattoon, still farther south, bed rock was reported at an elevation of 625 feet. These elevations of bed rock seem to indicate that the general direction of the preglacial drainage in this region was towards the north and northwest, and that the divide between the Wabash drainage basin and that of the Illinois basin at that time was farther east than it is at the present time.

The level of the present Illinois River in central Illinois is many feet higher than some of the elevations of bed rock given above. However, below the great bend of the Illinois River near Hennepin, the pres-

ent Illinois flows in an old preglacial valley the rock bottom of which is more than 100 feet lower than its present bed. This old valley was sufficiently low for it to have received such a tributary as the one above described.

Pleistocene Epoch

During the Pleistocene epoch the surface of Champaign County was covered by at least two, and probably three great ice sheets. The earliest of these that is certainly known to have moved over this area is known as the Illinoian. This was the third great ice sheet that advanced over portions of the upper Mississippi valley region. The center of accumulation of this great glacier is thought to have been in the Labrador region, from which it moved towards the south and west over southwest Canada and the northeastern part of the United States. It extended south almost to the southern border of Illinois, and pushed westward across the Mississippi River between Rock Island and Keokuk.

As this ice sheet passed over Illinois it was heavily loaded with subglacial debris which it gathered from farther to the northeast. This material was deposited as the ice melted, forming a bed of glacial till or unsorted drift, which was especially thick over such pregiacial valleys as the one above described in Champaign County. In some places the thickness of this glacial till exceeded 200 feet.

The surface of the Illinoian till sheet can be distinguished in many places by the presence of an old soil zone, or a bed of peat below a younger till sheet. One or more beds of water-laid sand and gravel occur within the till at a number of places in Champaign County. The thickness of the till in Champaign and Urbana is about 190 feet. In the vicinity of Philo, and in other places in this region, the thickness is equally great. In the eastern part of the County, over the preglacial uplands, the thickness of this till is not more than 30 to 45 feet.

Sand Beds Associated with the Illinoian Drift

Sand and gravel beds associated with the Illinoian till furnish nearly all of the water to the wells of Champaign County. Two of these beds are remarkably persistent in this area. They were doubtless formed as a result of the fluctuation of the ice margin, and were deposited by streams that flowed away from the front of the glacier. After the deposition of such a bed of sand and gravel by a stream, a re-advance of the glacier buried the sand beneath a bed of drift. Another recession of the ice permitted the deposition of another bed of sand by

the streams upon the surface of the former drift deposit. Like all such deposits made by glacial streams, the materials are very irregularly bedded, and change from sand to gravel or from coarse sand to fine within short distances in both horizontal and vertical directions. The upper one of these sand beds occurs immediately below the Sangamon interglacial soil horizon, and immediately above the Illinoian till, at a depth of 60 to 100 feet below the surface. In the northern part of the County this upper sand lies at an altitude of about 630 feet, while in the southern part the elevation of this bed is about 600 feet. The sand is thus inclined towards the south at an average rate of about one and one-half feet to the mile.

A contour map will show the southward dip of this sand bed, and because of the dip of this sand bed and its position beneath a younger till, a head of water pressure is produced which results in artesian conditions. Many flowing wells occur over the area.

The lower sand bed associated with the Illinoian till lies more nearly horizontal than the upper. In the northern part of the county these two sands are 40 to 50 feet apart while in the southern part they are separated by an interval of only 10 to 20 feet. The upper sand bed is 12 to 25 feet thick while the lower one is much thicker, in places reaching 70 feet.

The Sangamon Soil Horizon

The Sangamon soil and peat horizon lies immediately above the upper sand bed described above. This soil was developed during the long interval between the Illinoian glacial epoch and the time of main loess deposition, which occurred in early Peorian interglacial time. The thickness of this peat and soil zone ranges from one to three feet. A test boring for coal made in Champaign some years ago is said to have passed through a thickness of two feet of peat and wood fragments, at an elevation of about 610 feet. A drilling made in Urbana in 1884, about one-half mile east of the round house of the Big Four Railroad, encountered a like thickness of peaty soil at a depth of 78 feet, and at an elevation about the same as that in the Champaign boring. A well put down on the campus of the University of Illinois passed through this soil layer at a depth of 74 feet. In the vicinity of Tipton a similar soil band was reported from more than 70 wells at a uniform elevation of 610 feet. Such a carbonaceous zone has been reported also from wells in the vicinity of Philo, and St. Joseph, and many other places in Champaign County.

This peat and old soil is well exposed in the bank of Sangamon River, one and one-half miles southwest of Mahomet where the detailed section is as follows:

	Feet
Glacial till, consisting of grayish brown, pebbly clay	20
Loess, fine grained, yellowish brown	2
Peat and dark soil	2
Till, pebbly (Illinoian)	3

From the peat material at this locality the writer collected wing covers or elytra of beetles of various kinds, and other insect remains. These were sent to Professor Wickham[1], at the University of Iowa, who described the following new species from this deposit:

CARABIDÆ

Carabus mæander sangamon
Patrobus henshawi
Platynus pleistocenicus
subgelidus
calvini
Chlænius plicatipennis

DYTISCIDÆ

Agabus savagei
prælugens

STAPHYLINIDÆ

Olophrum interglaciale

CHRYSOMELIDÆ

Donacia styrioides

All of the types are to be found in the collections of the University of Illinois.

The fossils in the peat and soil zone seem to indicate climatal conditions during the formation of the Sangamon interglacial time not greatly different from those of today.

INTERGLACIAL LOESS DEPOSITS

A bed of loess of early Peorian age is commonly present above the Sangamon soil and peat zone, and beneath the younger glacial till. The thickness of this deposit varies from a few to six or eight feet. This loess deposit was doubtless made by the wind and was laid down above the old soil zone over all of this region before the later Wisconsin till was deposited above it. The manner of deposition, age, and origin of the loess in Illinois have been described by the writer in an earlier volume of the Proceedings of this Academy,[2] to which the reader is referred for this information.

WISCONSIN GLACIAL STAGE.

The Wisconsin ice sheet was the last Continental glacier that moved over portions of North America during the Pleistocene epoch. This

[1] Wickham, H. F., Amer. Jour. Science, vol. 44, pp. 137-145, 1917.
[2] Savage, T. E., The Loess in Illinois: Its Age and Origin. Ill. Acad. Sci. Trans., vol. 8, pp. 100-117, 1915.

ice sheet covered all of Champaign County, and extended south in this region about as far as Paris, Charleston, and Mattoon; and west as far as Decatur and Peoria. The till left when this glacier melted makes up the uppermost glacial deposit over all of this region. The surface it left was remarkably level, except for a few belts of ridges made at the margin of the ice when it halted for a long time in its retreat to the northward. These are called recessional moraines. One of them is known as Yankee Ridge, which extends in a nearly north-south direction between Urbana and Philo.

The thickness of the Wisconsin till in this county averages about 70 feet. It is here less sandy than the earlier Illinoian till, and contains fewer sand beds associated with it. This drift surface is so young that the streams have had time to develop only a few shallow valleys in this region since the glacier melted away. Over the surface of this till the wind has deposited a thin veneer of loess, but the thickness is commonly only a few inches.

The coarse sand beds buried in the glacial till, associated with old peat or soil beds containing large amounts of organic matter, furnish favorable conditions for the development and accumulation of small quantities of natural gas in the drift. Natural gas is reported in many water wells in this area and a few of the farmers have piped gas to their homes and used it for lighting purposes. The wells from which gas has been obtained in sufficient amounts to be used for lighting are indicated on the map, plate 2. All the materials necessary for the formation of the gas, and all of the conditions necessary for its accumulation, are supplied by the Pleistocene or glacial deposits of this region. The presence of the gas in the drift is no indication that oil or gas is present in the underlying hard rocks in this region. In fact, none of the wells or test borings put down into the bed rock in this area show any traces of either oil or gas.