STATE OF ILLINOIS

DEPARTMENT OF REGISTRATION AND EDUCATION
DIVISION OF THE
STATE GEOLOGICAL SURVEY

FRANK W. DE WOLF, Chief

EXTRACT FROM BULLETIN No. 38

THE GEOLOGY AND MINERAL RESOURCES OF THE EDGINGTON AND MILAN QUADRANGLES

By T. E. Savage and J. A. Udden

Printed by Authority of the State of Illinois

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MANZ ENGRAVING CO., CHICAGO
51882—2M

PREFACE

Recent field examinations in the area covered by this report have suggested radical changes in the assumed correlations of the coals. Meanwhile, the geological maps had been engraved and the report had been set in type for publication. Certain improvised changes in the map and report have been made but they are of necessity brief, and are not supported by a full discussion; therefore, the reader will be glad to know that a further statement is in preparation and will soon be available.

The principal coal of the Rock Island area has long been known to the trade as "Rock Island or No. 1 coal". It has many characteristics resembling those of the No. 1 bed of Fulton County, and was regarded by A. H. Worthen, the former State Geologist, as of the same age and horizon. Furthermore, plant fossils have seemed to indicate that this coal is of Pottsville age. However, H. E. Culver of the State Survey has recently found in the roof limestone of the coal at Matherville and Sherrard, numerous fossils of *Girtyina ventricosa,* which to the best of our knowledge occur only in the limestone overlying No. 6 coal. T. E. Savage, joint author in the present report, is quite confident that the coal known as No. 1 at these mines must really be No. 6, even though there may be elsewhere in the region thinner beds comparable with No. 1 of Fulton County and of Pottsville age. At his request the present report has been changed so as to recognize the new correlation.

This new evidence, together with observations by Currier, Savage, and Culver in western Illinois, suggests a marked period of erosion near the close of Carbondale time, after which No. 6 coal was deposited widespread. Evidently in places it immediately overlies various beds of the earlier Carbondale strata, and perhaps may be found directly on the Pottsville.

Further evidence and interpretation will be presented by Mr. Culver in a report on "Coal resources of District III", Illinois Mining Investigations.

F. W. DeWolf, *Chief.*

THE GEOLOGY AND MINERAL RESOURCES OF THE EDGINGTON AND MILAN QUADRANGLES

By T. E. Savage and J. A. Udden

OUTLINE

ILLUSTRATIONS

TABLES

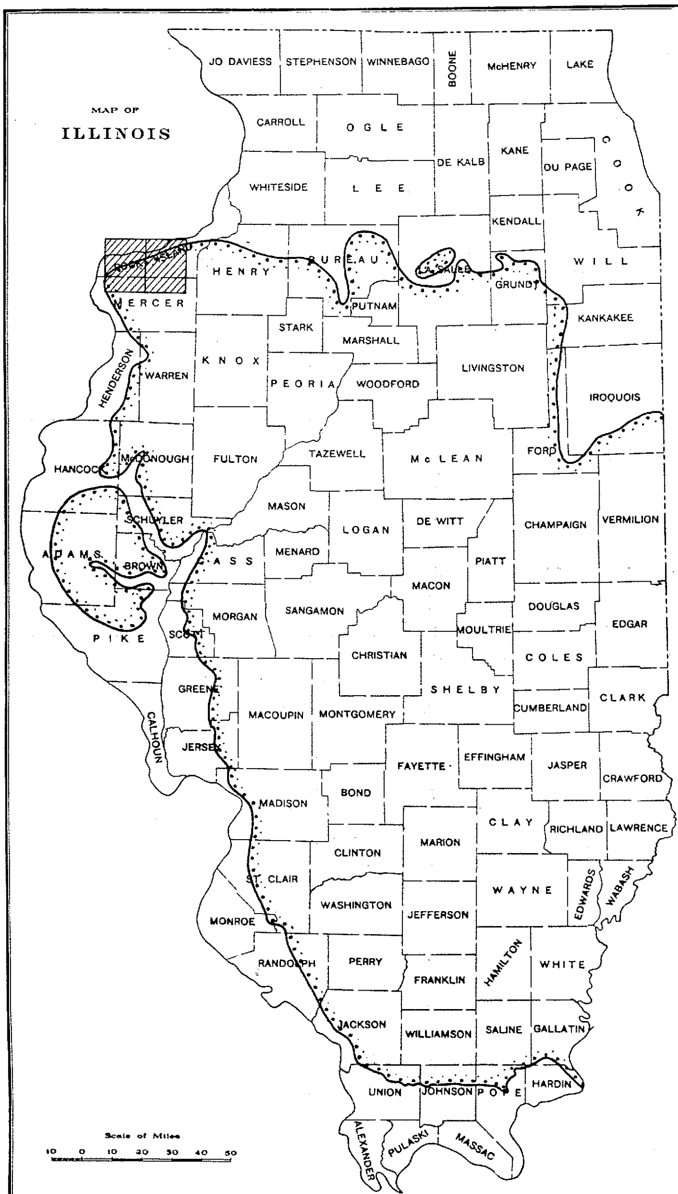

FIG. 13.—Index map showing the location of the Milan and Edgington quadrangles. The stippled boundary is the outline of the Illinois coal field.

INTRODUCTION

Position and General Relations

The Milan and Edgington quadrangles are included between the parallels 41° 15′ and 41° 30′ north latitude, and the meridians 90° 30′ and 91° west longitude. They thus embrace about one-eighth of a square degree, which at this latitude is equivalent to about 437.75 square miles. In addition to these quadrangles there is included in this report about 7 square miles lying south of the main channel of Mississippi River, and north of latitude 41° 30′. This latter tract includes the older parts of the cities of Rock Island and Moline, and the Government reservation of Rock Island, which lies between the two channels of the river. Fig. 13 is an index map showing the general position of the quadrangles.

The greater part of the area of these quadrangles is in Rock Island County, Illinois, but it also includes about 145 square miles of Mercer County, in the south part of the area, and about 60 square miles north of Mississippi River, which comprises parts of Scott and Muscatine counties, in Iowa. The principal cities in the area are Rock Island and Moline.

These quadrangles form a part of the great region known as the Glaciated Plains, which extends far to the east and west, with which this area is closely related in its physiographic and geologic history.

TOPOGRAPHY OF THE MILAN AND EDGINGTON QUADRANGLES

Relief

The surface of the Milan and Edgington quadrangles is that of a loess-covered drift plain that has been rather strongly dissected by stream erosion. In this old plain the Mississippi River and its tributary systems have carved valleys, in places one-half to 2½ miles wide, to a depth of 100 to 200 feet below the uplands. On account of the proximity of Mississippi River the extreme range of surface relief in the area is about 280 feet. The lowest place, slightly less than 540 feet above sea level, is in the valley of Mississippi River, in the northwest quarter of the Edgington quadrangle. The highest point is on the upland in the Milan quadrangle, about one mile southeast of Reynolds, where the elevation reaches 820 feet.

The area includes three distinct varieties of topographic features: upland prairies, erosion slopes, and flood plains.

Upland Prairies

The upland prairies comprise less than half the area of the quadrangles. The larger part of these uplands is included in two watersheds which extend in an east-west direction across the quadrangles, and represent the uneroded portion of the original drift-formed plain. The more northern of these divides lies between Mississippi and Rock River valleys in the north, and

Copperas and Mill creeks on the south. The second upland belt is bordered on the north by Copperas and Mill creeks and on the south by Eliza Creek and Camp Creek, and a third somewhat smaller belt of upland still farther south forms the watershed between Camp Creek and Edwards River. These upland areas are very irregular in outline. The two larger areas include a nearly continuous belt of level land one to three miles wide, extending entirely across both quadrangles. The general surface of the more northern upland belt lies between 730 and 800 feet above sea level, the highest part lying within about 5 miles east and west from the village of Edgington. The elevation of the southern area ranges from 740 to 820 feet above the sea, being higher in the Milan quadrangle, where the surface of the larger part of this belt lies above 800 feet altitude. From these main divides, inter-stream areas of varying width extend in irregular finger-like projections between the tributaries of the bordering streams, becoming progressively narrower in width and lower in altitude as the larger streams are approached.

Erosion Slopes

The valleys of Mississippi and Rock rivers are bordered by forested slopes 80 to 150 feet high. In places where the rivers have recently undercut one of their banks, a nearly perpendicular cliff of Pennsylvanian strata, 50 or more feet high, may be exposed. In other places where undercutting has not been active for a considerable period, the hard rocks are concealed by a mantle of unconsolidated material derived from slumping and sheet wash, but their presence near the surface is indicated by the steep lower slopes of the valley sides. The tributaries of Mississippi and Rock rivers, and of Edwards River, have cut valleys to the level of their master streams, and like them are bordered by rather steep slopes, a descent of 120 feet in a distance of a quarter of a mile being common. Pennsylvanian rocks are exposed in numerous places along these valleys.

One of the conspicuous features on the slopes, especially where the banks are largely composed of Pennsylvanian shale, is the slumps or landslides that have occurred on a large scale. Frequently five or six terrace-like offsets, 8 to 12 feet high and 10 to 15 rods long, are present in vertical succession on the same slope, in places where the valleys lie a considerable distance below the upland. Under such conditions slumping is one of the most important agents in the development of gentle slopes. At a considerable distance from the rivers the stream valleys are 50 to 100 feet deep, and are bounded by more gentle slopes. Toward their heads they become shallower and their slopes less steep until at length they merge insensibly into the uplands.

In the southwest part of the Edgington quadrangle, as along Eliza Creek and its branches, the banks of the streams are of Pleistocene material, and no hard rock is exposed. Along the west border of the area the top of the bluff bordering Mississippi River is in many places capped by a deposit of wind-blown loess or sand that increases the local relief.

Flood Plains

The larger flood plains in these quadrangles are along Mississippi River, Rock River, and Edwards River. Smaller areas of alluvial deposits occur in the valleys of the larger tributary creeks.

The flood plain of Mississippi River is 3½ miles wide where the river enters the Milan quadrangle, and continues equally wide to below the junction of Rock River and Mississippi, a distance of about 4½ miles. About 3 miles east of Andalusia the bluffs converge so that the width of the flood plain does not exceed 1½ miles. The valley continues about this width to Montpelier, below which it widens to nearly 2 miles, which width it holds as far as Muscatine on the west border of the Edgington quadrangle, with the exception of a slight constriction for two miles below Fairport.

This portion of the course of Mississippi River across the Milan and Edgington quadrangles is the lower part of the "upper narrows" of the river which begins at Cordova, about 22 miles above Rock Island. In this part of its course the river was diverted from its pre-glacial channel during Pleistocene time, and has here been cutting a new, relatively narrow channel across the pre-glacial upland. Where the river bends south, at Muscatine, it enters a portion of an old pre-glacial channel, and the flood plain abruptly broadens to a width of 7 miles, which width is maintained farther southward beyond the limits of the quadrangles.

Where Rock River enters the Milan quadrangle, the flood plain is 2½ miles wide, but the width gradually decreases until at Milan it does not exceed 1½ miles. The width of the flood plain of these rivers is clearly controlled by the character of the rock that forms the bordering banks. The glacial drift has offered the least resistance to the erosional work of the streams. Rocks of Pennsylvanian age, especially the sandstones, furnish a fair degree of resistance, but the resistance of the Devonian limestones is far greater than that of either the drift or the sandstone. The narrowing of the valley of Rock River in the vicinity of Milan is clearly due to the rise of the Devonian limestone in the banks on both sides of the stream. In like manner the constriction of the valley of Mississippi River above Andalusia is also due to the presence of Devonian limestone in the valley walls. The less conspicuous narrowing of the valley of the Mississippi below Fairport was caused by the unusual thickness of Pennsylvanian sandstone in the river banks in that locality. The width of the valley of Mill Creek, in the Milan quadrangle, where it is bordered by Devonian limestone for a distance of 4 or 5 miles above the junction with Rock River, is less than one-third of its common width farther upstream where the banks are composed of glacial drift or of Pennsylvanian shale and sandstone.

The width of the flood plain bordering Edwards River in the Milan quadrangle varies between half a mile and one mile.

The other larger streams in the quadrangles are Copperas, Camp, and Eliza creeks. These have developed flood plains throughout the greater part of their length, to a width generally less than one-fourth mile, but the larger ones are in some places nearly half a mile wide. The larger part of the flood plains of Mississippi and Rock rivers lies between 12 and 20 feet above the ordinary level of the water. The range of relief of these flood plains in the Milan quadrangle is less than 50 feet, ranging from about 560 feet above sea level near the channels of the rivers, to about 600 feet at the bases of some of the bordering bluffs. In the Edgington quadrangle the elevation of the surface of the flood plain of Mississippi River ranges from about 540 to 580 feet.

The surface of the flood plain of Mississippi River declines 15 feet in the distance of about 21 miles across the quadrangles. The principal inequalities of this river flat are broad, shallow depressions, representing partly filled channels that are followed by the flood waters. Such depressions are found northeast of New Rockingham, and also in secs. 3 and 10, South Rock Island Township, and west of Milan along Kickapoo slough. Near the main channel these depressions may contain water the most of the year, and form a network of bayous separated by sand bars or similar deposits of irregular character. Swamps and ponds are numerous over most of this valley flat.

In a few places islands of bed rock occur in the flood plain, as Rock Island on which the Government arsenal is located, and Vandruff Island in Rock River, north of Milan. However, most of the islands are formed of alluvium deposited by the river.

The thickness of the alluvial deposits along Mississippi and Rock rivers in the Milan and Edgington quadrangles usually varies from 15 to 45 feet, the rock bottom of the valley below the river lying at altitudes of from 515 to 535 feet. This slight thickness of the alluvium in the "narrows" of the river between Cordova and Muscatine is in strong contrast to the depth of alluvial deposits in the old portion of the river valley where it follows a preglacial channel (see figure 14). At Fulton, north of the "narrows," the flood-plain deposits extend downward 166 feet below the level of low water in the river, the altitude of the rock at the base of these deposits being about 400 feet above sea level. Udden[1] has reported two wells in the old channel below Muscatine that passed through about 158 feet of alluvial deposits, reaching rock at an altitude a little less than 400 feet above sea level. A well put down near the southeast corner of the Edgington quadrangle penetrated 120 feet of alluvial material without reaching bed rock.

Along the east bluff of Mississippi River north of Sears, and in the south part of Rock Island, a remnant of an old terrace extends in an almost continuous belt for 2 to 3 miles. A part of the surface of this terrace area rises above the 600-foot contour line, and the material consists mostly of cross-bedded sand and gravel. In a few other places terrace remnants appear near the bluffs where creeks leave the uplands in Buffalo, Andalusia, and Black Hawk townships.

In places where the slopes of the river banks are gentle the bottom lands rise as the bluffs are approached. This rise is doubtless due to the

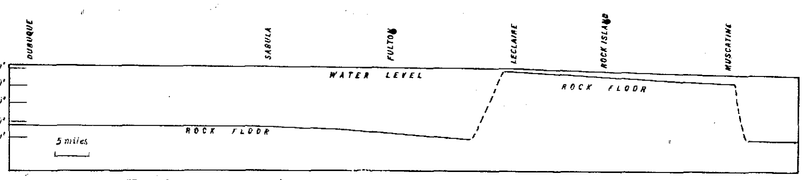

FIG. 14.—Profile of the rock bottom of Mississippi River between Dubuque and Muscatine.

deposition of sediment as sheet wash from the bordering banks, or as low, more or less coalescing alluvial fans deposited where small streams flowing down the steeper bluff slope have been unable to carry the load of sediment across the level flood plain.

DRAINAGE

All of the area included in the Milan and Edgington quadrangles belongs to the Mississippi River drainage system. The Mississippi enters at the northeast corner of the area, flows southwest to the mouth of Rock River, thence nearly west across the northwest quarter of the Milan quadrangle and the north part of the Edgington, and leaves the area in section 31, T. 17 N., R. 5 W.

The drainage basin of Mississippi River above Quincy includes about 135,500 square miles, while that portion of the basin above Moline is about 90,000 square miles. The run-off from the part of the basin above Quincy is about .538 second-feet per square mile. In this part of its course the river carries each year 108 tons of dissolved mineral matter, and 63 tons of suspended matter from each square mile of its drainage basin. At this rate more than 1,100 years are required to lower the entire surface of its drainage basin one inch, which is at the rate of one foot in from 13,000 to 14,000 years.

Rock River, the largest tributary of the Mississippi in the quadrangles, rises in Wisconsin, and flows in a southwest direction for nearly 300 miles, joining the Mississippi near the town of Milan. The drainage basin of Rock River is about 10,970 square miles, about half of which is in Wisconsin. From its source to its mouth the river falls about 340 feet, the average

[1]Udden, J. A., Reported by Leverett, U. S. Geological Survey, Mon. 38, p. 475, 1899.

slope being 1.2 feet to the mile. The greatest fall in Illinois, for any considerable distance is from Oregon to Sterling, a distance of 36 miles in which the average slope is 1.31 feet per mile. The average discharge of Rock River into the Mississippi from October 1, 1906, to July 31, 1907, was between 8,000 and 9,000 cubic feet per second. The river removes each year an average of 200 tons of mineral matter in solution and 180 tons of sediment in suspension from each square mile of its drainage basin. At this rate the level of the entire basin would be reduced one inch in 500 years, or at the rate of one foot in about 6,000 years.

Besides Rock River, the larger tributaries to the Mississippi in these quadrangles are Edwards River, and Copperas, Camp, Eliza, and Mill creeks. With the exception of Mill Creek, all of these flow in a general westerly direction, approximately parallel with the Mississippi in this area. Their channels are bordered by narrow, well-defined flood plains having an average slope of 8 to 12 feet to the mile. Mill Creek follows an easterly course throughout the greater part of its length, but bends abruptly northward about 5 miles above its mouth, and continues in this direction to its junction with Rock River a short distance east of Milan. The eastward course of Mill Creek is in a direction opposite to that of the other streams of the area, and its abrupt bend to the northward a few miles above its mouth are peculiar features for a stream in this region. The explanation is probably to be found in the irregularities in the original surface of the drift plain. The surface of the drift is now somewhat higher over the narrow divide between the headwaters of Copperas and Mill creeks than over any other part of the surface bordering the immediate valleys of these streams. This divide west of Reynolds has an elevation of 810 feet above sea level, and toward the south it merges into the watershed between Mill and Camp Creeks, on which, about a mile southeast of Reynolds, is the highest point in the quadrangles.

All of the larger streams in the quadrangles have numerous tributaries which generally are two to four miles long and are about one mile apart. They usually follow a north-south direction, and meet their major streams nearly at right angles.

CULTURE

The larger part of the surface of the quadrangles, except in the lower parts of the flood plains, is under cultivation, and agriculture is the principal industry. The area is rather thickly, though not densely, settled. The largest cities are Rock Island and Moline at the northeast corner of the Milan quadrangle. The population of Rock Island is 35,000, while that of Moline is 31,000. The smaller towns usually have only a few families, or a few hundred inhabitants. In the Milan quadrangle are Milan, Sears, Sherrard, Cable, Matherville, Reynolds, Andalusia, and Taylor Ridge in

Illinois, and the village of Buffalo in Iowa. In the Edgington quadrangle are the villages of Edgington, Illinois City, and Buffalo Prairie in Illinois, and Fairport and Montpelier on the Iowa side of the river.

There are a few commercial coal mines and several local mines in the area, but coal mining is not a very important industry in the quadrangles. Considerable manufacturing is carried on in the cities of Rock Island and Moline, and the railroads give employment to a large number of people.

The Milan quadrangle is well provided with transportation facilities, but the Edgington is less fortunate in this regard. The main line of the Chicago, Rock Island and Pacific, and the Chicago, Milwaukee and St. Paul railways pass through Moline and Rock Island, and follow the north side of the valley of the Mississippi across the north end of the quadrangles to Muscatine. The Peoria branch of the Chicago, Rock Island, and Pacific crosses the northeast quarter of the Milan quadrangle, connecting Rock Island and Peoria. The Sherrard and Cable branch of the Chicago, Rock Island and Pacific, and the Rock Island Southern Interurban connect Rock Island with most of the towns in the Milan quadrangle, and the latter continues southward to Monmouth. The wagon-roads, which are mostly dirt, follow land-survey lines and, except in the more hilly areas and over the swampy flood plains, there are few places in the quadrangles more than half a mile distant from a public road.

DESCRIPTIVE GEOLOGY

STRATIGRAPHY

GENERAL CHARACTER OF THE ROCKS

The rocks that are exposed at the surface or have been explored in deep drillings in the Milan and Edgington quadrangles include formations ranging in age from the Cambrian to Recent time. The Cambrian, Ordovician, and Silurian strata are known in this area only from deep well explorations made for artesian water in the north part of the Milan quadrangle, where they have been penetrated to a maximum depth of 2,368 feet The Devonian, Carboniferous, and Pleistocene rocks are known both from natural outcrops and from deep borings. A generalized columnar section of all the formations known in the quadrangles is shown in figure 15.

DATA ON ROCKS NOT EXPOSED IN THE QUADRANGLES

Information regarding the rocks older than the Devonian in the Milan and Edgington quadrangles has been obtained chiefly from eight deep well borings, a summary of the records of which is given below. As these records have been previously published[1], some of the details of the logs are here omitted.

[1]Udden, J. A., Deep well borings in Illinois: Ill. State Geol. Survey Bull. 24, 1914.

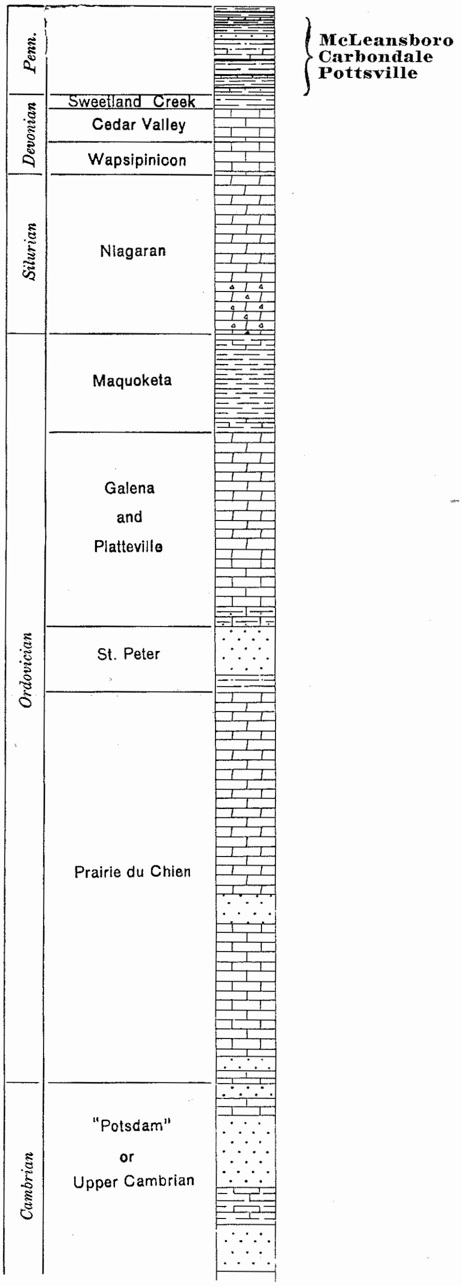

FIG. 15.—Generalized columnar section of the rocks exposed, and explored by deep borings in the Milan and Edgington quadrangles. (Scale, 1 inch=400 feet.)

RECORDS OF DEEP WELLS

The succession of strata penetrated in the well put down by the Modern Woodmen in Rock Island is as follows. The altitude of the curb is about 565 feet above mean sea level.

Log of the Modern Woodmen's well near Seventeenth Street and Third Avenue in Rock Island

Description of strata	Thickness Feet	Total depth Feet
Devonian and Silurian systems, undifferentiated—		
Limestone, samples not studied	160	160
Silurian system—		
Niagaran limestone—		
Dolomite, yellowish at the top, white in middle and lower parts, cherty near the base; molds of crinoid stems near the middle	300	460
Ordovician system—		
Maquoketa shale —		
Shale, fossiliferous in upper half, containing layers of dolomite at different levels, the lower 40 feet bituminous	170	630
Galena dolomite—		
Dolomite, coarse texture in some parts, with some chert	250	880
Platteville limestone—		
Limestone, non-magnesian, gray	85	965
Shale, green, and some sand	35	1000
St. Peter sandstone—		
Sand, quartz, in white, rounded grains	115 ?	1115 ?
Shale, green	8	1123

The deepest drilling made in the quadrangles was the well put down by the Tri-City Railway Company, in Prospect Park, in Moline. The record below 1,161 feet was furnished by J. G. Huntoon. The elevation of the top of the well is 611 feet above the sea.

Log of the Tri-City Railway Company's well in Prospect Park, Moline, near the center of the east line of sec. 8, T. 17 N., R. 1 W.

Description of strata	Thickness Feet	Total depth Feet
Quaternary and Pennsylvanian, undifferentiated—		
Boulder clay above, and shale and sandstone of Pennsylvanian age below	71	71
Devonian system—		
Middle Devonian series—		
Wapsipinicon and Cedar Valley limestones—		
Limestone, mostly compact, gray, or white, nonmagnesian	59	130
Silurian system—		
Niagaran series—		
Dolomite, straw-colored to grayish-white, and white, in places porous, and containing pockets of clay and some chert in the lower part	356	486

Log of the Tri-City Railway Company's well in Prospect Park, Moline, near the center of the east line of sec. 8, T. 17 N., R. 1 W.—Concluded

	Thickness Feet	Depth Feet
Ordovician system—		
Cincinnatian series		
Maquoketa shale		
Shale, gray and dark gray, containing fragments of brachiopods above, and bituminous material in the lower part	235	721
Mohawkian series—		
Platteville and Galena limestones—		
Dolomite, gray and yellowish-gray, with some chert in lower part	200	921
Limestone, yellowish-gray and bluish-gray, fissile, with a little chert	130	1051
Clay, greenish-gray, with rounded grains of sand	40	1091
St. Peter sandstone—		
Sandstone, in clean rounded quartz grains	40	1131
Clay or shale, greenish-gray, pyritiferous	30	1161
Canadian series—		
Prairie du Chien limestone—		
Limestone (Shakopee)	419	1580
Sandstone, hard and soft (New Richmond)	60	1640
Limestone, hard and soft	265	1915
Limestone and shale	10	1925
Sandstone, hard and soft	30	1955
Limestone	25	1980
Cambrian system—		
"Potsdam" series—		
Sandstone	110	2090
Shale, sandy	60	2150
Limestone and shale, with salt water	50	2200
Shale, sandy	65	2265
Sandstone	103	2368

A driller's record of the strata penetrated in the deep well in the town of Milan is given below. The elevation of the curb above sea level is 566 feet.

Log of the Milan city well, located on the south bank of Rock River

Description of strata	Thickness Feet	Total depth Feet
Quaternary system—		
Pleistocene and Recent series—		
Alluvium	7	7
Devonian system—		
Middle Devonian—		
Wapsipinicon and Cedar Valley limestones—		
Limestone, white (estimated)	58	65
Silurian system—		
Niagaran series—		
Limestone, white	325	390

Log of the Milan city well, located on the South bank of Rock River—Concluded.

	Thickness *Feet*	Depth *Feet*
Ordovician system—		
Cincinnatian series—		
Maquoketa shale—		
Shale, gray	160	550
Shale, with streaks of limestone	55	605
Mohawkian series—		
Galena limestone—		
Limestone, brown	95	700
Limestone, white	140	840
Platteville limestone—		
Limestone, brownish	90	930
Shale	30	960
St. Peter sandstone—		
Sand, quartz, in rounded grains	90	1050
Limestone, sandy, or calcareous sandstone	10	1060
Sand and limestone, with some shale	35	1095
Sandstone, hard and sharp	20	1115
Marl, red	10	1125
Canadian series—		
Prairie du Chien limestone—		
Limestone, white (Shakopee dolomite)	32	1157

A log of the Mitchell and Lynde well in Rock Island, was furnished by J. H. Southwell as follows. The elevation of the curb was 558 feet above sea level.

Log of the Mitchell and Lynde well, located between East and West Seventeenth Streets, north of Second Avenue, in Rock Island

Description of strata	Thickness *Feet*	Total depth *Feet*
Devonian system—		
Limestone	60	60
Silurian system—		
Limestone (Niagaran)	276	336
Ordovician system—		
Shale (Maquoketa)	180 ?	516
Limestone (Galena)	353 ?	869
Limestone (Platteville)	90	959
Sandstone (St. Peter)	186	1145
Limestone (Prairie du Chien)	811	1956
Cambrian system—		
Sandstone, compact	30	1986
Limestone	35	2021
Sandstone	130	2151
Limestone, shaly	75	2226
Sandstone	97	2323

There is given below a record of the strata penetrated in a well drilled by the Rock Island Brewing Company in Rock Island. The elevation of the curb is 654 feet above sea level.

Log of the Rock Island Brewing Company's well, on Elm Street, near Ninth Avenue, in Rock Island

Description of strata	Thickness *Feet*	Total depth *Feet*
Quaternary and Pennsylvanian systems—		
Undifferentiated	100	100
Devonian system—		
Middle Devonian series—		
Wapsipinicon and Cedar Valley limestones—		
Limestone, gray, with some shale in the lower 20 feet	50	150
Silurian system—		
Niagaran series		
Dolomite, yellowish-brown, with cavities filled with sandy shale	375	525
Ordovician system—		
Cincinnatian series—		
Maquoketa shale—		
Shale, bluish gray	205	730
Mohawkian series—		
Galena and Platteville limestones—		
Limestone	330	1060
Shale, blue	25	1085
St. Peter sandstone—		
Sandstone, with some shale below	204	1289
Canadian series—		
Prairie du Chien limestone—		
Limestone, with some caving shale and rotten limestone (Shakopee dolomite)	315	1604
Cambrian system—		
"Potsdam" series—		
Not described	346	1950
Sandstone of various colors	207	2157

THE GENERALIZED SECTION

From a study of the well records above described, supplemented by data from some other wells in this vicinity, the general character and thickness of the underlying rocks penetrated in deep drillings, but nowhere exposed in the quadrangles, are known with a fair degree of accuracy.

CAMBRIAN SYSTEM

"POTSDAM" SERIES

In the Mitchell and Lynde well a change from dolomite to compact sandstone was reported at a depth of 1,956 feet. A similar change at the base of this dolomite was noted in the well at the Glucose Factory in Davenport, a short distance north of the Milan quadrangle. The 347 feet of rock penetrated below the depth of 1,956 feet in the Mitchell and Lynde boring consisted of compact sandstone, 30 feet; limestone, 35 feet; sandstone, 130 feet; shaly limestone and shale, 75 feet; sandstone, 97 feet. In the well at the Glucose Factory in Davenport, the corresponding strata as far as explored were reported as follows: shale, 40 feet; sandy limestone, 20 feet; sandy rock, 160 feet; shale, 50 feet. Some of the sand in this part of the boring is said to be red. In the record of the Rock Island Brewing Company's well, on Elm Street, the strata penetrated below 1,950 feet were said to consist of "sand rock of various colors." In the log of the Tri-City Railway well in Prospect Park, in Moline, the strata beneath the Ordovician dolomites are described as follows: sand rock, 110 feet; sandy shale, 60 feet; limestone and shale with salt water, 50 feet; sandy shale, 65 feet; sand rock, 3 feet.

Ordovician System

PRAIRIE DU CHIEN LIMESTONE

The reported thickness of the Prairie du Chien limestone in the Mitchell and Lynde well is 811 feet. In the Paper Mill well in Moline 487 feet of this formation was penetrated, and 122 feet of sandstone is reported as occurring between 315 to 437 feet below the St. Peter sandstone. From samples of rock drillings from the City Park well in Davenport, which explored the upper 600 feet of this formation, some of the rock is known to consist of dolomite with more or less sand, and it also contains some green shale and some glauconite. The sandstone reported in the record of the Paper Mill well, between the depths 1,456 and 1,587 feet, is probably equivalent to the New Richmond sandstone member of the Prairie du Chien limestone.

ST. PETER SANDSTONE

The St. Peter sandstone is an important source of artesian water in northern Illinois and eastern Iowa, and it has been penetrated by almost all of the deep water wells in this region. In the most of the records of deep wells in the quadrangles a bed of shale is reported immediately above and another below the main bed of St. Peter sandstone. The normal sandstone is composed of well-rounded grains of clear quartz, remarkably free from impurities of any kind. The thickness of this formation recorded in the various logs of deep wells in the quadrangles ranges from 50 to 186 feet, the average being nearly 100 feet. The shaly material in the basal part of the formation is quite variable. In the Prospect Park well it is a green shale; in the Paper Mill well it is reported as a red marl; and in the log of the Milan city well it was described as "sand and limestone with shale and crevices," and some hard sharp sandstone resting on ten feet of red marl. The average thickness of these variable, basal, beds of the St. Peter formation, as given in the various records, is 37 feet.

The shale reported immediately above the St. Peter sandstone is greenish and probably belongs to the basal Platteville. In the Paper Mill well from which the greatest thickness of this part of the section was reported, it was said to be sandy, and contained streaks of sandstone. Elsewhere it has been found to contain rounded grains of sand and some white chert with a peculiar reticulated structure. It usually contains marcasite, and some dark and more indurated shale. In six borings in or near the quadrangles the average thickness of this shale horizon was about 40 feet.

PLATTEVILLE LIMESTONE

The rock overlying the shale above the St. Peter sandstone is a gray, non-magnesian limestone, highly fissile in the direction of its bedding planes. Some of the layers contain chert, and imbedded quartz sand grains of variable color. Fragments of bryozoa and other fossils have been noted in some of the drillings of the Platteville. Drillers usually have not reported this formation separately from the overlying Galena, but its measured thickness in four wells averaged nearly 100 feet, and ranged from 85 to 130 feet.

GALENA DOLOMITE

The Galena formation is usually a dolomite, the upper 50 feet of which is compact and light gray, below which the color changes to yellowish gray and the texture becomes more porous. The lower, yellowish rock in places contains some chert and quartz sand grains of various colors. At a level about 100 feet below the top of the formation, structures resembling spherules of oolite have been distinguished in some of the drillings. The porous portion of the Galena dolomite usually furnishes an abundant supply of water, but it is nearly always more highly charged with hydrogen sulphide gas than the water from any other deep water-bearing horizon in this region. In four wells where it has been separately measured, the thickness of the Galena ranged from 200 to 353 feet, with an average of 260 feet. In two wells where the Galena and the Platteville have not been separately measured, the average combined thickness was 395 feet. The average thickness of the Galena dolomite reported in all of the deep wells in and near the cities of Rock Island, Moline, and Davenport is about 262 feet.

MAQUOKETA SHALE

The lithologic characters of the Maquoketa shale are quite constant in the different wells in this immediate region, and certain features of lithology and texture are characteristic of certain horizons within the formation. The uppermost 120 to 150 feet of the formation consists of light greenish-gray shale, with little calcareous material, except in places near the top where fragments of calcareous shells are common, and sand is also present. A short distance below the middle of the formation the shale becomes gray and more calcareous. At this horizon crinoid segments, bryozoa, and other fossils are usually present in greater or less numbers. Marcasite is most abundant in a zone extending from the base of this fossiliferous horizon down to within 20 feet of the base of the formation. The lower 20 to 50 feet of the Maquoketa consists of dark, in places almost black, bituminous shale, which contains a considerable amount of combustible matter. It also contains some peculiar microscopic, brownish-yellow flakes which have an irregular outline and uneven surface, and some minute irregular agglomerations of extremely small particles suggestive of flocculation in the formation of these sediments. These agglomerations occur sparingly throughout the thickness of the Maquoketa, but are most abundant in the dark shale near the base where they appear to be composed of a greater number of particles than in the gray and green shale at higher levels. Layers of dark and gray dolomite in places occur at various levels in the formation. The measured thickness of the Maquoketa in seven wells in the quadrangles ranges from 170 to 235 feet, the average being 204 feet.

Silurian System

NIAGARAN LIMESTONE

The Silurian strata in this region are dolomitic, and are of Niagaran age. The upper third of the formation is a porous, and mostly coarsely crystalline dolomite which corresponds to the phase to which the name Leclaire limestone has been applied by the Iowa geologists.[1] This phase of the Niagaran dolomite outcrops on both sides of Mississippi River a short distance above the town of Hampton, about 12 miles northeast of the Milan quadrangle. The rock contains molds of brachiopods and crinoid stems, and is yellow where exposed, although the cuttings obtained from wells are more often white and granular. The lower half of the Niagaran limestone is of finer texture, somewhat softer, and less porous than the upper part, and shows dark streaks and blotches due to oxide of manganese. In some wells very hard dolomite has been penetrated near the middle part of the Niagaran. A thickness of forty feet or less in the basal part of the Silurian limestone contains several layers of chert or flint.

The upper half of the formation is water-bearing and is the source from which many deep farm wells in the surrounding country obtain their supply of water. The Niagaran limestone has many solution caverns, most of which are filled with sand and green clay. Seven measurements of the thickness of the Niagaran limestone in the well records of these quadrangles range from 276 to 375 feet, the average being 330 feet. This variation in thickness is thought to be mostly due to an erosional unconformity between the Niagaran and the overlying Devonian limestone.

[1]Norton, W. H., Geology of Scott County, Ann. Rept. Iowa Geol. Survey, vol. IX, p. 423, 1898.

ROCKS EXPOSED IN OR NEAR THE EDGINGTON AND MILAN QUADRANGLES

Devonian System

WAPSIPINICON AND CEDAR VALLEY LIMESTONES

The Devonian rocks in the Milan and Edgington quadrangles are about 140 feet thick, and consist mostly of limestone, with some shale and some dolomite. These should all be regarded as of upper Devonian age, and represent the Wapsipinicon and Cedar Valley stages. They outcrop only

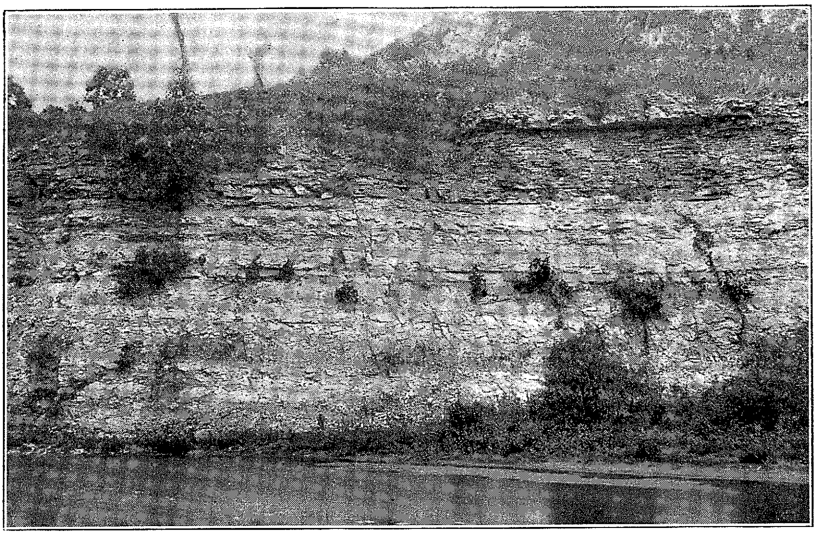

Fig. 16.—Thin-bedded limestone just below the horizon of the *Acervularia davidsoni* coral-reef horizon. The slightly overhanging layer in the upper right-hand side of the ledge is the coral reef rock. Exposure on Mill Creek near Milan.

in and near the valleys of Mississippi and Rock rivers in this region, but probably underlie the entire extent of the quadrangles. The general section of Devonian strata exposed near and within the limits of the quadrangles is given below:

Generalized section of the Devonian limestone in and near the Milan and Edgington quadrangles

	Thickness *Feet*
10. Dolomite, yellowish-gray to brown, compact, in layers ½ to 2 feet thick, alternating with thinner layers of clayey shale, containing many *Stromatoporoids, Zaphrentis sp., Stropheodonta* cf. *concava, Spirifer iowensis, S. subvaricosa, and Atrypa reticularis;* exposed along several of the creeks within a few miles both east and west of Andalusia.............	20

Generalized section of the Devonian limestone in and near the Milan and Edgington quadrangles—Continued.

	Thickness *Feet*
9. Limestone, thin bedded, gray, with partings of shale; containing *Stromatoporoids, Stropheodonta demissa, Schizophoria iowensis, Athyris fultonensis, Atrypa reticularis* (large shells), *Gomphoceras* cf. *ajax,* and other fossils; exposed near the mouths of a few of the streams within 1½ miles east and west of Andalusia, and in the vicinity of Buffalo, on the north side of the river..	4
8. Dolomite, yellowish-gray, in layers 12 inches or less thick; containing *Cystodictya hamiltonensis, Stropheodonta demissa, Athyris fultonensis, Spirifer asper, Spirifer euryteines, Spirifer subvaricosus, Cyrtina hamiltonensis, Atrypa reticularis* (small shells), and other fossils..........	6
7. Limestone; the upper 1½ feet is a coral reef (fig. 16), containing a profusion of corals, and other fossils, of which *Acervularia davidsoni, A. profunda, Cystiphyllum* cf. *americanum, Favosites placenta, Alveolites goldfussi, Cladopora sp.,* and *Atrypa reticularis* are common. At the base is an organic sand or breccia which in places projects by intersecting vertical plates into the underlying layer. This bed is exposed in the bank of the river below Andalusia. On account of its resistance to weathering it forms small rapids in a number of the small creeks on the north side of the river below Linwood, and forms the capping of the Devonian outcrops above Buffalo, and in the right bank of Mill Creek near the center of sec. 25, T. 17 N., R. 2 W., where it is the highest layer of Devonian limestone exposed........................	8
6. Limestone, impure, bluish-gray, crinoidal, thin-bedded, weathering yellow; containing the fossils *Cladopora iowensis, Striatopora rugosa, Megistocrinus latus, Stropheodonta demissa, Leptostrophia perplana, Chonetes scitulus, Spirifer asper, Spirifer euryteines, Spirifer iowensis, Spirifer subvaricosus, Cyrtina umbonata,* and *Dinichthys pustulosus;* exposed at most of the localities where the overlying coral reef outcrops	5
5. Limestone, blue, argillaceous, fine grained, with oblique fracture, weathering more rapidly than the overlying or underlying strata; containing *Spirophyton* sp., *Streptelasma rectum, Stropheodonta demissa, Leptostrophia perplana, Chonetes scitulus, Spirifer iowensis, Spirifer subvaricosus, Cyrtina umbonata, Atrypa reticularis, Atrypa aspera* var. *hystrix,* and other fossils. This limestone is exposed in the abandoned quarry near the corner of Fifth Avenue and Thirty-fifth Street in Rock Island; it forms the beach of the river front in Buffalo, and outcrops in the quarries near Linwood and Buffalo, and in the banks of nearly all of the creeks north of Mississippi River, and it is the most conspicuous part of the Devonian section along Mill Creek, in sec. 25, T. 17 N., R. 2 W.	20
4. Limestone, fine grained, rather thin bedded, the layers separated by partings of greenish shale; containing the fossils *Acervularia davidsoni, Heliophyllum halli, Cystiphyllum americanum, C. sulcatum, Favosites alpenensis, Schizophoria iowensis, Pentamerella dubia, Productella sub-*	

Generalized section of the Devonian limestone in and near the Milan and Edgington quadrangles—Continued.

	Thickness *Feet*
alata, Spirifer asper, S. bimesialis, Cyrtina umbonata, and many other fossils. This is the upper rock formerly quarried in Rock Island, Sears, and on Mill Creek	5
3. Limestone, hard, gray, in indistinct layers ½ to 2 feet thick; containing *Astreospongia hamiltonensis, Stromatoporoids, Heliophyllum halli, Chonophyllum magnificum, Diplophyllum* cf. *archiaci, Phillipsastrea billingsi, Cystiphyllum sulcatum, Favosites alpenensis, Spirifer subundiferus, Phacops rana,* and *Dinichthys pustulosus.* This limestone outcrops near the railroad bridge across Mill Creek, and near the wagon bridges across Rock River; it is the main horizon formerly worked in the old quarries in Rock Island, and near Milan, and in the west part of Davenport, and it is exposed in several places in the north bank of the Mississippi as far west as Linwood	7

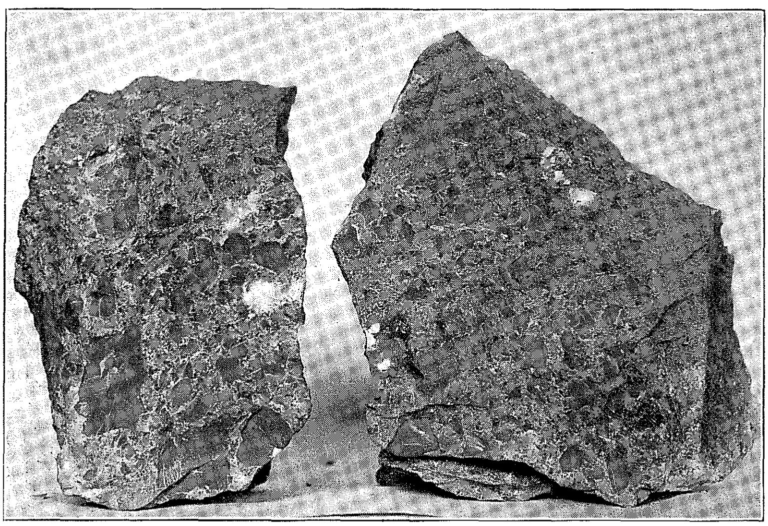

FIG. 17.—Photograph showing the character of the brecciated limestone in the basal part of the Devonian, near Rock Island, Illinois. (No. 2 of the generalized section of the Devonian limestone.)

2. Limestone, white to dark gray, fine grained, with few fossils; in layers ½ to 3½ feet thick, in places finely laminated, and showing dome-like convexities from ½ to 1 foot in diameter; usually much fractured and brecciated into fragments from 1 inch to 2 feet in diameter; worked in the Cady quarry in East Moline, and exposed in the south bank of the Mississippi in the city of Rock Island, and in the quarries around Oakdale on the north side of the river, and on Horse, Suburban, Sylvan, and Rock (Government) islands. It forms the main bed rock in the Rock River valley between Milan and Sears, and is exposed in the bed of Mill Creek near the Railroad Bridge in sec. 25, T. 17 N., R. 2 W.	50

Generalized section of the Devonian limestone in and near the Milan and Edgington quadrangles—Concluded.

	Thickness *Feet*
1. Limestone, white to yellowish gray, fine grained, not brecciated, in irregular layers some of which are porous and more or less bituminous; containing spherical concretions of chalcedonic quartz and numerous shells of *Spirifer subumbonus*. One of the layers, 1 to 2 feet thick, is crowded with shells of *Spirifer subumbonus*. This basal Devonian limestone is exposed on the east side of Campbells Island, about 4 miles northeast of the Milan quadrangle, and on the Illinois side of the river opposite this locality, and was partly explored in deepening the Sylvan channel above the Moline bridge near the east end of Rock Island (Government Island). Exposed 9 feet, estimated thickness............	20

In the south part of the Milan and in the Edgington quadrangles, several borings have pased through the Pennsylvanian rocks, and entered the Devonian limestone at depths varying usually from 150 to 250 feet; but in a few of the wells in the south part of the Milan quadrangle the depth to the top of the Devonian exceeds 300 feet. The greater depth to the limestone in this part of the area suggests that it may here be overlain by a remnant of the Sweetland Creek (Upper Devonian) shale, as it is in places in the north part of the Edgington quadrangle in Muscatine County, Iowa, and in Schuyler County and elsewhere in Illinois; but this shale is not exposed in the Illinois portion of the quadrangles.

The Devonian limestone above described falls readily into three easily distinguishable horizons, as follows:

Upper horizon:
 Dolomites and limestones, in places shaly, including numbers 8, 9, and 10 of the preceding general section.

Middle horizon:
 Limestones, mostly shaly, including numbers 3, 4, 5, 6, and 7 of the preceding general section.

Lower horizon:
 Limestone, mostly brecciated except in basal part, with few fossils, including numbers 1 and 2 of the preceding general section.

During the time of deposition of these limestones there seem to have occurred several changes in the sedimentary process. The lower group of limestones is mainly composed of a calcareous slime which may have accumulated rather rapidly. The middle group of shaly limestones (fig. 18) contains fossils which in places in the lower half are worn and more or less etched, and may represent levels of corrasion by submarine currents. The upper part of this group consists of crinoidal limestone deposited in quiet waters where even the delicate arms and calyx portions of large crinoids could be occasionally imbedded, and thus become preserved. These quiet conditions of crinoid growth were followed rather abruptly by widespread coral growth in such numbers that the accumulation of their hard parts formed a coral reef (fig. 16) over all of this region, constituting the basal member of the upper group. The thickness of the Devonian is different in different parts of the quadrangles, partly on account of the erosional uncomformity both above and below it, and partly as a result of the general dip toward the southwest of about 6 feet to the mile. West of Oakdale the southwestward dip is more than 12 feet per mile. The average slope of the upper surface of the Devonian is about 9 feet to the mile in a nearly southward direction. This difference in the direction of slope of the old erosion plane, and of the dip, indicates that the limestone is thickest in the southwest part of the area, and thins toward the northeast.

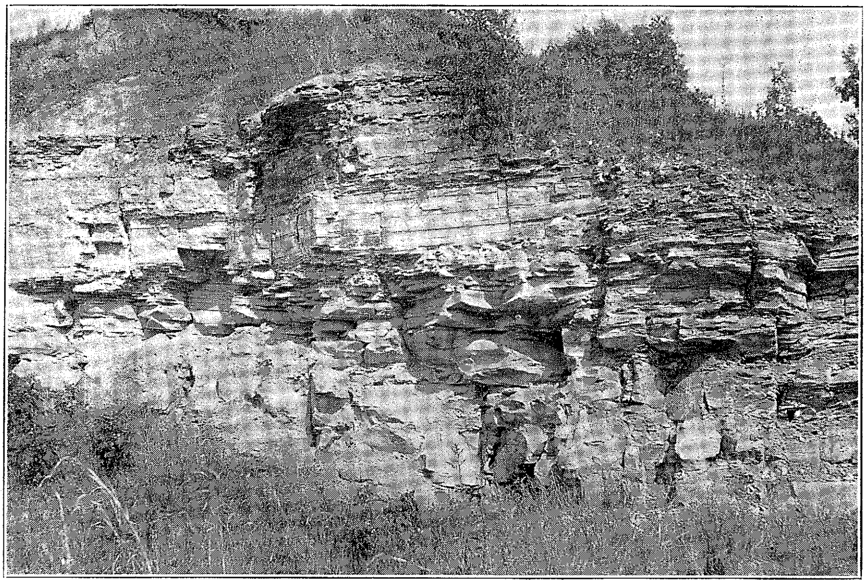

FIG. 18.—Shaly limestone in the middle part of the Devonian section, along Mill Creek, near Milan, Illinois.
(No. 5 of the generalized section of the Devonian limestone.)

In the country east of the junction of the Mississippi and Rock rivers, the pre-Pennsylvanian erosion of the Devonian removed all of the upper group and most of the middle one, while west of this junction probably all of the middle group, and nearly all of the upper one is usually present.

SWEETLAND CREEK SHALE

The Sweetland Creek shale (fig. 19) is brown to black in color, and contains numerous spores of a fern-like plant called *Sporangites huronense.* This shale is well exposed in the bed and banks of Sweetland Creek, in secs. 22 and 27, T. 77 N., R. 1 W., and in a few other places north of Mississippi River in the Edgington quadrangle. A brown shale ranging from a few feet to thirty feet thick was reported immediately above the Devonian limestone in the driller's logs of a number of coal-test borings in Buffalo Prairie Township. This shale is thought to represent the Upper

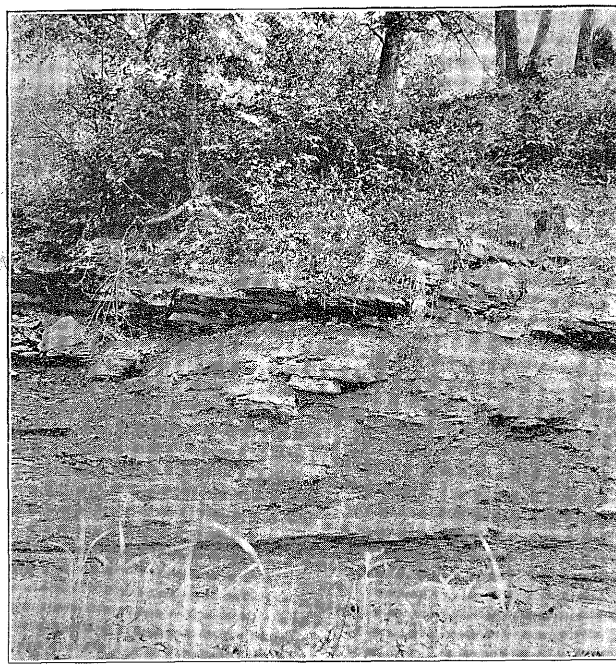

FIG. 19.—Sweetland Creek shale, along Sweetland Creek in the northwest quarter of the Edgington quadrangle.

Devonian (Sweetland Creek) shale which is known to be present at this horizon in many places farther east and south in Illinois.

Mississippian System

Strata of Mississippian age appear to be entirely absent from this immediate region, although chert masses are in places found in the basal conglomerate of the Pottsville that contain casts of Mississippian fossils which indicate that the lower Mississippian strata had originally been deposited over the entire quadrangles and possibly much farther north, but they were removed by erosion prior to the deposition of the Pottsville sediments.

Pennsylvanian System

The Pennsylvanian system is represented in the Edgington and Milan quadrangles by rocks of Pottsville and McLeansboro age and some Carbondale strata are also thought to be present.

The strata of Pennsylvanian age in the Milan and Edgington quadrangles are known from numerous outcrops, and also by means of test borings. Their character is shown in the generalized columnar section in figure 15, and on the following pages by means of sections and descriptions of outcrops.

The greatest known thickness of the Pennsylvanian rocks in the Milan and Edgington quadrangles is in the SW. cor. SW. ¼ SE. ¼ sec. 27, Buf-

FIG. 29.—Contact of the Devonian limestone and the basal Pottsville conglomerate, near Andalusia, Illinois.

falo Prairie Township, where a depth of 231 feet of these rocks was reported in a test boring. In the south part of the Milan quadrangle, where the greatest thickness might be expected on account of the southeastward dip of the Pennsylvanian rocks and the southward inclination of the upper surface of the Devonian, the thickness of the Pennsylvanian rocks is not known to exceed 150 feet.

In the north third of the Milan quadrangle the thickness of the Pennsylvanian rocks ranges from a few feet, where present at all, to about 100 feet, probably averaging about 50 feet. In the middle third of this quadrangle the average thickness is probably near 100 feet, and in the south third, the average thickness is perhaps 150 feet. In the west half of the Milan quadrangle the average thickness of the Pennsylvanian rocks is prob-

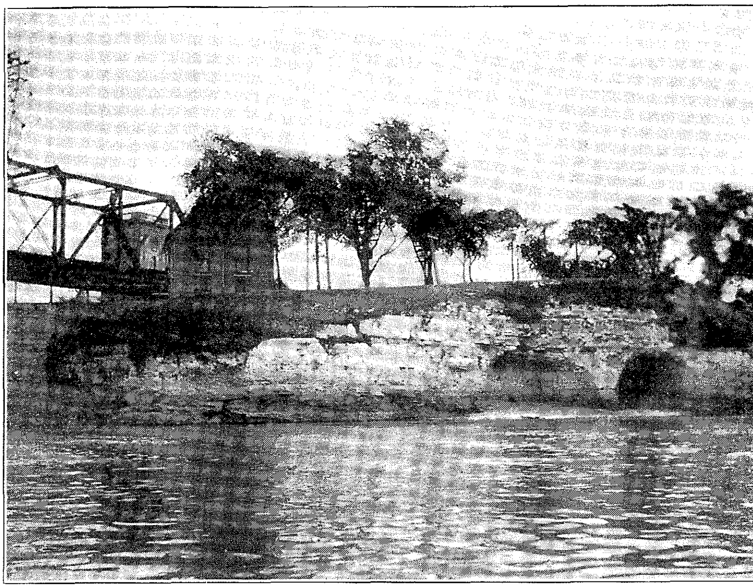

FIG. 21 —Old caverns in the Devonian limestone, the Pottsville filling of which has been removed by the river.

ably 50 feet greater than in the east half. In the Edgington quadrangle the average thickness of these strata in twenty-one measured records is 170½ feet.

DESCRIPTION OF OUTCROPS

POTTSVILLE FORMATION

The Pottsville formation includes all of the rocks from the base of the Pennsylvanian system up to the base of the Murphysboro or No. 2 coal bed, and is thought to about correspond in age to the Pottsville (lowest Pennsylvanian) formation of the Appalachian region. Stratigraphically it is the lowest Pennsylvanian formation in the quadrangles, over the whole of which it probably underlies the surficial deposits except in limited areas near the larger streams in the north and east parts where in places it has been removed by erosion, leaving the Devonian limestone immediately beneath the Pleistocene materials.

In the Milan and Edgington quadrangles the Pottsville formation consists of variable and mostly discontinuous beds of sandstone, shale, conglomerate, coal, and thin limestone which were deposited on the shoreward part of an advancing sea, producing an overlapping succession of more or less lenticular strata. The advance of this sea was probably interrupted at different times so that minor unconformities which are difficult to distinguish in this region probably occur at different levels. On account of this variable and lenticular character of the strata it has not been possible to identify any easily recognized stratigraphic units in the Pottsville which persist over all of the quadrangles.

The basal layers of the Pottsville formation in some places consist of conglomerate (fig. 20), in others of shale (fig. 22), and in still others of

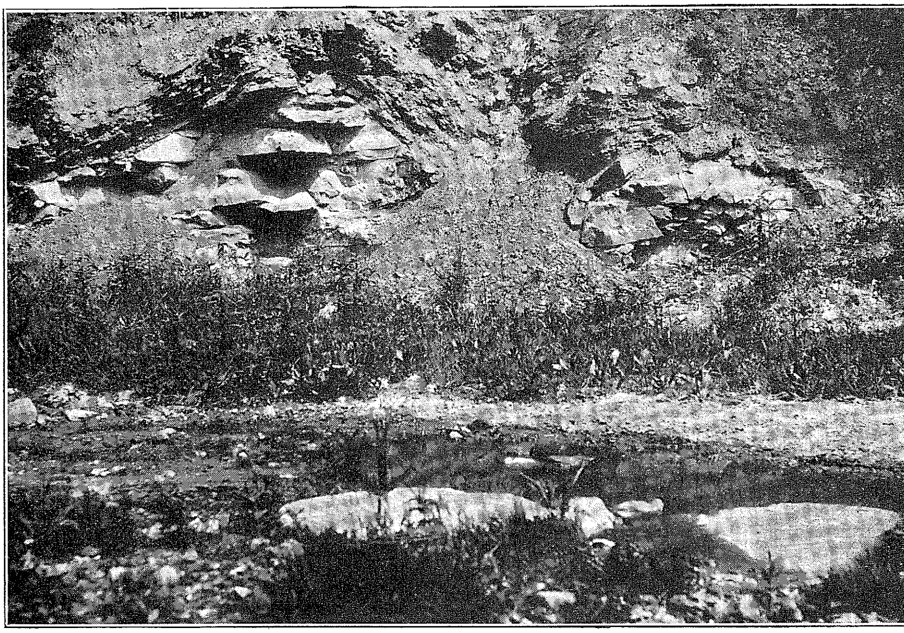

FIG. 22.—Unconformable contact of the Devonian limestone and Pottsville shale, near the south line of the NW. ¼ sec. 13, T. 17 N., R. 2 W. A 4-inch layer of limonite follows the upper eroded surface of the Devonian. The two light hummocks are elevations of the Devonian, covered by the limonite layer. Photograph by David White.

sandstone (fig. 23). The contact of the Devonian and Pottsville sediments is well exposed near the top of the face of an abandoned stone quarry in the city of Rock Island, about 200 feet south of Fifth Avenue, west of Thirty-fifth Street. The upper part of the Devonian at this place consists of yellowish-brown, rather thin-bedded limestone, having the upper surface strongly iron-stained. This limestone is overlain by a thickness of a few feet of brown or red, sandy conglomerate composed of coarse sand, and pebbles mostly 1 to 2 inches in diameter, with a few boulders ranging up to 12 inches. All of the pebbles and boulders are of flint or chert. At this place the conglomerate extends down into, and fills, a small cavern in the underlying Devonian limestone. Some of the chert boulders in the conglomerate contain imperfect casts of fossils among which the following have been identified by Ulrich:

Fossils from chert boulders in the basal Pottsville conglomerate.[1]

Orthothetes, near an unnamed Waverly and Keokuk species.
Spirifer keokuk or *S. leidyi;* cast of pedicle valve.
Productus sp., may be either *P. levicostatus* White from the Burlington limestone, or *P. tenuicostatus* Hall, from the St. Louis limestone.
Bellerophon-like shell, undeterminate cast.
Rhombopora sp., resembling *R. dichotoma* Ulrich.

The fossils listed above indicate that the cherts from which they came are of Mississippian age. Some Niagaran cherts are also present in this conglomerate.

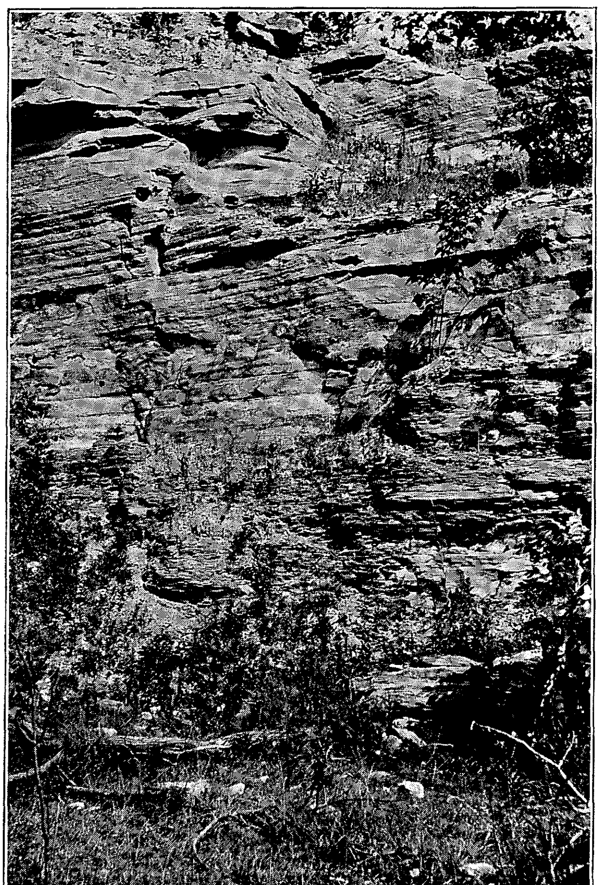

FIG. 23.—Thin-bedded sandstone in the lower part of the Pottsville, formerly quarried in sec. 7, Drury Township.

The greatest development of conglomerate noted in the basal part of the Pottsville was in the west bank of Mill Creek, about one-fourth mile

[1]An additional list of fossils from this conglomerate, determined by Ulrich: *Fenestella binodata* Condra. *Fenestella gracilis* Condra. *Fistulipora carbonaria* Ulrich, *Polypora bassleri* Condra. *Meekopora prosseri* Ulrich, *Stenopora heteropora* Condra.

southwest of the center of sec. 31, T. 17 N., R. 1 W. It is here 12 feet thick, and consists of layers of conglomerate, 1 to 1½ feet thick, interbedded with layers of sandstone. The pebbles range in size up to 4 inches in diameter and are all siliceous, ninety-eight per cent of them being chert and the remainder white quartz. Casts of a few brachiopod shells, indicating Mississippian age, were also noted in these pebbles. A similar conglomerate outcrops in a ravine a short distance northeast of Doxie School, in sec. 30, T. 17 N., R. 1 W. Another exposure of conglomerate occurs in the south bank of a creek, about 200 yards west of the center of sec. 13, T. 17 N., R. 2 W., where the deposit consists mostly of pebbles 2 to 3 inches in diameter, with some larger boulders up to 8 inches, cemented together with yellow calcite.

In some places the Devonian limestone is immediately overlain by Pottsville sandstone, with no intervening conglomerate. Such an outcrop occurs near the mouth of Coal Creek, in the SE. ¼ sec. 29, T. 17 N., R. 3 W., which furnished the following section.

Section of strata exposed along Coal Creek in sec. 29, T. 17 N., R. 3 W.

	Thickness *Feet*
Pennsylvanian (Pottsville) sandstone:	
Sandstone, yellowish gray, micaceous, thin bedded	9
Sandstone, in irregular layers, somewhat shaly in lower part	4
Shale, gray and brown, sandy, in discontinuous layers of variable thickness	½–2
Devonian limestone:	
Dolomite, yellowish brown, in layers ½ to 1 foot thick, containing the fossils *Stropheodonta demissa, Spirifer iowensis, S. subvaricosa,* and *Atrypa reticularis*	3+

The altitude of the top of the Devonian limestone at this place is about 563 feet. This is 7 feet lower than the top of the Devonian at the west end of the wagon bridge, 16 rods farther down this creek, and 9 feet lower than the top of the Devonian limestone in the east bank of the creek opposite the exposure at the bridge. About 20 rods up the creek from the place where the above section was made, a thickness of 8½ feet of somewhat cherty Devonian limestone outcrops to an altitude of about 566 feet above sea level. Farther west an outcrop of Devonian limestone in the Edgington quadrangle occurs in the SE. ¼ sec. 17, Montpelier Township, on the Iowa side of the river, where the elevation of its surface reaches 588 feet, and again in the SW. ¼ sec. 27, T. 17 N., R. 3 W., where the altitude is about 580 feet. In the town of Cable, in the southeast part of the Milan quadrangle, the elevation of the top of the Devonian is 549 feet.

The basal Pottsville sandstone and shale in many places fill cavernous depressions and passages that extend for a considerable distance into the Devonian limestone (see fig. 21). The sandstone is mostly white, soft, and moderately coarse grained; the grains are usually angular as a result of secondary crystalline enlargement. In some places the sand contains carbonaceous material in the form of wood fragments. The sand is in some localities interlaminated with shale which may be green and unctuous, or black from carbonaceous material. Pottsville deposits occurring in a cavern in the Devonian limestone in an old quarry north of Fifth Avenue, near Twenty-eighth Street, in Rock Island, showed rill marks of the kind once described as fossil fern leaves, and called *Dendrophycus*. In the south bank of Mississippi River between Forty-second and Forty-fourth streets in Rock Island, the Pottsville sandstone is exposed in contact with the Devonian limestone, and at one place its lowermost layer contains brachiopods that had weathered out of the Devonian limestone, and later become imbedded in the basal layer of the overlying Pottsville formation. In the old quarry near Thirty-fifth Street and Fifth Avenue, in Rock Island, a cavern in the Devonian more than 20 feet deep, and equally wide, is filled with Pottsville shale that contains impressions of *Calamites*, and leaves of ferns. The wall of the cavern is lined with a layer of impure limonite, from one inch to several inches thick, in the form of gossan. Such a limonite deposit is common at the contact of the Devonian-Pennsylvanian unconformity in all of this region. On Mill Creek in sec. 31, T. 17 N., R. 1 W., it is almost everywhere present at this contact, its thickness varying from 6 inches to 2 feet. It is also exposed in the bottom of a creek near the south line of the NW. ¼ sec. 13, T. 17 N., R. 2 W., where it covers small, dome-like elevations of the Devonian rock surface (fig. 22).

In one place in a mine in the northeast corner of sec. 20, T. 77 N., R. 2 E., coal rests directly on the Devonian limestone, and in other parts of the same mine a thin underclay separated the coal and limestone. Similar conditions are known in a coal mine near the center of sec. 16, of the same township, as shown in the following section:

Section of shaft of coal mine near the center of sec. 16, T. 77 N., R. 2 E.

	Thickness	
	Ft.	*In.*
Clay, yellow	5	..
Shale, soft, light gray	5	..
Sandstone	14	..
Shale ("miner's slate"), with septaria	1	..
Coal	2	8
Underclay	12	..
Shale, light gray, and "miner's slate"	17	..
Coal	2	..
Shale, light gray, and "miner's slate"	50	..
Coal	4	..
Underclay	2	..
Limestone (Devonian)	+	..

In the shale pit formerly worked by the National Coal Company, near Sears, a coal bed is separated by only a few feet of shale from the Devonian limestone, as shown in the section given below:

Section of abandoned clay pit of the National Clay Company, in the bluff of Rock River, near Sears.

	Thickness *Feet*
Loess	40
Sandstone, white, friable, with impressions of *Calamites* and *Stigmaria*	8
Shale, dark, containing disintegrated septaria, and other concretions...	2
Shale, gray, and dark gray	6
Coal, weathered	1
Underclay, unctuous, in places red or variegated, and known in the clay works as "castile clay"	3
Shale, dark gray, with some concretionary material in the upper part..	8
Coal	2
Underclay, white, sandy	4
Shale, greenish-gray	1
Limestone (Devonian)	..

In the north bank of Rock River, at Black Hawk's Watchtower the succession of strata described below is exposed in the lower part of the bluff:

Section of strata exposed at Black Hawk's Watchtower, east of Sears.

	Thickness *Feet*
Loess	50
Till, leached, not well exposed	3
Sandstone, coarse	10
Sandstone, dark, soft, shaly	2
Shale, dark	1
Coal	1
Shale, dark, and underclay, with streaks of sandstone and coal, not well exposed	46
Limestone (Devonian)	4+

About three miles east of Andalusia there is exposed near the base of the Mississippi bluffs a thickness of 20 or more feet of sandstone, in layers 1 to 1½ feet thick, which doubtless lies near the base of the Pottsville formation.

The sections given above, and the records of several of the coal-test borings in the quadrangles, show that two thin coal beds are generally present and in many places three or more coals occur in the Pennsylvanian rocks of this region. One of these coals lies 30 to 50 feet below the horizon of the Herrin (No. 6) coal, and another one occurs 50 to 90 feet higher than this lower coal. These are usually thin, but in a few places, as along Coal Creek west of Andalusia, in the country near Buffalo, and along a creek near the west side of sec. 13, T. 17 N., R. 2 W., they have been profitably mined by drifts for local use. At the last-named locality the coal dips from both sides at the rate of 15 feet in a distance of 100 feet, toward a trough or syncline which extends in a general northwest-southeast direction. West of Andalusia, along Coal Creek, and in the banks of the streams that join the Mississippi on the south, between Coal Creek and Illinois City, some part of the following section of lower Pennsylvanian strata is exposed above the basal sandstone of the Pottsville formation:

General section of the Pennsylvanian rocks, exposed along Coal Creek and other streams south of Mississippi River, between Andalusia and Illinois City.

	Thickness Feet
McLeansboro formation—	
15. Sandstone, thin bedded, gray to yellow, micaceous	12
14. Shale, gray, sandy, in layers 1 to 6 inches thick, with bands of sandstone and thin clay-ironstone concretions	25
13. Coal (locally present)	½
12. Shale, gray	4
11. Limestone, concretionary, argillaceous (locally absent)	1– 4
Carbondale formation—	
10. Coal, Herrin (No. 6) bed (?); locally present	4–11
Pottsville formation—	
9. Sandstone, thin bedded	4½
8. Coal (locally present)	1– 1½
7. Shale, gray to dark, with many small concretions of clay-ironstone	13
6. Coal (locally present)	½–1½
5. Sandstone, gray, micaceous, in thin layers, with a thicker layer at the top	3½
4. Shale, gray to black, the middle part with large concretions and bands of dark nodular limestone the surfaces of which are covered with "cone-in-cone" structures, and in places nodules covered with pisolite	21
3. Sandstone, hard, quartzitic, in two layers	1½
2. Coal, in some places	½–2
1. Shale, gray to dark	23

In the banks of a stream in the NE. ¼ sec. 36, T. 17 N., R. 4 W., the limestone member, number 11 in the foregoing section, is 3½ feet thick, and contained the fossils *Girtyina ventricosa, Productus cora, Productus semireticulatus, Spirifer cameratus,* and *Composita argentea.* At this place a bed of coal 2½ feet thick underlies the limestone, being separated from it by 6 inches of shale. This is probably the Herrin (No. 6) coal bed with the typical limestone cap rock that is usually present in other parts of the quadrangles and farther east, in Fulton County.[1]

In a tributary that joins this creek from the east about 50 rods east of the exposure last mentioned, and in the banks of a stream still farther east, this limestone is 4½ feet thick, and furnished *Girtyina ventricosa, Productus cora, Productus semireticulatus, Spirifer cameratus, Spirifer cameratus* var. and *Composita argentea.* At the former place the underlying coal is only about 6 inches thick, and is separated from the limestone by 3 feet of

[1]Mr. Harold E. Culver of the State Geological Survey has recently shown the presence of the *Girtyina* limestone in this region.

shale. The upper layer of limestone at this place contains many calcite-filled tubes which average nearly one-fourth inch in diameter. These are among the few exposures in which the Herrin Coal and the overlying limestone containing *Girtyina ventricosa* can be certainly recognized, and its stratigraphic relations determined in the northern part of the quadrangles. At this place it lies about 35 feet above the horizon of large concretions with cone-in-cone and pisolite structures, and about 75 to 85 feet above the base of the Pottsville formation, at an altitude of about 660 feet above sea level.

Strata equivalent to members 1 to 14, inclusive, of the foregoing section outcrop along a creek a short distance west of the middle of the south half of sec. 30, T. 17 N., R. 3 W., and along the creeks that join the river near the middle of the S. ½ sec. 25, T. 17 N., R. 4 W. Members 1 to 11, inclusive, can be recognized along a creek that follows near the west side of the S. ½ sec. 30, T. 17 N., R. 3 W., but the limestone is only about one foot thick, and the Herrin coal is not present in these outcrops. Members 4 and 5 of this section can be seen in outcrops along the lower course of the creek that joins the river in the NW. ¼ sec. 32, T. 17 N., R. 4 W., and strata belonging to higher levels are exposed farther up this stream. In the SW. ¼ sec. 4, T. 16 N., R. 4 W., a coal bed 20 to 26 inches thick has been worked by drift in a number of places at an altitude of 710 to 714 feet above sea level. The dip of the coal at these localities is variable, the strongest slope being toward the south, at the rate of about one foot in 10 feet. A slight western inclination was also present. The coal is overlain by a thin-bedded sandstone or sandy shale 3 or 4 feet thick. The dark shale bed containing concretionary limestone masses covered with cone-in-cone structure and pisolite is also exposed about a quarter of a mile above the mouth of the creek that joins the river in the NW. ¼ sec. 33, T. 17 N., R. 4 W. About 40 rods farther up this creek a coal bed, 22 inches thick, overlying a thin-bedded, micaceous sandstone has been worked in a small way at an altitude of about 582 feet. The strata in this part of the quadrangle are more or less undulating, dipping in different directions in different places, but the conspicuous prevailing dip in this part of the area is southward, with a smaller inclination toward the west. The zone of large concretions with cone-in-cone structure and pisolite is conspicuous in all of the streams where its horizon is exposed. It occurs at a level about 35 to 50 feet above the base of the Pottsville. The altitude of this "cone-in-cone" and pisolitic zone along Coal Creek is about 623 feet above sea level, but about 5½ miles farther west, in the NW. ¼ sec. 33, T. 17 N., R. 4 W., the elevation of this "cone-in-cone" concretionary horizon has declined to about 576 feet above the sea. Still farther west sandstone becomes more prominent in the Pennsylvanian section. Along a creek that crosses the middle part of sec. 1, T. 16 N., R. 5 W., the following succession of strata is exposed:

Section of rocks exposed along a stream in sec. 1, T. 16 N., R. 5 W.

	Thickness *Feet*
7. Shale, gray to blue	28
6. Shale, white (pottery clay)	5-7
5. Shale, dark and gray	36
4. Shale, with ironstone and nodular bands 1 to 3 inches thick, with "cone-in-cone"	2½
3. Shale, dark	22
2. Shale, dark and gray	10
1. Sandstone	22

The white shale member number 6 in the foregoing section outcrops near the middle of the south half of the section. It was worked by Mr. Tyler prior to 1890 for white pottery clay which was used at that time in the manufacture of jugs, crocks, and jars at four pottery plants in and near Illinois City. Considerable clay was also hauled to Fairport, Iowa, where it was manufactured into similar wares. A similar clay that burns white occurs on land of A. J. Lyon, half a mile north of Illinois City, and probably represents the same bed as that formerly worked by Mr. Tyler. At this place the white shale bed lies about 35 feet above the zone of small dark concretions, the base of it being about 695 feet above sea level. It belongs to a level several feet above the level of the Rock Island (No. 1) coal bed which is usually absent along these streams south of the Mississippi, but possibly outcrops in the river's north bank, 3½ miles northeast of this place at an altitude of about 658 feet, about 60 feet above the top of the Devonian limestone exposed in the bank of Pine Creek one mile farther northeast.

The sandstone bed in the lower part of the Pottsville formation continues to thicken farther westward, as shown by the exposures along a stream in the NE. ¼ sec. 2, T. 16 N., R. 5 W., where the following section was made:

Section of strata exposed in the NE. ¼ sec. 2, T. 16 N., R. 5 W.

	Thickness *Feet*
Coal (alt. about 674)	1½+
Shale, black, with large concretions, laminated in lower part	22
Shale, gray to dark	6
Shale, light and dark, partly concealed	20
Sandstone, gray to yellow, micaceous, in thick and thin layers, some of which are cross-bedded	35

The strata at this place dip south and a little west at the rate of about one foot in a distance of 10 feet. The coal has been worked by drifts in two or three places in this vicinity for local use.

About one mile west of the place where the last section was made the following succession of strata outcrop in the banks of a stream in the east half of sec. 3, T. 16 N., R. 5 W.:

Section of strata exposed in the E. ½ sec. 3, T. 16 N., R. 5 W.

	Thickness Feet
Coal (altitude about 656)	2
Shale, gray and dark	18
Coal, locally present	1
Limestone, concretionary, with iron	¼
Cone-in-cone band	⅓
Shale, dark, with large concretions covered with cone-in-cone structure	11
Shale, dark alternating with clay-ironstone bands in layers 1 to 4 inches thick	2
Shale, gray, sandy	6
Sandstone (partly concealed), with an iron-cemented conglomerate 1 foot or more thick at the base	45
Shale, gray and dark	25
Coal (altitude about 563 feet)	1⅔
Sandstone, in thin layers	7
Shale, black	3

In the foregoing section the coal at the top is equivalent to the upper member of the preceding section, the westward dip being about 11 feet to the mile. This coal outcrops near the middle of section 2 at an altitude of about 665 feet. The sandstone bed, number 5 of the last section, clearly corresponds with the lowest member in the preceding section.

The succession of strata exposed along a stream in the W. ½ of section 3 of this township is as follows:

Section of strata exposed in the W. ½ sec. 3, T. 16 N., R. 5 W.

	Thickness Feet
Sandstone	15
Shale, gray, sandy	21
Coal	1½+
Sandstone	4½
Shale, dark	10
Shale, light	6
Shale, dark	9½
Sandstone	7
Shale, sandy	10
Sandstone, partly concealed	30+

For a distance of one and one-half miles west from the place where the last section was made, as far as Jimtown School, a massive sandstone outcrops in the south bank of the river to a height of more than 100 feet above the level of the flood plain. The foot of the bluff is concealed by talus, so that the full thickness of the sandstone could not be seen, but it can not be less than 60 feet and probably in places reaches 80 feet. This is doubtless the continuation of the sandstone exposed in picturesque ledges along Pine Creek in secs. 17 and 18, T. 77 N., R. 1 E. This sandstone rests with marked unconformity upon different levels of older Pennsylvanian strata in this region; and possibly it is to be correlated with the massive sandstone that unconformably overlies different levels of McLeansboro strata in Clark and Coles counties.

In the banks of the creek that joins the river just east of Jimtown School, the following succession of strata is exposed.

Section of rocks exposed in secs. 4 and 5, T. 16 N., R. 5 W.

	Thickness *Feet*
Sandstone	50 to 70
Shale, dark	30
Shale, dark and light	11
Sandstone	12
Coal (altitude 558 feet)	1½
Underclay, gray	2

The coal has been drifted on in several places below the school house in this vicinity. The strata rise toward the west at the rate of about one foot in a distance of 60 feet. The thick sandstone at the top of the section probably fills an old channel, and rests in erosional unconformity on the underlying strata. The altitude of the base of the thick sandstone near the Jimtown School is about 611 feet above sea level, while that of the base of this sandstone two miles farther east is about 571 feet above the sea. Across the river from Jimtown School, near the mouth of Sweetland Creek, Devonian limestone is exposed to a height of about 572 feet above the sea.

Along a creek that crosses the south half of sec. 5, of this township, a one-foot conglomerate lies above 17 feet of shale, at the base of the thick sandstone bed at an elevation of about 619 feet. At this place the sandstone is underlain by 17 feet or more of dark shale.

Along the Muscatine-Rock Island wagon road up the hill in the east bank of the river, near the middle of the south side of sec. 6, T. 16 N., R. 5 W., there is exposed the following succession of shale which dips gently toward the east.

Strata exposed along wagon road near middle of south side of sec. 6, T. 16 N., R. 5 W.

	Thickness *Feet*
Sandstone, in thick and thin beds, in places massive and strongly cross-bedded, the false bedding planes dipping toward the west. This is probably the thick sandstone exposed near the top of the bluff west of Jimtown School	38
Shale, dark	12
Clay-ironstone band	⅓
Shale, dark	9
Clay ironstone bands alternating with bands of shale, 1 to 3 inches thick	2½
Shale, dark	16
Shale, gray, sandy	12
Sandstone	6

About 40 rods east of this road a quarry was formerly worked in a sandstone bed that corresponds with the basal member of the foregoing section (fig. 23). The sandstone is 22 feet thick in this old quarry. It is underlain by 2½ feet of black shale, and is followed above by a thickness of 11 feet of gray, sandy shale. The wagon road up the hill half a mile east of the road, where the last section was made, passes over a thickness of 55 feet of light and dark shale which corresponds to that portion of the foregoing section between the upper and basal sandstones. The following succession of strata, exposed along Copperas Creek, corresponds in a general way with those outcropping along the streams south of Mississippi River, described above. The youngest rocks appear near the headwaters of this creek where the section given below is exposed near the middle of the east side of sec. 36, T. 16 N., R. 4 W.:

Section of rocks exposed in sec. 36, T. 16 N., R. 4 W.

	Thickness *Feet*
Shale, gray	7
Shale, red and pink	9
Shale, gray	6
Sandstone, thin bedded	12

The elevation of the top of the exposure at this place is about 740 feet. About half a mile farther up this creek a sandstone 5 feet thick, dipping toward the south, is exposed above the level of the uppermost shale in the above section. Strata belonging below the basal member of the foregoing section outcrop in the east bank of a tributary of Copperas Creek, along the wagon road near the middle of the W. ½ sec. 27, Buffalo Prairie Township, as shown in the section given below:

Section of strata near the middle of W. ½ sec. 27, T. 16 N., R. 4 W.

	Thickness *Feet*
Shale, gray	4½
Coal (altitude about 710 feet)	1⅙
Shale, sandy, gray	13
Sandstone	9

Rock Island (?) coal and associated strata.—From one-half mile to one mile farther down the creek in the SE. ¼ sec. 21, and the SW. ¼ sec. 22, T. 16 N., R. 4 W., the following succession of strata outcrop at an altitude lower than the base of the last section:

Section of strata exposed in the SE. ¼ sec. 21, T. 16 N., R. 4 W.

	Thickness *Feet*
Shale, dark	11
Shale, dark and light, with concretionary clay-ironstone bands	16
Limestone, dark, fossiliferous	1½+
Coal (No. 1) (?) (altitude about 654 feet)	1½

The coal has been worked by drifts in a number of places near the junction of this stream with Copperas Creek. Rocks corresponding to some part of the shale portion of the last section are exposed in the banks of Copperas Creek in places for a distance of two miles above the mouth of this stream. About three miles farther west, along a tributary of Copperas Creek, in the W. ½ sec. 19 and the N. ½ sec. 24, of the same township, and farther west in the Edgington quadrangle, the Rock Island (No. 1) (?) coal and its limestone cap rock are absent, and their place appears to be occupied by a sandstone bed 28 feet thick, which is thought to correspond to the sandstone that outcrops in the upper part of the river bluff west of Jimtown School.

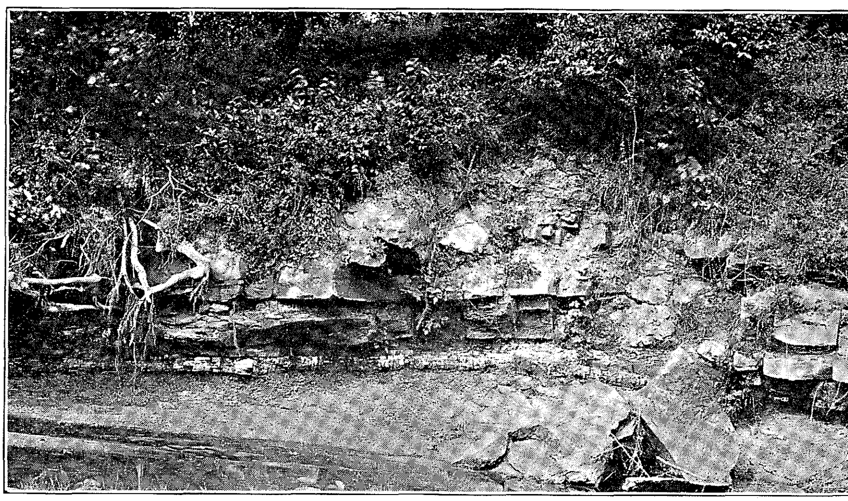

FIG. 24.—Sandstone overlying a thin coal bed in the lower part of the Pottsville formation, in the SW. ¼ sec. 23, Drury Township.

In the SW. ¼ sec. 23, T. 16 N., R. 5 W., there is exposed the following succession of strata (see fig. 24) belonging to a level below the sandstone above described:

Section of strata outcropping in sec. 23, T. 16 N., R. 5 W.

	Thickness *Feet*
Sandstone, yellowish gray	6
Coal	½ to 1
Shale, gray and dark	18

The lowest strata appearing along Copperas Creek are exposed along a stream in the NW. ¼ sec. 29 of Drury Township.

Section of strata in the NW. ¼ sec. 29, T. 16 N., R. 5 W.

	Thickness *Feet*
Shale, gray	7
Shale, sandy, or shaly sandstone	11
Coal (altitude 592 feet)	1
Underclay, gray	½ to 1
Sandstone, thin bedded	19

In places these strata lie nearly horizontal, and in others they dip southward at a low angle.

A limestone that may represent the limestone above the Rock Island (No. 1) (?) coal bed is reported in the log of a boring in the NE. ¼ NW. ¼ sec. 34, T. 16 N., R. 4 W., at an altitude about 642 feet above sea level. This coal and the dark limestone cap rock are exposed in the SE. ¼ sec. 21, about one and one-half miles north of the test boring last mentioned, but they are not known farther west in the Edgington quadrangle on the Illinois side of the river. The coal outcrops on the Iowa side of the river in the north part of the Milan quadrangle, where it has been mined in a small way a short distance north of the center of sec. 11, T. 17 N., R. 2 E., at an elevation of about 650 feet, and near the northwest corner of sec. 15 of the same township, where the elevation is about 660 feet. It also outcrops near the middle of the SE. ¼ sec. 20, T. 77 N., R. 1 E., at an elevation of about 658 feet. Most of the logs of coal-test borings in secs. 16, 21, 22, 27, 28, 29, and 34, T. 16 N., R. 4 W., report neither the coal nor the dark limestone cap rock that usually overlies it. These strata are not exposed at any other places along the streams in the northern, middle, and western parts of these quadrangles.

CARBONDALE AND MCLEANSBORO FORMATIONS

Along Camp Creek and its branches, in the southeast quarter of the Edgington quadrangle, the Herrin (No. 6) coal bed, with its dark limestone cap rock containing *Girtyina ventricosa,* outcrops in several places at altitudes ranging from 645 to 675 feet. Along the roadside in the north bank of Camp Creek, near the middle of the S. ½ sec. 24, T. 15 N., R. 4 W., the following succession of rocks is exposed:

Section of rocks exposed near the middle of the S. ½ sec. 24, T. 15 N., R. 4 W.

	Thickness *Feet*
Sandstone, thin bedded	5
Limestone, dark, shaly, containing *Girtyina ventricosa*	12
Coal (Herrin or No. 6, altitude 672 feet)	2½
Underclay, gray	4

The sandstone member number 4 of the above section is said to be 35 feet thick in an old coal shaft near this place.

A few rods south of the exposure above described, the Herrin coal outcrops at about the same elevation, and is overlain by sandstone, the limestone cap rock being absent. Here, as elsewhere, such alternations of sandstone and limestone immediately above the coal bed within so short a distance are thought to indicate erosional unconformity, the limestone normally lying above this coal having been removed by erosion previous to the deposition of the sandstone that in places rests directly upon this coal bed. Probably in places the coal also was entirely removed. Herrin (No. 6) coal was formerly worked by several drifts near the south side of the NW. ¼ sec. 19, T. 15 N., R. 3 W., at an altitude about 675 feet above sea level. No good exposures were seen in the last locality, but fragments of dark limestone on the old coal dumps indicate that the dark limestone cap rock that normally overlies this coal in the vicinity of Matherville and in Fulton County, is also here present above the coal. This same coal bed is exposed in two or three places in the NE. ¼ SE. ¼ sec. 24, T. 15 N., R. 3 W., where the following section was made, but the dark limestone that usually overlies it is absent.

Section of strata exposed in the NE. ¼ SE. ¼ sec. 24, T. 15 N., R. 3 W.

	Thickness *Feet*
Shale and sandstone	17
Sandstone, thin bedded	8
Coal (No. 6, altitude 673 feet)	2
Shale, gray above and dark below	9

Strata similar to those in the outcrop above described are exposed near the middle of the north side of sec. 25 of Duncan Township, where the altitude of the coal is about 662 feet. The Herrin (No. 6) coal also has been drifted on in several places in the SE. ¼ sec. 23 of Duncan Township, at an elevation of about 657 feet above sea level. A section of the rocks in this locality is given below:

Section of strata exposed in the SE. ¼ sec. 23, T. 15 N., R. 4 W.

	Thickness *Feet*
Sandstone, or sandy shale	16
Coal (No. 6, altitude about 657 feet)	2
Shale, light and dark	20

In the south bank of Little Camp Creek, in the SW. ¼ sec. 34, Duncan Township, the Herrin coal and associated strata are exposed, as shown in the section given below:

Section of rocks exposed in the SW. ¼ sec. 34, T. 15 N., R. 4 W.

	Thickness *Feet*
Coal (No. 6, altitude 658 feet)	2
Shale, gray and dark	23
Coal	½
Shale	2

The Herrin coal and the dark limestone cap rock outcrop near the middle of the north side of the SE. ¼ sec. 27 of the same township, as shown below:

Section of rocks exposed in north side of the SE. ¼ sec. 27, T. 15 N., R. 4 W.

	Thickness *Feet*
Sandstone	3
Limestone, dark with several fossils	2
Coal (Herrin or No. 6)	3
Shale, light and dark	12

The limestone above the Herrin coal at this place furnished the fossils *Girtyina ventricosa, Orbiculoidea missouriensis, Productus cora, Productus semireticulatus, Marginifera muricata, Spirifer cameratus,* and *Composita argentea,* which species also occur in the limestone above this coal farther southeast in Fulton County.

Farther west, in the southwest quarter of the Edgington quadrangle, no rocks of Pennsylvanian age outcrop along Eliza Creek or its tributaries or on Winters Creek, or along the tributaries of Mississippi River south of Copperas Creek, except a few small exposures in sec. 6, Eliza Township, where the following succession of strata was seen in the bank of the river nearly a mile west of the quadrangle:

Strata exposed in the bank of the river near the west side of sec. 6, T. 15 N., R. 5 W.

	Thickness *Feet*
Coal (altitude about 573 feet)	1½
Shale	3
Sandstone	14 to 17

In the southeast quarter of the Milan quadrangle the Herrin (No. 6) coal is exposed in several places in the vicinity of Matherville, at elevations ranging from 624 to 650 feet above sea level. The coal bed varies considerably in thickness from place to place; even in the same mine it is said to be 4 feet thick or more in some places, and to pinch out entirely in others. The thickness is said to be more persistent in a north-south than in an east-west direction. The dark limestone is usually present above the coal in this region.

Along a stream near the center of sec. 33, Preemption Township, the Herrin coal has been mined in a drift at an altitude of 652 feet. The bed at this place is 3 feet 10 inches thick, and is overlain by a thickness of

12 feet of dark limestone called "blue rock" by the miner. A section of the strata exposed at this locality is as follows:

Section of rocks exposed near the middle of sec. 33, T. 15 N., R. 2 W.

	Thickness *Feet*
Sandstone, white, shaly	3
Shale, dark and gray	11
Limestone, dark, shaly, fossiliferous	9
Coal (No. 6, altitude about 652 feet)	2½
Shale, gray	7
Sandstone	1
Shale, gray	1½

The fossils in the limestone above the coal at this place include *Girtyina ventricosa, Productus cora, Spirifer cameratus, Composita argentea.*

In the shaft of mine No. 3 of the Coal Valley Mining Company, in the SE. ¼ sec. 27, Preemption Township, the Herrin (No. 6) coal lies about 69 feet below the surface at an altitude of about 624 feet above the sea. The coal in this mine is pockety, ranging in thickness from less than 3 to nearly 5 feet and dipping in different directions in different parts of the mine.

About 30 rods north of the place where the last section was made, a thickness of 12 feet of sandstone is exposed at the level of the limestone member in the detailed section last described. Along the wagon road up the hill on the east side of this creek, along the north side of the NE. ¼ sec. 33, Preemption Township, the following succession of strata is exposed:

Section of strata exposed along the north side, sec. 33, T. 15 N., R. 2 W.

	Thickness *Feet*
Shale	3
Limestone, concretionary, with cone-in-cone structure	1 to 2
Shale, gray	7
Sandstone	16

The altitude of the concretionary limestone is about 693 feet, or about 41 feet higher than the level of No. 6 coal less than a mile farther south.

In a drift mine operated by Dougherty Brothers in the SW. ¼ sec. 26, Preemption Township, the Herrin coal is worked at an altitude of about 646 feet. The bed is 3 to 4 feet thick, and is overlain by 2 feet of black, fissile shale, followed above by 14 feet of dark limestone underlying 13 feet of sandstone.

A coal-test boring in the town of Cable penetrated the following succession of Pennsylvanian rocks, as shown in the log furnished by Mr. B. B. Peterson:

Log of test boring in the town of Cable

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Soil and clay	9	9
Pennsylvanian system—		
Pottsville formation—		
Sandstone and shale	3	12
Limestone, blue, shaly	9	21
Coal (No. 1 (?) altitude 654 feet)	3½	24½
Underclay and shale	57	81½
Sandstone	30	111½
Coal (altitude 585 feet)	2½	114
Underclay and shale	12	126
Devonian system—		
Limestone	52	178

The altitude of the upper coal, possibly No. 1, at this place is about 654 feet, and the elevation of the top of the Devonian limestone is about 549 feet.

This coal is also exposed along a stream south of the wagon road in the N. ½ sec. 20, Richland Grove Township, where the following section was made:

Section of strata exposed along a stream in sec. 20, T. 15 N., R. 1 W.

	Thickness *Feet*
Limestone, dark	2+
Coal (No. 1(?), altitude about 667 feet)	2
Underclay	4

In an abandoned drift mine in the NE. ¼ sec. 20, T. 15 N., R. 1 W., this same coal bed lies at an altitude of 662 feet, and ranges in thickness from 2 to 3 feet. In a local mine working this coal about one-half mile east of Cable, the bed is said to average 3½ feet thick and lies at an elevation of about 646 feet. The operator reported that the coal was thickest in the lowest part of the depressions, and that dark shale comes in above the coal and has the greatest thickness over the lowest part of the depressions.

In mine No. 2 of the Coal Valley Mining Company at Sherrard, it is reported that the coal ranges in thickness from 3 to 5 feet in places where it has been mined, but it becomes so thin toward the east, north, and west that it does not pay to work it farther in those directions. The thickness persists toward the south, in which direction they have mined into the old works at Cable. The coal is said to be undulating, the ridges and troughs corresponding in a general way with the hills and valleys in the surface. A difference in elevation between the crest of the ridges and the bottom of the troughs is in some places as much as 12 feet. The coal is reported to be usually thicker in the troughs than in the ridges. The altitude of the coal in the shaft of this mine is about 612 feet above sea level.

Over the middle part of the Milan quadrangle the glacial drift is more than 100 feet thick, and no exposures of Pennsylvanian rock are to be seen.

In a test hole put down a few rods south of the middle of the north side of sec. 32, T. 17 N., R. 1 W., blue limestone was reported 40 feet below the surface, at an altitude of 650 feet. This limestone was probably the cap rock or dark limestone that usually overlies the Herrin (No. 6) coal bed. Farther west in the Milan quadrangle, if the Herrin coal bed is present on the south side of Mississippi River, it is thin, and the dark limestone that usually occurs above it in the southeast part of the quadrangles, and possibly north of Mississippi River in this area, is absent, so that the Herrin coal bed can not be distinguished.

A coal 2½ feet thick has been stripped in the bed of a creek near the southeast corner of sec. 33, T. 17 N., R. 3 W. This coal lies at an altitude of about 650 feet, and is overlain by a dark shale bed containing some calcareous nodular material, and may possibly represent the Rock Island bed.

UNCONFORMITIES WITHIN THE PENNSYLVANIAN

An intra-Pennsylvanian unconformity is believed to be indicated in the exposures in the SW. ¼ sec. 24, T. 15 N., R. 4 W., where sandstone immediately overlies the Herrin (No. 6) coal, and only a few feet distant at the same level the normal dark limestone immediately overlies this bed. A large unconformity is also thought to be indicated in Montpelier and Drury townships, where a thick-bedded, coarse-grained sandstone replaces shale and other strata within short distances in a horizontal direction. The Herrin coal and the overlying limestone containing *Girtyina ventricosa* overlap the underlying strata in marked unconformity.

An old channel in the coal bed in the Sherrard mine (fig. 25) is thought to furnish additional evidence of an unconformity within the Pennsylvanian. Operations in this mine, which have extended under nearly two sections of land, have disclosed a channel about 300 feet wide in the coal bed where the coal is either wholly absent, or so thin and affected to such an extent with faults and slips that it could not be profitably worked. The channel follows a sigmoid course from northeast to southwest, as shown in the sketch of the mine map, figure 25. It has been traced from near the center of the south side of sec. 5, T. 15 N., R. 1 W., to near the center of the NE. ¼ sec. 4, of the same township, a distance of

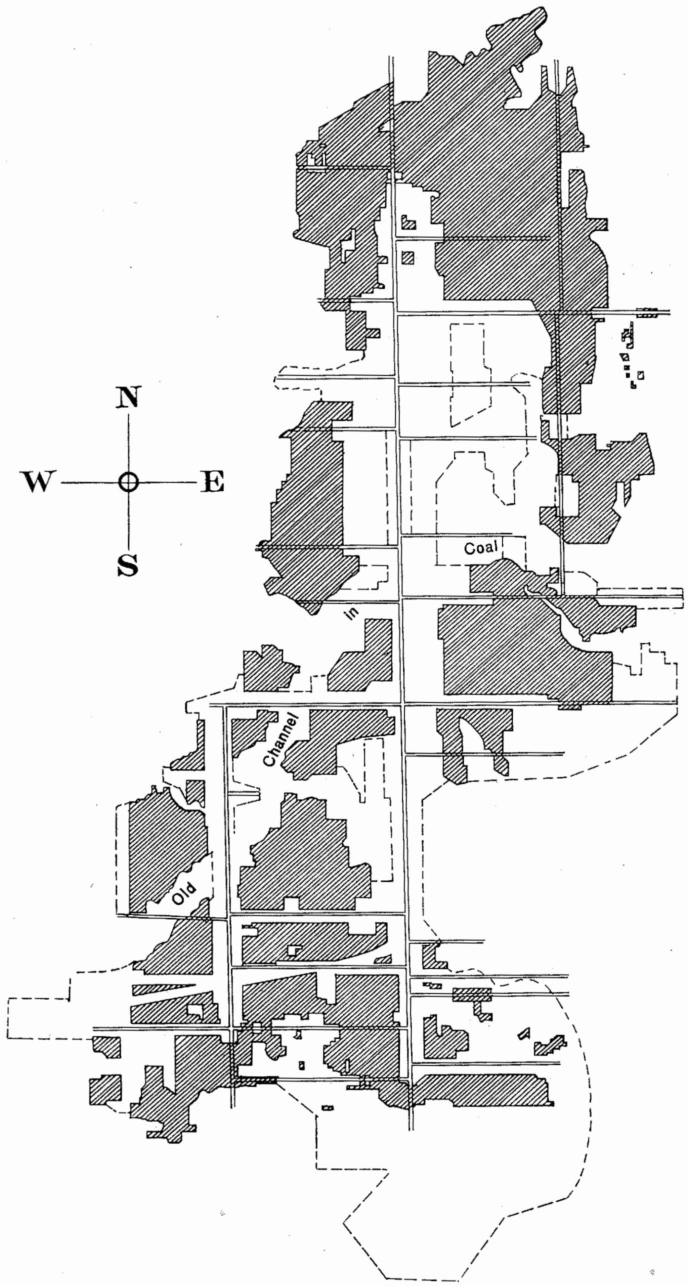

FIG. 25.—Mine map of mine No. 2 of Coal Valley Mining Company at Sherrard, showing location of old channel in the coal.

about one mile. Two smaller unproductive belts, which appear to be tributaries, join the main channel from the northwest.

One possible explanation of these channels is that they represent ancient drainage courses in the original peat swamp in which the coal was formed. However, if these represent such channels, like that of Dismal River in the Great Dismal Swamp, the dark limestone cap rock, which is marine, would be expected to extend across the channel, bending down into it from both sides, if a depression existed there when the limestone was laid down; or owing to later compression of the peat, it might bend upward at the margins, and lie at a higher level above the channel if the latter was filled with mud or sandy sediment before the limestone was deposited.

Instead of either of these conditions prevailing, the limestone is usually absent over the channels, thinning out irregularly and somewhat abruptly as they are approached. In one place also the limestone has been reduced by the solvent action of water, and there are small, collapsed caverns along the thinned edge of the limestone near the border of the channel. These features are best explained on the assumption ot unconformity within the Pennsylvanian, the channels having been formed by erosion inaugurated some time after the deposition of the limestone, but previous to the time of deposition of some of the higher Pennsylvanian beds.

Quaternary System

CHARACTER AND THICKNESS OF THE DEPOSITS

Over a large part of the Edgington and Milan quadrangles the Quaternary or surficial deposits have an average thickness of nearly 100 feet; in some places the thickness is reported to be more than 200 feet. They consist of pre-Illinoian clay or sand, Pleistocene glacial drift or till, loess, and terrace deposits and Recent alluvium and dune sand deposits. All of these materials have been derived from indurated rocks partly through normal processes of weathering, partly through the grinding action of the glaciers, and in small part by the abrasive action of stream erosion. They have been transported and deposited by ice, wind, and water.

The greatest known thickness of the Quaternary deposits in the area is near the southeast corner of the NE. ¼ sec. 9, T. 16 N., R. 1 W., where a water well 220 feet deep was reported to have stopped on the top of bed rock.

In a water well put down near the middle of the S. ½ sec. 9, T. 15 N., R. 5 W., the top of the Pennsylvanian was said to have been reached at a depth of 200 feet, and in another well near the middle of the west side of sec. 23 of the same township, the Quaternary deposits were reported to be equally thick. Over most of the area of the quadrangles south of Mississippi and Rock rivers the thickness of the surficial deposits exceeds 125 feet. In 19 wells which were reported to have reached the top of the Pennsylvanian rocks the average thickness of the Quaternary deposits was 145 feet. In 58 other wells which did not reach the base of the Quaternary, the average thickness of the surficial materials penetrated was 125 feet.

PLEISTOCENE SERIES

DIFFERENTIATION OF DEPOSITS

The Pleistocene series is represented in the Edgington and Milan quadrangles by six of the different glacial and interglacial stages recognized in North America. The lowest bed of glacial drift that has been differentiated in the area has been found in only a few places, and is thought to belong to the Kansan stage. It is overlain by a dark clay or soil zone which corresponds to the Yarmouth interglacial stage. The upper glacial till that underlies almost the entire area is the Illinoian, and it is covered in many places by the Sangamon soil. The surface of the quadrangles is almost everywhere underlain by a bed of loess, a large part of which is thought to be of late Iowan and early Peorian age. In a few places in the valleys of Mississippi and Rock rivers are terrace deposits that are thought to be of Wisconsin age.

The topography of the glacial drift in this area is nowhere of the morainic ridge type. The surface is partially dissected ground moraine or drift plain that has been covered with a mantle of loess.

KANSAN TILL

The drift was derived from two different ice invasions, the earlier, Kansan, which invaded from the north or northwest, and the Illinoian, which advanced from the northeast. The deposits left by these two drift sheets are for the most part indistinguishable in character and appearance. Since the places are rare where the old Yarmouth soil bed that was formed on the surface of the Kansan till before the advent of the Illinoian glacier was left undisturbed by the latter ice sheet, and exposures of this Yarmouth soil horizon are still more rare, there are only a few places in the area where these two till sheets are exposed in superposition, or penetrated in well borings, so that they could be certainly differentiated.

An outcrop of the Kansan drift separated from the overlying Illinoian till by an old soil band representing the Yarmouth interglacial stage was seen in the banks of a ravine east of the center of the west line of sec. 8, T. 15 N., R. 1 W., about one and one-half miles southwest of

Sherrard. A section of the Pleistocene deposits exposed at this locality is given below:

Section of strata exposed in sec. 8, T. 15 N., R. 1 W.

		Thickness Feet
5.	Loess, yellowish	18
4.	Till, pebbly, yellow	12
3.	Soil-like layer, dark, with a few pebbles	2
2.	Till, pebbly, gray, leached	3
1.	Till, pebbly, unleached	30+

In the foregoing section members 1 and 2 represent the Kansan till, member 3 the Yarmouth interglacial soil horizon, and member 4 the Illinoian till. A comparison of the pebbles in the two tills seen in the above-mentioned exposure shows that among those measuring one-third of an inch in diameter, greenstone and limestone are more common in the lower till than in the upper; and dolomite pebbles are more common in the upper till than in the lower. A similar difference has been found to distinguish these two tills in eastern Iowa. The lower till in this exposure is doubtless the Kansan which has a wide distribution in Iowa and northern Missouri.

The lower till, members 5 and 6, in the log of the well near Seventh Avenue and Thirty-fifth Street, given in a preceding page, is also thought to represent the Kansan.

In the city of Davenport, immediately across the river from Rock Island, a weathered zone between two beds of till was formerly exposed along Eighth Street, between Myrtle and Vine. Leverett[1] has described the section of Pleistocene strata at this place as follows:

Section of Pleistocene strata formerly exposed in Davenport

	Thickness Feet
Loess	30
Till, reddish brown, leached and stained	2½ to 3
Till, brown, calcareous, crumbling readily	15
Clay, gummy, ash colored, with black streaks, apparently of humus (Yarmouth)	2 to 3
Till, brown, jointing in cubical blocks, color changing to grayish blue at 12 to 15 feet	25

The surface of the Kansan drift, the lowest till noted above, appears to have been subjected to erosion before the overlying till was deposited, as indicated by the fact that the surface of this lower drift declines 15 feet in a distance of 20 rods in passing toward the river valley.

A succession of Pleistocene deposits similar to those described in Davenport has been reported in the banks of the river in Muscatine, a short distance west of the Edgington quadrangle. A section of strata at this place, as reported by Leverett[2] is as follows:

[1]Leverett, Frank, The Illinois Glacial Lobe, U. S. Geological Survey Monograph XXXVIII, p. 45, 1899.
[2]Leverett, Frank, Op. cit., p. 47.

Section of Pleistocene strata exposed on Green Street, Muscatine, Iowa

	Thickness *Feet*
Loess, partly eroded	10
Silt, brownish black	1½ to 2
Soil, pebbly, black (Sangamon)	3
Till, brown, leached (Illinoian)	6
Till, brown, unleached, with many boulders in lower part (Illinoian)	12
Silt, calcareous (Yarmouth)	6 to 8
Till, calcareous, brown (probably Kansan)	10

A similar succession of Quaternary deposits is exposed along the branch of Eliza Creek, in the SW. ¼ sec. 14, T. 15 N., R. 5 W., in the Edgington quadrangle, where the following section was made:

Section of strata outcropping in the SW. ¼ sec. 14, T. 15 N., R. 5 W.

	Thickness *Feet*
5. Loess, yellowish brown	2 to 3
4. Till, pebbly (Illinoian)	19
3. Sand, more or less stratified	3 to 4
2. Loess-like silt	2½ to 3½
1. Till, pebbly, bluish (probably Kansan)	3

The lower till in the exposure last described probably represents the Kansan. A somewhat similar succession of strata exposed in the SW. ¼ sec. 26, T. 16 N., R. 5 W., may indicate deposits of two different glacial stages, as shown below:

Section of strata outcropping in the SW. ¼ sec. 26, T. 16 N., R. 5 W.

	Thickness *Feet*
Loess, yellowish brown	5
Till, pebbly (Illinoian)	11
Sand and gravel, irregularly bedded	2 to 3½
Till, pebbly (possibly Kansan)	4

It is somewhat uncertain whether the lower till in the last section represents an earlier glacial stage than the upper one, or whether the sand and gravel bed that separates the two drifts may have been spread over the lower till as an outwash deposit during a temporary withdrawal for a short distance of the margin of the single ice sheet. There is not sufficient evidence in such a bed of water-laid sand and gravel to prove whether it was deposited during an interglacial stage when the ice sheet had entirely melted from the region or during a temporary withdrawal of the ice front.

Compared with the younger Illinoian drift, the Kansan till is more bluish in color, where unweathered, and has a greater tendency to joint into cubical blocks when dry. It also contains a larger percentage of greenstone and limestone pebbles and fewer dolomite pebbles than are found in the upper or Illinoian drift in this region.

A count of the pebbles or different kinds of rock over one-third of an inch in diameter was made from the lower (Kansan) and upper (Illinoian) till at the exposure 1½ miles northwest of Cable, with the following results:

Kind of rock	*Number of pebbles* Kansan till	Illinoian till
Quartz	11	5
Greenstone	10	5
Quartzite	4	4
Diabase	18	17
Granite	11	20
Limestone ($CaCO_3$)	14	6
Dolomite	0	4
Chert	15	16
Sandstone (Pottsville)	3	5
Shale (Pennsylvanian)	1	2
Chert, oolitic	1	4
Red crystalline rock	3	2

The Kansan ice sheet probably covered all of this region, but in many places the material it left was probably incorporated in the later drift sheet.

YARMOUTH INTERGLACIAL STAGE

Exposures showing a soil and weathered zone that was developed on the surface of the Kansan drift during the long Yarmouth interglacial stage have been described in connection with the discussion of the Kansan till. Such a soil and weathered zone presents the most convincing evidence of the intervention of a long interglacial stage between the time of deposition of the two drift sheets which it separates. Many other records of wells in the quadrangles report a dark-colored clay, or soil, or carbonaceous bed beneath the Illinoian drift, but in most places this bed immediately overlies Pennsylvanian strata, and hence it can not be determined whether the soil or peaty zone was developed wholly during Yarmouth time, or whether it represents a much longer period of pre-Illinoian soil or humus development.

PRE-ILLINOIAN DEPOSITS

A thickness of 5 feet of clay or silt underlying the Illinoian drift was exposed for a distance of nearly 100 yards in grading the wagon road a few years ago a short distance south of the center of sec. 12, T. 17 N., R. 2 W. This clay was homogeneous, and not laminated, resembling loess in texture and appearance. It contained shells of several species of air-breathing gastropods similar to those that occur in the surface loess of this region.

A similar deposit containing the same and other species of fossils was found in other places in the quadrangles; viz., on Thirty-ninth Street in Rock Island, between Seventh and Eighth avenues; on Thirty-eighth Street between the same avenues; and in a well put down at the base of the bluff bordering Mississippi River 100 feet northeast of the crossing of Seventh Avenue and Thirty-fifth Street. In the bluff behind the well there is exposed a thickness of several feet of glacial till overlain by 40 feet of loess above the top of the curb. The log of this well is given below:

Log of well at the base of the bluff near Seventh Avenue and Thirty-fifth Street

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Till, yellow (probably Illinoian)	5	5
Muck, black, with wood fragments (Yarmouth soil zone)	1	6
Till, brown, leached for 2 or 3 feet	7	13
Till, blue (Kansan)	4	17
Silt, loess-like, ash colored, calcareous, with loess fossils	8	25
Muck, black	4	29
Clay, greenish, residual, with many pebbles of local rocks, but no igneous fragments	5	34
Pennsylvanian system—		
Shale	..	..

In the exposure of these beds on Thirty-eighth Street the upper layer was laminated, as if waterlaid, and the underlying loess-like clay also contained many shells of pulmonate gastropods.

Another such bed of loess-like silt underlying the till, and resting directly upon Pennsylvanian rocks, is exposed along a ravine near the west side of sec. 7, T. 17 N., R. 1 W., where the following section was made:

Section of strata exposed along the west side of sec. 7, T. 17 N., R. 1 W.

	Thickness *Feet*
Loess	45
Soil, black	2
Till, yellowish brown (Illinoian)	12
Loess-like silt containing loess fossils	several feet
Sandstone (Pennsylvanian)	..

A good outcrop of this lower, loess-like clay is found in the east bluff of Mississippi River, in the SW. ¼ sec. 31, T. 16 N., R. 5 W., a section of which is given below:

Section of strata exposed in the east bank of Mississippi River, sec. 31, T. 16 N., R. 5 W.

	Thickness *Feet*
Loess	25
Soil, black	2 to 3
Till, mostly bluish (Illinoian)	90
Loess-like clay, with many fossils	12

The species of fossils collected from the lower loess-like silt at the outcrop along Mississippi River were identified some years ago by Dr. Dall, and are listed below:

Helicina occulta Say (very abundant)
Helicodiscus lineatus Say
Limnaea humilis Say, var.
Pyramidula perspectiva Say
Pyramidula striatella Auth.
Pupa armifera Say
Strobilops labryinthica Say
Succinea avara Say (less abundant than in the surface loess)
Succinea luteola Gould
Vitrea arborea Say?

In texture and general appearance this lower loess-like silt closely resembles the surface loess, and was probably deposited by the wind in a similar manner. It is probably rather widely distributed beneath the oldest drift in Rock Island County, and like the surface loess it is probably thicker near the east bank of the river than at a considerable distance from the larger streams.

ILLINOIAN TILL

Except along the streams where it has been removed by post-Illinoian erosion, the Illinois till underlies the loess over almost the entire area of the

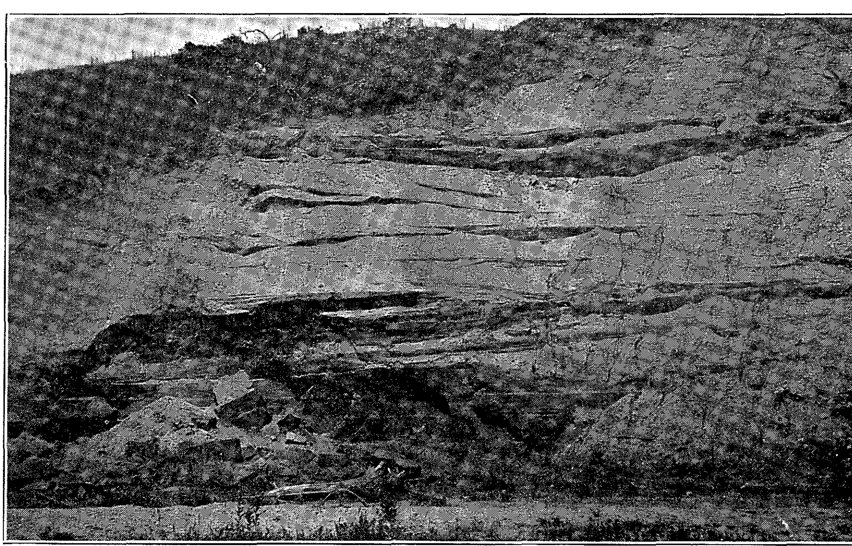

FIG. 26.—Fine-grained water-laid sand, 50 feet thick beneath a few feet of Illinoian till in the SW. ¼ sec. 8 of Eliza Township.

quadrangles. It is a bluish-gray till which weathers to yellowish gray and contains sufficient sand to make it crumble more readily than the older, Kansan till. The sand and clay making up the main body of the till were probably derived for the most part from local beds of shale and sandstone that had been rather deeply weathered before the glacier moved over the region. The coarser constituents of the Illinoian till consist in part of pebbles and boulders of crystalline rock transported from areas far to the north and northeast of the quadrangles, and in part of fragments of chert and limestone probably derived from Paleozoic limestones that outcrop in northern Illinois and southern Wisconsin.

The Illinoian drift is exposed in numerous places along the most of the larger streams of the area. It is thickest over the upland south of Mill

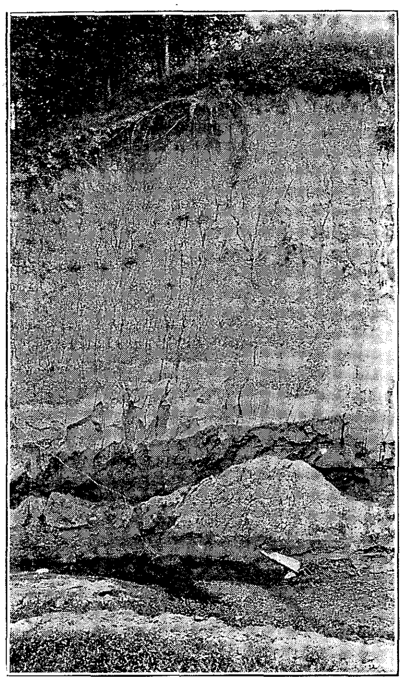

FIG. 27.—"Sea mud" or fine-grained sand underlying sand and gravel below Illinoian till in the NE. ¼ sec. 14, Elizabeth Township.

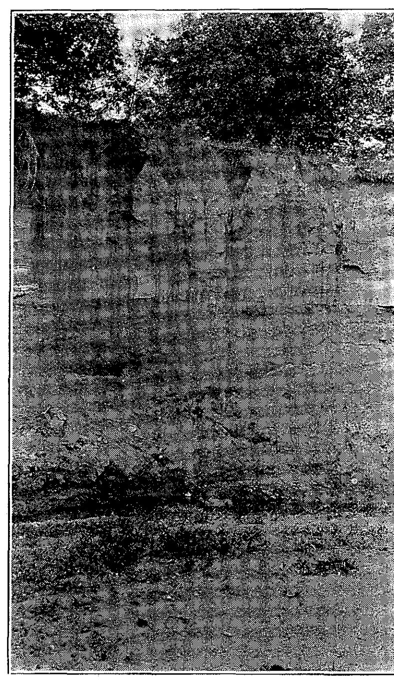

FIG. 28.—Sand and gravel below Illinoian till, exposed in the NW. ¼ sec. 26, T. 16 N., R. 5 W.

Creek and Copperas Creek in the Milan quadrangle, where many wells penetrate a thickness of 100 to 150 feet or more of Pleistocene deposits, the greater part of which is Illinoian till. The thickness is only slightly less on the upland south of Copperas Creek in the Edgington quadrangle and on the divide between this creek and the branches of Mississippi River, where many water wells pass through more than 100 feet of Pleistocene strata. The Quaternary deposits are in places 200 feet thick over the uplands in Eliza Township, in the southwest quarter of the Edgington quadrangle, but a greater thickness of loess and sand covers the hills in that region, and the bed of sand underlying the Illinoian till is also thicker there than over the greater part of the quadrangles, so that the thickness of the Illinoian till is probably less than on the areas mentioned. In many places a bed of fine-grained sand (figs. 26, 27, and 28), known by the well drillers as "sea mud," underlies the Illinoian till; and a bed of sand and gravel is often present immediately above this drift. Thin lenses of sand or gravel are also present at one or more levels within the Illinoian drift in this region.

The thickness and relations of the Illinoian till in different places in the quadrangles are shown in the logs of the following wells:

Log of well at the McDonald (No. 92) School, near the SE. cor. sec. 30, T. 16 N., R. 1 W.

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Loess, yellow	35	35
Till, dark blue, pebbly	95	130
Sand	9	139
Till, light blue	36	175
Sand, dirty	7	182

Log of well near SW. cor. sec. 2, T. 15 N., R. 3 W.

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Soil, black	4	4
Loess, yellowish	15	19
Clay, black, with wood fragments	2	21
Till, blue, pebbly	26	47
Sand	60	107

Log of well in NE. ¼ sec. 8, T. 15 N., R. 3 W.

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Soil and loess	18	18
Clay, black (muck or chip pile)	2	20
Till, blue, pebbly, with streaks of sand	30	50
Sandstone	2	52

Log of well in SE. ¼ sec. 28, T. 16 N., R. 4 W.

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Clay, yellowish	20	20
Clay, black, with wood fragments	4	24
Till, blue, pebbly (hard pan)	52	76
Sand	5+	81+

Illinoian till is exposed in many places along the streams in both the Milan and Edgington quadrangles. An exposure along the wagon road up the river hill south from Jimtown School, in the NE. ¼ sec. 5, T. 16 N., R. 5 W., shows the following succession of strata:

Section of strata exposed near Jimtown School

	Thickness Feet
Loess, yellow, fossiliferous	22
Till, pebbly, bluish gray	35
Shale, dark and gray	43

In the south bank of Copperas Creek in the NW. ¼ sec. 19, T. 16 N., R. 4 W., there is exposed a bed of sand and gravel within the Illinoian till. A section of the strata outcropping at this place is as follows:

Section of strata exposed in the NW. ¼ sec. 19, T. 16 N., R. 4 W.

	Thickness Feet
Loess, brown, sandy	5
Till, sandy, with small pebbles	8
Sand and gravel	4 to 5
Till, bluish gray, pebbly, and sandy	10

Farther south, in the southwest quarter of the Edgington quadrangle, a bed of sand several feet thick, which probably corresponds to the 4-to-5-foot sand and gravel bed of the last section, is exposed in many places beneath a few feet of Illinoian till. A typical section of such an outcrop is given below:

Section of Pleistocene strata exposed in the SE. ¼ sec. 18, T. 15 N., R. 5 W.

	Thickness Feet
Loess	7 to 9
Till, pebbly, bluish gray	10
Sand, irregularly stratified	35

In an exposure about three-eighths of a mile west of the one last described, a thickness of 53 feet of irregularly bedded sand is present below 6 to 9 feet of Illinoian till. Whether another bed of till underlies the sand in this region could not be determined.

Another outcrop of Pleistocene strata on a branch of Copperas Creek in the SE. ¼ sec. 17, T. 16 N., R. 5 W., shows the following succession of deposits:

Section of Pleistocene strata exposed in SE. ¼ sec. 17, T. 16 N., R. 5 W.

	Thickness Feet
4. Loess, brown	4
3. Till, sandy and gravelly, in some places rather distinctly sorted	8 to 11
2. Till, brown, pebbly	16
1. Till, darker than No. 2 above, and separated from it by a rather definite plane; to water level	4

The lower till in the last section may represent the Kansan, as the plane of contact of this bed with the overlying brown till is sharp and conspicuous. However, the evidence regarding the different age is not conclusive.

A bed of sand and gravel probably deposited as an outwash when the Illinoian ice sheet was melting from the region is in many places present above the Illinoian drift, and beneath the loess. A representative exposure of such a sand bed was seen on a branch of Eliza Creek, near the NE. corner of sec. 22, T. 15 N., R. 5 W., the relations of which are as follows:

Section of Pleistocene deposits exposed near the NE. cor. sec. 22, T. 15 N., R. 5 W.

	Thickness *Feet*
Loess, yellowish brown, fossiliferous	15
Sand and gravel, and boulders up to 6 inches in diameter	2½ to 4
Till, bluish, pebbly	11

A succession of strata similar to those described in the last section outcrops near the SE. corner sec. 20, T. 16 N., R. 5 W., as shown below:

Section of Pleistocene strata exposed in sec. 20, T. 16 N., R. 5 W.

	Thickness *Feet*
Loess	13
Sand and gravel in irregular layers	3 to 5
Till, bluish gray, sandy, with pebbles	19

In a few places in the quadrangles a thin bed of gravel that appears to have been concentrated by the removal of the finer constituents of the till is present at the top of the Illinoian drift and beneath the loess. An exposure of such a bed of concentrated gravel was seen in the SW. ¼ sec. 28, T. 16 N., R. 5 W., as shown below:

Section of Pleistocene strata exposed in the SW. ¼ sec. 28, T. 16 N., R. 5 W.

	Thickness *Feet*
Loess	1½
Gravel, apparently concentrated from the till	1
Till, bluish gray, with pebbles	26

SANGAMON SOIL ZONE

The Sangamon interglacial soil or peat horizon is represented in this region by a band of black carbonaceous clay containing many plant remains and wood fragments. This dark-colored band contains such a large amount of imperfectly decomposed vegetable material that it is often reported by the well drillers as a "brush pile" or "chip pile" or "manure pile." It was developed as a soil or peat horizon on the surface of the Illinoian till during the interglacial stage that intervened between the withdrawal of the Illinoian ice sheet and the deposition of the overlying loess. The relation of this Sangamon soil band to the Illinoian till is shown in some of the logs of wells given on the preceding pages to illustrate the stratigraphic relation of the Illinoian till. The Sangamon soil zone was reported in the logs of 61 wells in the quadrangles which are well distributed over the area. It lies immediately beneath the loess at depths ranging, with the varying thickness of the loess, from 12 to 30 feet.

A few additional logs of water wells in different parts of the quadrangles will show the character and distribution of the Sangamon soil in this area.

Log of well near middle of E. ½ sec. 12, T. 16 N., R. 5 W.

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Clay, yellow: loess	17	17
"Chip pile"	3	20
Clay, blue, pebbly (Illinoian till)	22	42

Log of well near middle of W. ½ sec. 36, T. 17 N., R. 4 W.

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Soil and yellowish clay (loess)	18	18
Clay, dark, with much plant debris (Sangamon soil)	2	20
Clay, bluish gray, pebbly (Illinoian till)	20	40

Log of well in SW. ¼ sec. 12, T. 15 N., R. 4 W.

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Soil and yellow clay (loess)	15	15
Clay, dark, with wood fragments (Sangamon soil)	3	18
Clay, bluish, pebbly (Illinoian till)	42	60
Sand white	..	..

Log of well in SW. ¼ sec. 2, T. 15 N., R. 3 W.

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Soil and clay	15	15
"Manure pile"	3	18
Clay, pebbly, blue	25	43
Sand	60	103

THE LOESS

Over all of the uplands in the Milan and Edgington quadrangles loess overlies the Illinoian drift and Sangamon soil to an average thickness of perhaps 25 feet. On the tops of the bluffs bordering the south and east sides of the larger streams the thickness in places reaches 40 or more feet. On Thirty-eighth Street, in Rock Island, it measures 40 feet. On the bluff at Black Hawk's Watch Tower, in the SE. ¼ sec. 14, T. 17 N., R. 2 W., the thickness is 55 feet. In the abandoned clay pit of the old National Clay Company, in the east bluff of the river, near Sears (fig. 29), the loess is 40 feet thick. In many places on the bluffs along the rivers the thickness exceeds 30 feet. At a distance from the rivers the thickness decreases, in many places being less than 20 feet.

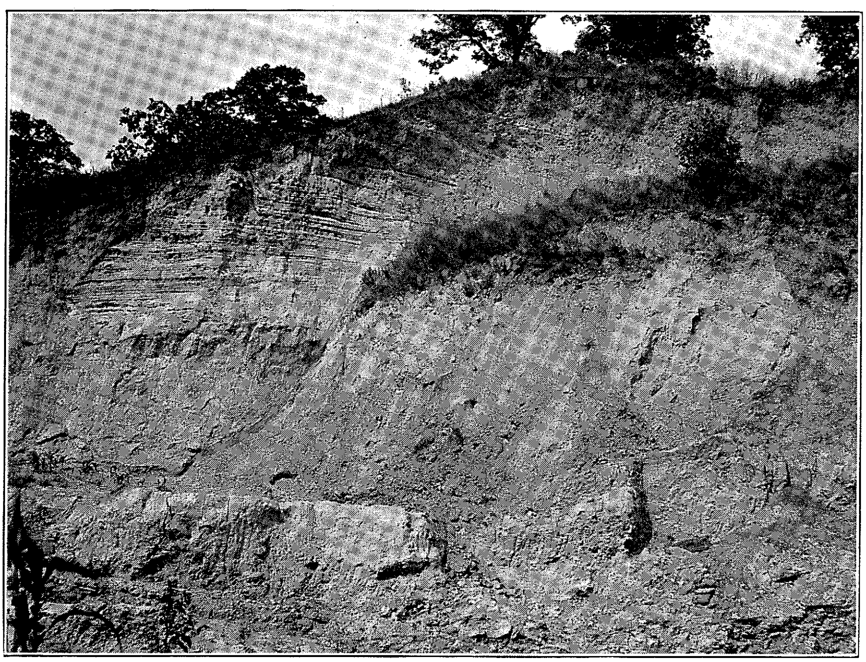

FIG. 29.—Bluff of loess in old clay pit of Blackhawk Manufacturing Company, at Sears, Illinois. The loess here is somewhat sandy, and on weathering shows laminations. The holes were made by bank swallows.

As shown in well sections and outcrops the loess in most places lies just beneath the surface soil, and consists of uniformly fine-grained, unstratified, dust-like material that contains a small amount of calcium carbonate. Where it has been cut by streams or excavations it stands for a long time in almost vertical banks. In many places, especially on the hill tops where the deposit is thick, it contains indiscriminately distributed shells of air-breathing gastropods.

The following species identified by Dr. Dall, of the United States National Museum, are among the common fossils that occur in the loess of this region:

List of fossils occurring commonly in the loess of the Milan and Edgington quadrangles

Helicina occulta Say
Succinea luteola Gld.
Succinea avara Say
Succinea obliqua Say
Polygyra pennsylvanica Green
Polygyra thyroides Say
Pupa alticola Ingersoll
Pupa pentadon Say
Pupa muscorum Linn
Pyramidula striatella Anthony

The color of the loess on the hills is yellow grading to brown or gray, but on the level prairies, where the dark surface soil is deeper, the underlying loess is more gray in color. The difference in the color of the loess on the hills and on the prairies is not thought to be due to any difference in origin, but to differences in the degree of leaching and alteration by the action of organic matter.

In the SW. ¼ sec. 36, T. 17 N., R. 3 W., a thickness of 22 feet of loess containing many loess fossils and calcareous concretions, or loess Kindchen, is exposed. An iron-stained band, one inch thick, is present near the middle of this exposure, above which the deposit is slightly more brown than that below it. The tops of the hills bordering Mississippi River in the vicinity of Illinois City and farther east, are capped with loess. Near the foot of the hill in the SW. ¼ sec. 31, T. 17 N., R. 4 W., a sandy loess containing loess fossils is exposed to a height of 12 feet, and a similar loess deposit covers the drift all the way up this hill in the NW. ¼ sec. 6, T. 16 N., R. 4 W. A thickness of 35 feet of loess overlies the till along the wagon road near the middle of the N. ½ sec. 2, T. 16 N., R. 5 W. Over the western part of the Edgington quadrangle, as elsewhere in this region, loess usually covers the slopes at least part way down where they are steep, and entirely to the bottom where they are moderately gentle, as well as the tops of the hills, and the uplands. It is in places underlain by a sandy bed of reddish-brown color, which overlies the drift. At the base of this sand bed springs issue in many places in the banks of the streams.

Topographic features of the loess.—Near the river the ravines are deep with steep sides which give the impression of youthfulness to the topography. This is due to the thick deposit of loess on the hills where it tends to stand in nearly perpendicular banks.

In places along the bluff-lines facing north and west the loess has a characteristic relief peculiar to itself. As the bluff is approached from the upland the surface slopes gently toward the river until about one-fourth mile from the bluff, where the slope becomes reversed as a result of the piling up of the loess on the tops of the hills bordering the valley. There is formed in this way a rim of thick loess along the bluff behind which there may occur a shallow, poorly drained depression. Such a feature is conspicuous in the southeast part of Rock Island, and in the bluffs forming the south bank of Mississippi River for some distance east and west of Andalusia.

Another topographic feature of this deposit is the low, loess-covered margin of the uplands about a mile south of Milan, where there is an area about a mile long and a half a mile wide that is noticeably lower than the adjacent portion of the marginal upland. The loess that covers this lower area is somewhat coarser than the typical loess, and is in places obscurely stratified. A similar deposit occurs in the basal part of the loess on Seventh Avenue near Thirty-fifth Street, where it grades horizontally into typical loess.

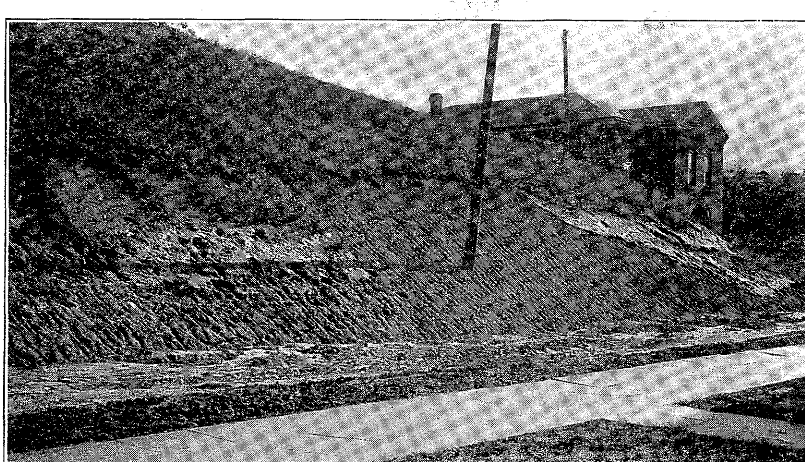

FIG. 30.—Faults in the Pleistocene deposits near Augustana College in Rock Island. Three blocks are seen separated by two sharply marked vertical faults. The boulder clay can be distinguished from the overlying loess by the small parallel rills in the surface of the former. The nearest block has settled most. In it the base of the loess lies below the shadow of the telephone pole. In the middle block its base is covered by a growth of grass. The farther block has settled unequally so that the base of the loess is slanting.

Miscellaneous features of the loess.—Two other uncommon features occur in the loess in this area. In some places the lower part of the loess deposit is crumpled into small flexures about one foot in height and width, and in other places it is intricately faulted in such a manner as to indicate that the deposit was frozen when the faulting occurred, as shown in figures 30 and 31. The larger of these faults extend downward into the underlying till, and some of the fissures have been enlarged and filled with water-laid sand.

The basal part of the loess shows considerable variation in physical characteristics. In many places there is a gradual change from a leached till below to a humus-filled loess or clay (Sangamon soil) above, in which fossil wood is common, and bones and teeth of elephants are occasionally found.

A carpal bone and part of a tooth of an elephant were found in such a deposit in the bluff near Twentieth Street, in Rock Island, and a piece of a tusk was found in the base of the loess at Sears. In other places the till changes upward into a ferruginous red zone which is overlain

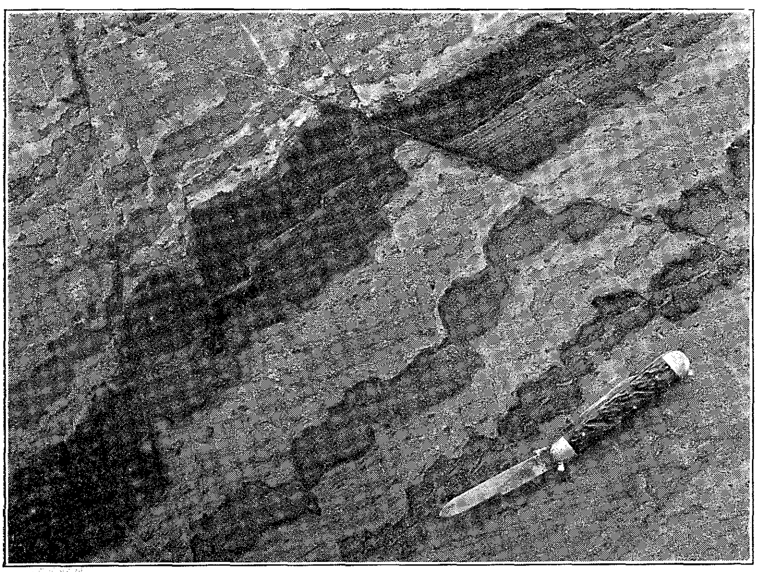

FIG. 31.—Small faults in the loess, in Rock Island.

by normal upland loess. In a few places there is an abrupt change from fresh, unleached till to typical loess above, the contact being sharply marked. An exposure of such a contact was seen in the south bluff of Rock River on the east side of the new wagon road that follows the east boundary of the Milan quadrangle. On the west side of the road at this place a thickness of 3 feet of gravel intervened between the loess and the till.

The geographic relation of the main deposit of loess in the upper Mississippi valley to the border of the area covered by the Iowan ice sheet; its stratigraphic position beneath the Wisconsin drift, and above the Illinoian and older drifts from which it is in many places separated by a leached zone, peat, or soil bed, and by an erosional unconformity representing a long period; and the presence in the loess of fossil shells of air-breathing gastropods that lived under climatic conditions similar to those prevailing in the region today make it probable that conditions peculiarly favorable for the accumulation of loess occurred during the melting and for some time after the disappearance of the Iowan ice sheet. A small amount of loess overlies the Wisconsin drift in Illinois, and dust deposits somewhat resembling loess are now being formed. It is probable that a part of the original main deposit of loess has been shifted and reworked and that other dust has accumulated since the Peorian interglacial stage, but the total amount of such material is comparatively small.

There seems no doubt that the loess in this region, as elsewhere in the Mississippi valley, was deposited by the wind. This is shown by the following facts: (1) The deposit does not tend to level the inequalities of the surface, but mantles hills, prairies, and lowlands alike. (2) It is conspicuously thickest, and somewhat coarser in texture, on the tops of the hills bordering the south and east sides of the larger streams in places where the prevailing westerly winds, after following the stream valley for some distance, would be obstructed by the opposing banks, and compelled to drop a large part of their load as a result of their reduced velocity. (3) The loess differs from ordinary water-laid clay in the general absence of stratification. (4) It contains shells of air-breathing gastropods which, though exceedingly fragile, are commonly unbroken.

TERRACE DEPOSITS

In places along Mississippi and Rock rivers there are small terrace areas that are remnants of an alluvial filling in the valleys of these streams deposited during the stage of Wisconsin glaciation. The upper surface of the terraces lies 20 to 30 feet higher than the level of adjacent flood plains of the streams. The largest of these terrace areas is between one-fourth and one-half mile wide, and extends almost continuously near the east bank of Mississippi River from Twenty-eighth Street in Rock Island south as far as Sears. The material in this terrace consists mostly of sand, with some gravel, which is covered by a thin veneer of loess or silt. Sand and gravel pits were once extensively worked in this terrace deposit in the south part of Rock Island. Some sand and gravel in the south bank of the Government reservation above the west end of the power dam probably belongs also to this terrace deposit. The hill at Mount View School on the flood plain of Rock River in the N. ½ secs. 20 and 21, T. 17 N., R. 1 W., is a remnant of such a terrace that has been protected from destruction by the river by an outlier of Devonian limestone at the east end. Some of the terrace sand at this place has been blown into small dunes.

In several places where creeks emerge on the alluvial plains of the rivers there are some remnants of deposits evidently formed in backwater in the valleys of the small tributaries. Such a small terrace fragment is present in the valley of Mill Creek one-half mile south of the river bluff, and in the west bank of Warren Creek, a short distance southeast of the center of sec. 29, T. 17 N., R. 2 W. A section of the backwater deposits at this place is as follows:

Section of terrace deposits at mouth of Warren Creek

	Thickness	
	Ft.	*In.*
Loess	1	6
Joint clay, dirty brown	2	..
Silt, yellow, moderately fine	3	..
Silt, yellowish gray, laminated	4	..
Silt, red	1	4
Silt, dark gray, irregularly laminated	..	8
Silt, pink and gray	..	8
Silt, gray, not distinctly laminated	3	6
Sand and gravel, yellow	3	..
Concealed by talus	8	..

A red and yellow silt similar to that exposed on Warren Creek outcrops under the railroad bridge over Turkey Hollow, in section 30 of the same township. At the latter place a part of the old terrace has been cut away by the present stream, the more recent alluvium overlying the terrace deposits unconformably. On the west side of a creek cutting the Mississippi bluffs in the NE. ¼ sec. 26, T. 17 N., R. 3 W., there occurs a terrace remnant several acres in extent, and a few small patches were noted in other places as indicated on the accompanying geological map of the quadrangles.

RECENT SERIES

ALLUVIUM

Deposits of alluvium are present along most of the streams in the quadrangles, the most extensive being along the valleys of Mississippi and Rock rivers. Smaller areas of alluvium border the channels of Edwards River and Mill, Copperas, Camp, and Eliza creeks, and the lower courses of smaller streams.

The thickness of the alluvial deposits is relatively thin, being less than 20 feet over the greater part of the bottom lands of this region, including those of the rivers. In one place, however, a short distance north of the southwest corner of the Edgington quadrangle, a water well was reported to have penetrated a thickness of 120 feet of alluvial sand and gravel without reaching bed rock, and a test boring put down on the flood plain of

Copperas Creek in the SE. 1/4 sec. 16, T. 16 N., R. 4 W., passed through a thickness of 68 feet of unconsolidated surficial deposits above the Pennsylvanian rocks. A well on the flood plain of Rock River, in the NE. 1/4 sec. 20, T. 17 N., R. 1 W., passed through 42 feet of sand and clay, and another well near the edge of the flood plain in the NE. 1/4 sec. 30, of the same township penetrated 47 feet of alluvial material. The deposit in many places consists of sand and small pebbles, as near the SW. corner of sec. 22, T. 17 N., R. 2 W., where it is worked on quite a large scale for gravel. In other places, as along Edwards River, silt and clay are the principal constituents. While the greater part of the material of the flood plain deposits was laid down by the main streams that occupy the valleys and is fairly well sorted, on the margins of the valleys near the foot of the bluffs a considerable amount of poorly sorted talus, sheet wash, and alluvial-fan material is mixed with the alluvium where this valley plain rises in a short slope to the bluffs.

DUNE SAND

Although considerable sand is present in places over the flood plains of Mississippi and Rock rivers, in only a few localities has the sand been shifted by the wind to any important extent, and deposited in hills or dunes. A few small hills have been formed on the surface of the terrace on which Mound View School is located, in secs. 20 and 21, T. 17 N., R. 1 W., and in a few places on the Mississippi River flood plain in secs. 31 and 32, T. 17 N., R. 5 W. Sand or sandy loess caps several of the hills that border the east side of the valley of Mississippi River near the west side of the Edgington quadrangle, as in secs. 18, 19, 30, and 32, T. 15 N., R. 5 W., and in secs. 8, 18, 19, and 30, T. 16 N., R. 5 W. In sec. 8 of the latter township there are a number of small ponds surrounded by hills of sandy material. These ponds have not yet developed outlets, probably because the water readily soaks out through the porous sand that forms the higher parts of their banks.

STRUCTURE OF THE PALEOZOIC ROCKS

In the Milan and Edgington quadrangles the layers of rock are not quite horizontal, but in general they slope toward the south at the rate of a few feet to the mile. In an east-west direction the dip of the strata is more irregular and undulating; in some places the slope is toward the west, and in other places the direction of dip is eastward.

Structure of Pre-Pennsylvanian Rocks

The structure or dip of the Silurian and Devonian rocks appears to be somewhat different from that of the Pennsylvanian strata in this region. These older rocks dip in general toward the southwest at the average rate of about 9 feet per mile, as shown by the following observations:

In George Gray's well, one-fourth mile north of the southeast corner of sec. 10, T. 15 N., R. 3 W., the main water-bearing stratum of the Niagaran limestone lies about 332 feet above sea level, and in the well at Augustana College, about 14 miles north and 7 miles east of the former well, the corresponding horizon was reached at an altitude of 485 feet.

The southward descent of the Devonian rocks near the east border of the Milan quadrangle between Mississippi and Rock rivers is nearly 10 feet to the mile; but there is a rise of these rocks in the next 3 miles farther south. In the vicinity of Cable, near the southeast corner of the Milan quadrangle, the elevation of the top of the Devonian is about 513 feet above the sea. If the upper surface of the Devonian at Cable is the same horizon as that of the top of the Devonian exposed along Mississippi River, 15 miles farther north, a general southward dip of these strata at an average rate of only 3 feet per mile is indicated between Cable and Mississippi River.

In an east-west direction along Mississippi River the Devonian limestone dips toward the west across the Milan quadrangle, as shown by the fact that the top of the unfossiliferous Devonian limestone along Sylvan channel is about 580 feet above the sea level, while a short distance below Andalusia, 12 miles farther west, the altitude of this horizon of the Devonian is about 535 feet, making the average westward dip between these places about 4 feet to the mile. Six miles still farther west, in the SE. 1/4 sec. 17, T. 17 N., R. 1 E., the corresponding level of the Devonian limestone occurs at an altitude of 585 feet, indicating a rise of the Devonian between these points of 50 feet, or about 8 feet to the mile. The elevation of the same rocks in the north bank of Rock River at the east border of the Milan quadrangle is about 545 feet, which is only 10 feet higher than 12 miles farther west, and about 40 feet lower than 18 miles farther west.

Near the south end of the quadrangles the dip of the Devonian strata is in general quite similar to that along Mississippi River farther north. A well near the middle of the east side of sec. 33, T. 15 N., R. 5 W., was reported to have reached the top of a thick limestone, which was probably Devonian, immediately beneath a bed of sand and gravel at an elevation about 445 feet above sea level. If the horizon of the top of the Devonian at this place corresponds with that of the top of the Devonian in the George Gray well 13 miles farther east, where the altitude is 457 feet, a westward dip of about one foot per mile is indicated between these places. Between the George Gray well and Cable, a distance of 10 miles, the top of the Devonian declines toward the west 56 feet, or about 5½ feet to the mile. Between the locality in the Edgington quadrangle in sec. 33, T. 15 N., R. 5 W., and the SE. 1/4 sec. 20, T. 17 N., R. 1 E., a distance of about 16 miles, the southward slope of the top of the Devonian is 163 feet, or about 10 feet to the mile.

On this general dip some minor flexures are imposed. One of these, known from outcrops and well records, consists of an uplift or anticline 20 to 30 feet in height, exposed in the bed and banks of Mill Creek near the center of sec. 25, T. 17 N., R. 2 W., where for a short distance the unfossiliferous member (No. 2) of the general Devonian section rises in the left bank 5 feet above the bed of the creek. A short distance farther north this horizon of the Devonian suddenly disappears, and the overlying member, No. 3, of the general section is exposed in the banks of the creek for about one-fourth mile farther north, where these strata also disappear beneath the bed of the creek. A slight northward dip continues to Vandruff Island, where member No. 2 of the general Devonian section lies about at the level of low water in Rock River. The arch or uplift exposed along Mill Creek is also clearly indicated in the deep well at Milan, where the base of the Maquoketa lies 30 feet higher than it does in the wells in Rock Island 3 to 4 miles farther north. Member No. 2 of the Devonian general section is exposed near Oakdale, in the SE. ¼ sec. 18, T. 17 N., R. 3 E., a few feet above its normal altitude in this area, which suggests that the anticline indicated along Mill Creek and in the Milan well may continue through Oakdale about 20 rods north of the wagon bridge over the creek in the NE. ¼ sec. 27, T. 17 N., R. 3 W. A low anticline about 50 feet in width is exposed in the banks of a creek, and a short distance farther north a shallow syncline also crosses this stream. The axis of the anticline and syncline trends northwest-southeast in a direction nearly parallel with that of the uplift indicated at Milan and Oakdale.

The general southwestward tilting of the pre-Pennsylvanian rocks was not entirely accomplished before the Pennsylvanian rocks were deposited, for the latter strata are slightly affected by this movement. The elevation of the Herrin (No. 6) coal is usually lower in the localities where it outcrops a short distance east of the middle of the south side of the Edgington quadrangle, than that of the coal 17 miles farther east in the vicinity of Cable.

Structure of the Pennsylvanian Rocks

In the north and south parts of the quadrangles wherever the Herrin (No. 6) coal bed is present, the structure of the Pennsylvanian rocks can be determined fairly accurately by using this coal as the key horizon.

In the Edgington quadrangle the coal beds show a very slight southward dip between the places noted below: In the SE. ¼ sec. 20, T. 77 N., R. 1 E., the Herrin coal outcrops at an elevation of 658 feet. About 7 miles farther south, in the SE. ¼ sec. 21, T. 16 N., R. 4 W., the altitude of the coal is 654 feet. Seven miles still farther south, in the SE. ¼ sec. 28, T. 15 N., R. 4 W., the altitude of the Herrin coal is 650 feet. In the Milan quadrangle the lay of this coal bed is more irregular, and undulating, but the general southward dip is also slight. Near the middle of the north line of sec. 32, T. 17 N., R. 1 W., the altitude of the Rock Island (?) coal is about 654 feet. Seven miles farther south near the NW. corner of sec. 4, T. 15 N., R. 1 W., the elevation of this bed is 629 feet. Four miles farther south, in the NE. 1/4 sec. 29, T. 15 N., R. 1 W., the coal has risen again to 650 feet in altitude.

In an east-west direction the Rock Island (?) coal bed lies at an elevation of 658 feet in the SE. 1/4 sec. 20, T. 77 N., R. 1 E., while 7 miles farther east, in the NW. 1/4 sec. 16, T. 77 N., R. 2 E., the altitude of this bed is 660 feet, and about 13 miles farther east, at Coal Valley, the altitude is 648 feet. Near the south end of the quadrangles the Herrin coal outcrops on the SE. 1/4 sec. 28, T. 15 N., R. 4 W., at an altitude of 650 feet. Three miles farther east, near the middle of the east side of sec. 24 of the same township, it has risen to 674 feet. Ten miles farther east, in the vicinity of Matherville, the altitude has decreased to 650 feet above sea level. While the general dip of this coal in any direction is slight, local dips of 25 feet in short distances are found. In mine No. 3 of the Coal Valley Mining Company at Matherville the Herrin coal lies at an elevation of about 630 feet, while about one mile southwest of this place near the middle of sec. 33, T. 15 N., R. 2 W., this coal outcrops at an altitude of about 650 feet. Another place where the altitude of the Rock Island (?) coal is low is in the shaft of mine No. 2 of the Coal Valley Mining Company at Sherrard, where it lies at an elevation of 612 feet, while at Cable about 3 miles farther south its altitude is 654 feet. In a test boring in the town of Cable the altitude of the Rock Island (?) coal is reported 30 feet higher than its elevation in an old coal shaft only 14 rods farther northeast. Whether this abrupt change in elevation is due to a fault or a steep dip could not be determined. In the coal mine at Sherrard the coal is undulating, a difference in altitude of 12 feet or more between the crests and troughs being common. The coal is usually thicker in the troughs, and thinner on the crests of these rolls. In mine No. 7 of the Alden Coal Company, the coal thins out in the east, north, and west directions, but maintains its thickness toward the south, as in the Sherrard mine. The main dip of this coal is toward the south and east.

Some of the minor local changes in the altitude of this coal are doubtless due to slight folding, but some of the irregularities are probably also due to the inequalities of the surface on which the vegetable matter that formed the coal bed accumulated, and to the unequal thickness of the vegetable matter of this bed from place to place, permitting unequal shrinkage when this vegetable matter was transformed into coal. The No. 1 and No. 6 coals are probably absent over the larger part of the middle portion of the Milan quadrangle, and over all but a very narrow belt one to two miles east of the central part and in the southeast corner of the Edgington quadrangle. On this account no attempt has been made to show the structure of the Pennsylvanian rocks in the quadrangles in this limited area by means of contours on the coals, but the altitude of the coal is shown by figures at the different localities in the area where it has been found in outcrops, shafts, or borings.

GEOLOGIC HISTORY

Imperfection of the Record

A considerable part of the geologic history of these quadrangles from the beginning of the Paleozoic era to the present can now be deciphered from the rocks exposed at the surface or encountered in borings in this region. The succession of events from the beginning of the Paleozoic era to the end of the Pennsylvanian epoch can be sketched in a broad way from the records preserved in the ancient rocks of this and adjacent areas. The times of submergence, the sources of the invading seas, and the general topography of the region during the times of emergence can be described with a good degree of assurance. The history of Mesozoic and Tertiary time has not been preserved in sedimentary deposits in this immediate region, but can be inferred from what is known of the events of this time in other parts of the continent, where such deposits have been studied. The record of many of the principal events of the Quaternary period has also been preserved in the quadrangles in legible form. Many other facts in the geologic history of the quadrangles can be safely inferred from the results of studies in other areas in this general region, for the processes that operated in the quadrangles affected also an extensive province around them.

During the Paleozoic era the surface of Illinois was intermittently submerged by an epicontinental sea, the shores of which migrated widely and almost continuously, though the rate at which they shifted varied greatly from time to time. Since Paleozoic time this surface, with the exception of a small area in the southern part of the State, has been continuously above sea level, and subjected to the agents of erosion which are constantly acting upon the lands.

Paleozoic Era

CAMBRIAN PERIOD

At the beginning of Paleozoic time the surface of Illinois had probably been above the sea for a long time, and had been worn by erosion to a nearly level plain. This planed, almost level, surface of Algonkian rocks doubtless forms the floor beneath the Paleozoic strata over the entire State, and extends far beyond its borders on every side. During the latter part of the Cambrian period a sea advanced from the southwest over this region, and deposited the sand, clay, and calcareous material that make up the sandstones, shale, and limestone of the upper Cambrian or Croixan (Potsdam) series in the Mississippi Valley. Of these sediments sandstones predominate, the entire series having a known thickness of 868 or more feet. A few deep borings in the State have penetrated these upper Cambrian rocks to a depth of 1,100 feet without reaching the top of the Algonkian.

ORDOVICIAN PERIOD

The sediments deposited in this region during Ordovician time consist mainly of limestone and dolomite, but at certain times important deposits of sand and mud accumulated over extensive areas. The oldest division of this system is the Prairie du Chien limestone or dolomite, which was accumulated in rather clear seas and has a thickness in the quadrangles of 668 to 811 feet. After a break in sedimentation this limestone deposition was followed by the St. Peter sandstone, which doubtless also underlies the entire State except in a few small patches where it has been removed by erosion. Its thickness in this area ranges from 50 to 204 feet. Above the St. Peter sandstone were deposited in this area the Platteville and Galena limestones, 320 to 370 feet thick, after which a withdrawal of the sea put a stop to deposition. During the next submergence this region, like the greater portion of Illinois, received deposits of mud, sand, and limy sediment which now compose the shales, sandstones, and shaly limestones of the Maquoketa formation. The average thickness of this formation in deep wells in the area was 204 feet.

SILURIAN PERIOD

This region was land during early Silurian time, but in middle Silurian time the area comprised in the Edgington and Milan quadrangles was covered by a clear sea, and received calcareous deposits known as the Niagaran limestone or dolomite, which ranges in thickness from 215 to 375 feet.

DEVONIAN PERIOD

After a long emergence the sediments that accumulated above the Niagaran in this region consist of limestones, of late middle Devonian age, which have a thickness in the quadrangles of about 140 feet. This was followed in Upper Devonian time by the widespread deposition of dark mud containing great numbers of fossil spores, of lycopodaceous plants. This is known as the Sweetland Creek shale formation, which was probably laid down over almost the entire State. It is well exposed along Sweetland Creek, in Iowa, in the northwest quarter of the Edgington quadrangle, and has been identified in well borings in many places in Illinois.

MISSISSIPPIAN PERIOD

This region was a land surface between the deposition of the upper Devonian strata and the lowermost Mississippian. During the Mississippian epoch the southern part of the Mississippi valley was extensively submerged.

Although no rocks belonging to this epoch have been found in place in the quadrangles, yet fragments of chert occurring in the basal conglomerate of the Pennsylvanian system contained molds and casts of fossils characteristic of early or middle Mississippian rocks, indicating that more or less of these strata were originally deposited over the area.

PENNSYLVANIAN PERIOD

POTTSVILLE TIME

For a long time after the middle Mississippian submergence this region was a land surface which became much trenched by erosion channels and developed considerable relief before the Pennsylvanian sea invaded the region. Upon this unevenly eroded surface the early Pennsylvanian rocks were laid down when the sea next covered the area. Slight warping preceded the invasion of the Pennsylvanian sea which transgressed older formations over extensive areas in the northern part of the Mississippi valley. In early Pennsylvanian time sedimentation was restricted to a rather narrow area in the Eastern Interior coal field of Illinois and northwestern Kentucky. As a result of further warping movements and erosion the sea was permitted to gradually spread northward, and extend farther eastward and westward. In this gradually enlarging basin were accumulated the sand and mud and limy clay which now make up the sandstone, shale, and impure limestone of the Pottsville formation. Layers of vegetal material interbedded with the other sediments indicate the existence of marshes at different times. The vegetal material that accumulated in these marshes now forms irregular layers or lenses of coal, ranging from thin films to beds which locally reach a thickness of 3 to 5 feet. The seas that from time to time covered this area during the Pottsville epoch were so shallow that some of the higher places were probably not entirely covered during the time of submergence, and a slight lowering of the strand line resulted in the emergence of the higher areas. Hence deposition was not uniform over this region, and frequent changes in the character of the sediment and local erosional unconformities occur within the Pottsville beds.

CARBONDALE AND MCLEANSBORO TIME

During the Carbondale and McLeansboro epochs this immediate area remained above the sea a large part of the time. However, in late Carbondale time a marsh in which the vegetal material accumulated that later became the Herrin coal, existed in places over the area; and during early McLeansboro time there was a great transgression of the sea, permitting the deposition of the limestone containing *Girtyina*, and higher strata.

POST-PENNSYLVANIAN DEFORMATION

Deposition of Pennsylvanian time was closed by widespread movements which resulted in the uplift of the Appalachian Mountains in the east and the Ouachita and Ozark Mountains to the southwest, and the further uplift of the La Salle anticline in Illinois. Attending these larger movements there were formed also the faults and minor folds that affect the Pennsylvanian rocks in different parts of the State. These movements permanently banished the sea from the region.

The rocks of the Edgington and Milan quadrangles were not greatly disturbed by these deformations, no faults having been found in the area, and the tilting and slight flexing of the strata that occurred at that time are so gentle that they are scarcely distinguishable from original irregularies of deposition. The general altitude of the surface was probably considerably increased, the region being elevated from near sea level to a position a few hundred feet above it.

Mesozoic Era

After the elevation and deformation that occurred near the close of the Pennsylvanian period, the areas that had received deposits of sediment at different times during the Paleozoic era were subjected for a very long time to continuous denudation. Erosion has progressed almost without interruption from that time to the present, although at different times it has been accelerated by slight uplifts, and at others it was probably retarded by a more or less close approach to peneplanation.

Cenozoic Era

TERTIARY PERIOD

Some time before the close of the Tertiary period the surface of the greater part of Illinois and adjacent regions had been reduced to a nearly level plain, as shown by the fact that the surface beneath the Quaternary deposits is quite level except where narrow valleys were cut in late Tertiary and early Quaternary time.

Near the end of the Tertiary period there occurred a general uplift of the land which quickened erosion and caused the streams to deepen their valleys. Well borings show that many such rock valleys 100 to 200 feet deep, now filled with drift, occur in Illinois, and a few such buried valleys have been found in the Milan and Edgington quadrangles. The valley of Mississippi River, near the southwest corner of the Edgington quadrangle, was cut at least 120 feet below the level of the present flood plain, and the valley of Copperas Creek, in the NE. ¼ sec. 16, T. 16 N., R. 4 W., was about 65 feet below its present level.

The maximum relief of the preglacial surface was at least 234 feet, but except in the deepest valleys it did not exceed 80 or 90 feet.

QUATERNARY PERIOD

PLEISTOCENE EPOCH

At the beginning of the Quaternary period, the surface of the Milan and Edgington quadrangles was much like the present surface, but different from it in one important particular. The topographic features of that time had been developed solely by erosion, whereas those of the present surface were in part produced by deposition of drift, and in part by the subsequent erosion of these deposits by the present streams.

Kansan time.—Relatively early in the Pleistocene epoch, during the Kansan stage of glaciation, an ice sheet developed at the north and spread broadly over the upper Mississippi basin, invading western Illinois from the Iowa side. After a long period of glacial occupation the ice melted away, leaving a thick mantle of clay, sand, pebbles, and boulders over the area it had covered.

Yarmouth time.—A change of climate from some cause or causes resulted in the melting of the Kansan ice sheet, which was followed by a long interval during which the climate did not greatly differ from that prevailing in the region today. During this interglacial stage, known as the Yarmouth, the surface of the Kansan till was covered with vegetation, and after a long time a soil was developed in the upper part of the till, and the glacial deposits suffered considerable alteration and erosion.

Illinoian time.—The next event of importance was the advance over the region of the Illinoian ice sheet which came from the northeast, centering in Labrador. As it moved forward it gathered up much of the material left by the Kansan ice sheet and mixed it with other debris brought from the north. In some places, however, it overrode without greatly disturbing the older drift, or even the soil which had developed upon it, but buried it just as it was. When the Illinoian glacier melted it left over the surface a thick bed of till which completely buried the hills and valleys developed by the streams during Yarmouth time, leaving the surface more nearly level than before.

Sangamon time.—Upon the surface of the nearly level drift plain left by the Illinoian glacier, new drainage lines were gradually developed, and over the more level areas the organic matter from successive generations of plants accumulated to such an extent as to form a carbonaceous soil (the Sangamon soil) which was in places peaty and contained large amounts of undecomposed plant remains. Percolating ground water leached and otherwise weathered the upper few feet of the underlying till. On the slopes where erosion was active, organic matter was not allowed to accumulate, but there was developed in places a thin bed of gravel which was concentrated at the surface by the removal by sheet wash and erosion of the fine constituents of the till.

Iowan and Peorian time.—The invasion of the Iowan glacier was not recorded by deposits of till in this immediate area. However, after the development of the present stream channels and the weathering of the upper portion of the till were well advanced, conditions arose in late Iowan and early Peorian time which favored the accumulation of extensive deposits of dust. This dust or loess was spread over the surface of the Illinoian drift sheet, covering the Sangamon soil and peat, the concentrated gravels, and over the leached and eroded surface of the Illinoian till where the soil, peat, and gravel were absent. Later, dust transportation diminished, and the erosive processes again became dominant. The carving of valleys continued without interruption until the Wisconsin time, when they had reached almost their present forms.

Wisconsin time.—After the close of the Peorian interglacial time, ice of the Wisconsin stage invaded northern and eastern Illinois and spread westward to a position within 50 miles of the area under discussion. The headwaters of Rock River and of other tributaries of the Mississippi in this region were covered by the Wisconsin ice sheet. The water liberated from the melting ice and loaded with glacial debris, followed these stream valleys westward from the ice sheet, depositing in their channels, and along the Mississippi into which they discharged, large quantities of sand and gravel. After the Wisconsin glacier melted from the region, the streams, in adjusting their channels to the reduced volume and load, cut down into the coarse materials they had recently deposited, and developed flood plains at lower levels. The greater part of this old filling has been removed, but in a few places patches of this material have escaped erosion and stand several feet above the level of the present flood plains as remnants of terraces, which indicate the height to which the stream valleys had been filled.

RECENT EPOCH

In the Recent epoch the altitude of this region is not known to have changed in any important way. The principal event has been the removal of a part of the material deposited during the Pleistocene epoch. During this time the streams have been widening their valleys and forming broader flood plains.

MINERAL RESOURCES

The principal mineral resources of the Milan and Edgington quadrangles comprise coal, shale and clay, limestone, sand and gravel, and water. To these may be added the soil which is the chief source of wealth in the area.

Coal

The Milan and Edgington quadrangles lie near the northwest corner of the eastern interior coal basin (fig. 13), and in the part of this basin where the Rock Island and Herrin coals, exist only in patches.

COALS OTHER THAN THE ROCK ISLAND AND HERRIN BEDS

In many places two or more coal beds besides the Rock Island and Herrin coals are known to be present in this area. These coals are thin, usually ranging from a few to 18 inches thick, and in only a few places is the thickness of one or more of them known to reach 24 to 30 inches. The distribution of these coals is as irregular as their thickness, some of them being absent and others present in different outcrops and test borings less than one mile distant from each other.

One of the thicker of these coals occurs near the base of the Pennsylvanian, but it is not persistent at this horizon. In the abandoned clay pit of the National Clay Company, at Sears, a coal 2 feet thick occurs about 5 feet above the Devonian limestone. In the log of a test boring in the SE. cor. SW. 1/4 SE. 1/4 sec. 28, T. 16 N., R. 4 W., a coal bed 19 inches thick is reported 17 feet above the Devonian limestone at an elevation of 569 feet, and another boring one-half mile farther northwest found a coal 29 inches thick 12 feet above the top of the Devonian, at an altitude of 550 feet. In a boring one-half mile east of the one last mentioned a coal 21 inches thick was found 35 feet above the Devonian limestone at an elevation of 510 feet. Another coal, reported 38 inches thick, occurs 14 feet higher, at an altitude of 524 feet. In another boring one-half mile south of the last, a coal 18 inches thick was reported 17 feet above the Devonian at an altitude of 490 feet; another coal, 8 inches thick, occurs about 61 feet higher, and a third bed 25 inches thick, is reported 50 feet still higher, at an elevation of 603 feet.

The following data on the coals penetrated in four test borings around the border of a single quarter section of land will illustrate the very variable distribution and thickness of these coals:

In the log of a boring on the NW. cor NW. 1/4 SE. 1/4 sec. 28, T. 16 N., R. 4 W., a coal 29 inches thick was reported about 14 feet above the Devonian limestone at an altitude of 549 feet; another coal 26 inches thick was found at an elevation of 645 feet; another 11-inch bed occurred at an altitude of 655 feet; and another 8-inch coal was present at 679 feet. Another boring one-half mile east and one-fourth mile south of the last, passed through a coal 21 inches thick, lying 35 feet above the Devonian, at an altitude of 509 feet; another bed 38 inches thick at 526 feet altitude; a 4-inch coal at 542 feet altitude; a 20-inch bed at 634 feet altitude; and a 6-inch coal at an elevation of 650 feet above sea level. A boring one-fourth mile south of the last passed through 18 inches of impure coal 17 feet above the Devonian, at an elevation of 489 feet; an 8-inch bed at 550 feet altitude; a 25-inch coal at an elevation of 603 feet; a 6-inch coal at 622 feet altitude; and a 5-inch coal at 647 feet elevation. A fourth boring one-fourth mile west of the last found 19 inches of coal above the Devonian, at an elevation of 569 feet, and an 8-inch coal at an elevation of 650 feet.

These variations are shown in the accompanying columnar sections (fig. 32).

As indicated above, it is not probable that any of these thin coals are peristent over very large areas, and the thicker beds appear to be somewhat more restricted in distribution than the thinner ones. In a few places near, or at, their outcrop in the banks of the tributaries south of Mississippi River, one or another of these coals has been worked on a small scale, by drifts

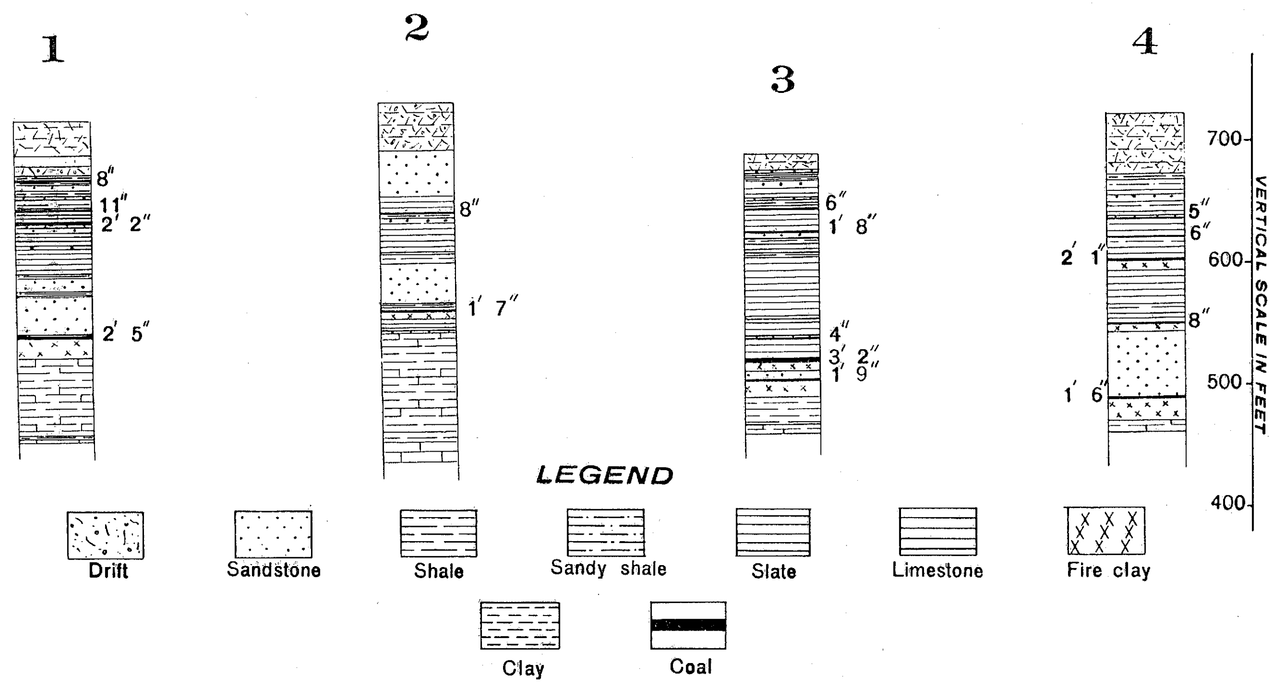

FIG. 32.—Columnar sections showing the variations in the number and thickness of the various coals penetrated in borings near Andalusia and Illinois City.

or strippings, for local use. Such old workings are most common along some of the streams between Illinois City and Andalusia, where the different coals thicken and thin within short distances. They reach thicknesses of 18 to 28 inches in the places where they have been worked, and the range of elevation of the various beds locally mined in this part of the area ranges from 575 to 714 feet. On account of the irregularities in the thickness and extent of these coals it seems improbable that they will ever become of more than local interest and importance.

ROCK ISLAND (NO. 1) (?) AND HERRIN (NO. 6) COALS IN THE MILAN QUADRANGLE

The Herrin (No. 6) bed is the only coal that has been worked on a commercial scale in the quadrangle. This bed is known to be present over the greater part of the southeast quarter of the Milan quadrangle, to which area its commercial exploitation has been limited. Logs of borings in sec. 32, T. 17 N., R. 1 W., and in sec. 5, T. 16 N., R. 1 W., indicate that over a small area one of these coals may be present in that part of the quadrangle, from which it probably extends east towards Coal Valley, where outcrops are known to occur. In these areas the Herrin (No. 6) coal is usually overlain by a dark, impure, in places siliceous limestone known to the drillers as "blue rock," which is easily recognized in borings or outcrops. A small drift formerly worked in sec. 32, T. 17 N., R. 3 W., shows an unusual thickness of very impure coal, 24 to 42 inches, overlain by a thin-bedded sandstone, at an altitude of 642 feet. This coal may possibly represent the Rock Island bed, but there is no way of certainly determining that it does. A coal was formerly drifted on in the bank of the creek in the NE. 1/4 sec. 2, T. 16 N., R. 3 W., at an altitude of 660 feet. On the old dump at this locality were found septaria with cone-in-cone structure, and containing shells of a small *Productus* and other brachiopods, which may represent the dark limestone that normally overlies the Herrin (No. 6) coal. However, it is certain that the horizon of numerous large septarian concretions with cone-in-cone structure, so well developed along Coal Creek and other streams farther west, belongs to a level approximately 30 feet lower than that of the Herrin coal bed. North of Mississippi River in the northwest quarter of the Milan quadrangle, these coals have been recognized in a few places in secs. 9, 11, and 15, T. 77 N., R. 2 E.

It is thought that the coal is absent over the larger part of the Milan quadrangle south of Mississippi River, outside of the area above mentioned. It may have originally been deposited over a greater or less part of this area in which it is now absent, having been removed by pre-Pleistocene erosion. Preglacial erosion was strong in parts of the quadrangle, as is shown in the fact that all of the Pennsylvanian strata were removed in places near Mississippi and Rock rivers, and Mill Creek where the Devonian limestone lies immediately beneath the drift. Records of water wells in parts of sec. 9, T. 16 N., R. 2 W., also show that in those localities all of the Pennsylvanian rocks were removed before the glacial drift was deposited. It seems probable, however, that the Rock Island coal was never present over parts of this area since Pennsylvanian outcrops and well records are known up to altitudes higher than that of the Rock Island coal bed farther east, north, or south in which neither this coal nor the dark limestone that usually overlies it are present.

ROCK ISLAND (NO. 1) AND HERRIN (NO. 6) COALS IN THE EDGINGTON QUADRANGLE

The Herrin (No. 6) coal outcrops in several places along Camp Creek and Little Camp Creek, and probably underlies the larger part of the south half of the southeast quarter of the Edgington quadrangle. It may also extend to a greater or less distance eastward into the Milan quadrangle. The Herrin coal bed is thought to be absent over almost all of the other parts of the Edgington quadrangle south of Mississippi River. It outcrops in a few places in sec. 30, T. 17 N., R. 3 W., and one or two small outcrops of dark, impure limestone belonging to a horizon immediately above the No. 1 or No. 6 coal occur in the south bank of Copperas Creek, in secs. 21 and 22, T. 16 N., R. 4 W. This limestone was underlain by a thin coal, possibly the Herrin bed, which lies at an altitude of about 654 feet above sea level. Both the coal and the limestone occur at this locality only in small patches, as is shown by the fact that logs of test borings made in these sections, and in secs. 27 and 28, adjacent on the south, show no trace of the dark limestone or the Herrin coal. North of Mississippi River this coal and the overlying dark limestone outcrop in the SE. ¼ sec. 20, T. 17 N., R. 1 E., and in a few other places in the Iowa part of the Edgington quadrangle. The Herrin coal is known in outcrops and test borings in too few places to justify plotting the rock structure of the quadrangles on the stratum. The altitude of this coal in the places where it is known is shown by figures on the map, Plate II.

As in the Milan quadrangle, the Herrin coal probably accumulated over a larger area than that which it underlies at present. From such areas a part of it may have been removed during the long post-Pottsville-pre-Pleistocene interval of erosion, during which in places all of the Pennsylvanian strata were denuded, as in the SE. ¼ sec. 33, T. 15 N., R. 5 W., and in several places in the northern part of the quadrangle, where the Quaternary strata rest on Devonian limestone. It is not at all improbable also that coal never accumulated over a large part of the area in which it is now absent in the quadrangle, or, if it did, it was removed by contemporaneous erosion indicated by more or less local intra-Pennsylvanian unconformities.

There is little doubt that the Herrin coal occurs in many places where it is not now known, for a considerable part of the area of the quadrangles has not been thoroughly tested. This coal probably underlies considerable parts of Perryton and Preemption townships, between the areas in which it is known in the southeast part of Edgington and that on the southeast part of the Milan quadrangle. It is probably absent over Eliza and Drury townships, and a sufficient number of test borings and sections of outcrop are known in Buffalo Prairie Township to show that the coal is there present in only a few small patches. In Edgington, Bowling, the north half of Rural, and the greater part of Black Hawk and Andalusia townships, the Pleistocene deposits are deep, and doubtless cover preglacial lowlands where all but isolated remnants of this coal were eroded away before the drift was deposited. If such remnants are found in these townships, they will probably have a poor cover, and prove of little value on account of difficult mining conditions.

CHARACTER OF THE HERRIN (NO. 6) COAL

In the mines where the Herrin coal bed has been worked, the thickness varies from 2½ to nearly 5 feet. It is a black, and rather soft coal, having a dark-brown streak. Where it is normally developed it is in a single bed which contains a parting with some impurities a short distance below the middle part. The details of this coal and associated strata at different localities where the bed could be well studied are shown below:

Section of Herrin coal in mine No. 3 of Coal Valley Mining Company at Matherville

	Thickness *Feet*
Limestone, dark	7+
Shale, black, fissile, fossiliferous	¼
Coal, with much mineral charcoal in thin bands, and showing indistinct impressions of leaves and other parts of plants. Sulphur occurs disseminated in chunks or small particles in the lower part of the coal, and in thin leaf-like layers in the upper	3½ to 5

Section of Herrin bed in mine No. 7 of the Alden Coal Company, at Matherville

	Thickness *Ft.*	*In.*
Limestone, dark	7+	..
Shale, dark	3	2
Coal, upper bench	1	4
Coal, middle bench	..	10
Coal, lower bench, with a little marcasite near the top	2	6
Shale, with marcasite and imprints of *stigmaria*	1	..
Underclay	3	6

Section of the Herrin coal in the mine of Dougherty Bros., near Boden

	Thickness Ft.	In.
Limestone, dark	14	..
Shale, black, fissile	2	..
Coal	2	10
Shale, or bony coal, brown, containing marcasite	..	2
Underclay, gray	2+	..

MINES AND MINING METHODS

All of the commercial coal mines operated in this area are in the southeast quarter of the Milan quadrangle. Three commercial mines are in operation in this quadrangle, and another was opened in 1917 about one-fourth mile south of the border of the quadrangle, along the Rock Island Southern Railroad. Besides these shipping mines, several local mines are worked during the autumn and winter months to supply local trade. The most of the mining is done on the room-and-pillar method. The haulage is by mule-tail rope or electric or gasoline motors. The roof conditions are good, and the flow causes little trouble. Below is given a list of the shipping mines, the average thickness of the coal in these mines, the depth to the bottom of the Herrin coal bed, and the altitude of the base of the coal in each mine.

TABLE 1.—*Shipping mines in the Milan and Edgington quadrangles, 1920*

Name	Depth to bottom of Herrin coal	Thickness of Herrin coal bed	Altitude of base of Herrin coal
	Feet	*Inches*	*Feet*
Alden Coal Co., mine No. 7	92	34-54	598
Coal Valley Mining Co., mine No. 3	69	36-60	624
McCraney Sand and Gravel Co	56	46	654

Besides the shipping mines listed above, about 10 local mines in the quadrangles are worked during a few months of each year.

CHEMICAL ANALYSES

Samples of coal were collected from several of the mines in the area and the results of analysis are shown in Table 2. The analyses for which "C" numbers are given in the second column of the table, are republished from Illinois Mining Investigations Bulletin 3.

TABLE 2.—*Analyses of mine samples from the Edgington and Milan quadrangles*

Not exactly indicative of commercial output

Lab. No.	File No.*	Date 1912	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free.				Sulphur	CO_2	B. t. u.	Unit coal
					Moisture	Volatile matter	Fixed carbon	Ash				
5338	C19 0227a	......	Mercer.......	6	13.23	40.29	37.20	9.28	4.37	.41	11104	....
					Dry	46.43	42.88	10.69	5.04	.47	12797	14641
5339	C19 0227a	8/12	Mercer.......	6	15.24	37.66	35.73	11.37	4.80	1.47	10353	....
					Dry	44.44	42.15	13.41	5.66	1.73	12214	14478
5340	C19 0227a	8/12	Mercer.......	6	15.15	39.06	38.48	7.31	3.30	.17	11252	....
					Dry	44.44	42.15	14.41	5.66	1.73	12214	14478
5363	C19 0227a	8/12	Mercer.......	6	14.97	38.27	37.07	9.69	3.75	.33	9637	....
					Dry	46.03	45.36	8.61	3.89	.19	13260	14760
5364	C19 0227a	8/12	Mercer.......	6	14.46	40.42	35.33	9.79	4.23	.69	10780	....
					Dry	44.99	43.61	11.40	4.95	.43	12749	14712
5365	C19 0227a	8/12	Mercer.......	6	14.07	39.95	34.01	11.97	4.55	.78	10525	....
					Dry	47.24	41.32	11.44	4.94	.59	12603	14551
5359	C18 0227	8/12	Mercer.......	6	14.58	39.49	36.82	9.11	5.60	.15	10894	....
					Dry	46.49	39.59	13.92	5.29	.91	12247	14604
5360	C18 0227	8/12	Mercer.......	6	15.07	38.14	37.44	9.35	4.85	.34	10790	....
					Dry	46.23	43.09	10.68	6.56	.18	12754	14642
5361	C18 0227	8/12	Mercer.......	6	14.10	39.60	36.73	9.57	3.92	.23	10956	....
					Dry	44.91	44.01	11.02	5.71	.38	12705	14618
5371	C17 0104	8/12	Mercer.......	1?	17.75	39.50	34.61	8.14	5.53	.86	10435	....
					Dry	48.03	42.08	9.89	6.72	1.05	12687	14373
5372	C17 0104	8/12	Mercer.......	1?	17.50	38.78	33.66	10.06	4.51	.29	10238	....
					Dry	47.00	40.80	12.20	5.46	.35	12409	14372
2775	0528	11/09	Rock Island..	...	17.30	38.25	36.25	8.17	5.10	....	10578	....
					Dry	46.25	43.82	9.87	6.16		12791	14533
1758	0536	8/08	Rock Island..	...	15.36	35.64	37.03	12.07	6.45	....	10178	....
					Dry	42.05	43.70	14.25	7.61		12010	14673

*Analyses having the same file number are from the same mine.

SHALE AND CLAY

Shale, loess, and alluvial clay have been used in this region in the manufacture of clay products. Of the shale, two beds have been used. The lower one lying near the base of the Pottsville was worked a few years ago by the Black Hawk Clay Manufacturing Company, at Sears, in making the better grades of pressed brick and building brick. A thickness of about 24 feet of shale was dug and mixed with a considerable percentage of the overlying loess as the raw material.

In the vicinity of Illinois City a bed of white shale 5 to 7 feet thick was formerly worked for white pottery, and used by four plants near Illinois City in the manufacture of jugs, crocks, and jars. Considerable quantities of this shale were also hauled to Fairport, and used in the manufacture of similar products. This bed of white clay lies about 35 feet above the upper zone of thin clay-iron stone concretions at an altitude of about 695 feet. It appears to be of limited distribution, this white phase especially not having been recognized outside of a small area, less than one square mile in extent, in the vicinity of Illinois City. This shale has not been utilized for a number of years.

The Davenport Brick and Tile Company operates an up-to-date clay plant at Buffalo, Iowa, across the river from Andalusia. Shale from the basal part of the Pottsville mixed with the overlying loess is the material from which hollow building block, sidewalk brick, paving brick, building brick, sewer pipe, and drain tile are manufactured.

For several years Mr. Hans Paulson has operated a brick yard on Twelfth Street road in South Rock Island. The more common grades of building brick are made from the surficial clays, about 34 per cent of loess being used in the mix with about 66 per cent of the underlying blue clay, a vertical face of 26 feet being dug.

A few years ago Olaf Atkinson and Mr. Richmond in Rock Island, and August Raistens in Moline, operated plants for the manufacture of the more common building brick, using surficial clays as the raw material. In recent years work in these plants has been discontinued.

Limestone

The only limestone of commercial importance that outcrops in the quadrangles is of Devonian age, and is exposed along the rivers in the north part of the area.

The Moline Stone Company formerly operated a large quarry in the limestone from the lower part of the Devonian, in Moline. The stone was crushed, and large quantities sent to the Rock County Sugar Company at Janesville, Wisconsin, for use in refining sugar. Considerable quantities of crushed stone were also shipped to various places within a radius of 100 miles, for use in concrete and road building.

The Cady quarry and Swan Tropp quarry in Moline have taken out a large amount of Devonian limestone for use in the city and adjacent territory.

In the bank of the river at Sears considerable limestone has been quarried for Government use in connection with the canal and locks, and other improvements in that vicinity. Limestone has also been quarried in the bank of the river south of Sylvan Island, and near the east end of Rock Island, for Government use.

Large quantities of limestone are quarried by the Linwood Quarry Company at Linwood and the Dorese Brothers Crushed Stone Works at Buffalo. The larger part of this stone is sold for riprap, or crushed for concrete and other purposes. It finds market in many places between Rock Island and Kansas City.

Sand and Gravel

Sand suitable for plaster and cement is abundant in many places along Mississippi and Rock rivers, and along the channels of several of the larger creeks in the quadrangles. Large quantities of both sand and gravel have been taken from a large pit worked by the Rock Island Southern Railroad Company on the flood plain of Mississippi River near the SE. cor. sec. 21, and the SW. cor. sec. 22, T. 17 N., R. 2 W. A vertical face 12 to 14 feet high has been worked in this pit for a distance of about 20 or more rods. The material consists mostly of small gravel mixed with coarse sand. This is an important source of gravel which is sorted from the sand by screening. Large amounts of sand are hauled from the channels of Rock Creek and Mississippi River for use in plaster and concrete in Rock Island and Moline.

Portland Cement Material

The chief raw materials required for the manufacture of Portland cement are limestone and clay or shale. The limestone should be relatively free from such undesirable impurities as dolomite, chert, and pyrite. The clay or shale should not contain much sand, pyrite, or gypsum.

Limestone in sufficient quantities and apparently of requisite purity is available, convenient to the Chicago, Rock Island and Pacific Railroad, in the vicinity of Sears and Milan, in the northeast part of the Milan quadrangle. This limestone is of Devonian (upper Wapsipinicon and lower Cedar Valley) age; a working face of 20 to 40 feet could be in places developed.

Shale of Pennsylvanian age that appears to be suitable for Portland cement material is exposed in the old clay pit of the Black Hawk Manufacturing Company only a short distance from the limestone outcrops. While tests and analyses of these materials should be made before their suitability for Portland cement manufacture could be certainly determined, yet these deposits appear promising and their ready accessibility and nearness to the railroad would seem to warrant an investigation of this locality on the part of anyone looking for available material for Portland cement purposes.

The limestone worked in the old Cady quarry in East Moline also seems to be relatively pure calcium carbonate, and suitable clay or shale could doubtless be found at no great distance away.

Possibilities of Oil and Gas

No definite and systematic testing for oil or gas has been done in this region. The churn-drill coal borings serve to test the rocks for oil and gas to the depth these borings penetrate the Pottsville strata, and the deep water wells in the area furnish information regarding the presence of oil and gas in strata as far down as they explore. Owing to the lack of any single, easily recognized key stratum in the Pennsylvanian rocks, the altitude of which could be determined from outcrops in borings in many places over the entire area, it has not been possible to present a structure map of the quadrangles showing the lay of the rocks in different places, and the areas where small domes arches, or synclines might be present. A few small structural features are known, as the low anticline extending in a northwest direction from near the center of sec. 25, T. 17 N., R. 2 W., probably passing through Milan and across Mississippi River near Oakdale. This arch is 20 or more feet in height, and presents somewhat favorable oil structure. A small dome appears to be indicated by the altitude of the Herrin coal bed in sec. 24, Duncan Township, and sec. 19 of Perryton. What the eastward extension of this convex structure may be can not be determined by the explorations made up to the present time.

The rise of the Rock Island coal from Sherrard, where its altitude is about 612 feet above sea level, to Cable, where its elevation reaches 654 feet, indicates a dome or anticlinal structure in the vicinity of Cable of sufficient magnitude to warrant testing, if any oil tests were to be made in this vicinity.

Another small dome is indicated southwest of Matherville. The altitude of the Herrin coal at Matherville is about 630 feet, while about one mile southwest of this place the coal rises to 650 feet.

However, it should be remembered that the presence of oil depends on several factors besides structure, so there is a large element of uncertainty regarding the presence of oil even where the structure appears favorable.

GAS IN GLACIAL DRIFT

Small quantities of gas have been reported from a few water wells in the quadrangles. Gas was reported in a well about one-fourth mile east of the center sec. 35, T. 17 N., R. 2 W. In another in the NE. ¼ sec. 35, T. 16 N., R. 5 W., gas was found in a bed of sand or sandy clay at a depth of 85 feet. In another well in the NW. ¼ sec. 36 of the same township gas is said to have been found at two levels, respectively 80 and 119 feet below the surface. In all of these cases the gas occurred in porous beds of sand or sandy clay enclosed in the drift. In such cases the gas was doubtless derived from the decomposition of relatively small amounts of organic matter that was buried in the glacial drift, and it can not be expected to occur in such quantity as to be commercially important. Such gas-bearing beds of sand or gravel enclosed in glacial drift have no necessary connection with oil or gas accumulations in the deeper rock strata, nor does the presence of gas in the glacial drift furnish any indication of the presence of oil or gas in the deeper, hard rock strata of the region in which it occurs.

Soil

Five of the types of soil differentiated in the soil survey of the Illinois Agricultural Experiment Station are found in this area. These are: (1) black clay loam, found on the poorly drained prairies; (2) brown silt loam, found on the undulating uplands; (3) yellow silt loam, found on the hilly areas; (4) brown loam characteristic of the flood plains or bottom lands; and (5) sand soil, found in places along the flood plains, and crowning the hills in places along the east bank of Mississippi River.

Like all others, these soils have been formed by geologic processes, to which they owe to a considerable extent their texture, their chemical and physical composition and their fertility. The character of the soil at any place depends on the character of the rock or rocks from which it was derived and on the conditions and forces to which it has been subjected.

In the Milan and Edgington quadrangles the black clay loam has been formed from the loess under conditions of poor drainage which permitted the residual, imperfectly decomposed plant debris to accumulate in the soil. Probably imperfect drainage and humid climate are the chief factors concerned in the development of the dark color of this soil.

The brown silt loam has been developed under conditions similar to that of the black clay loam, except that erosion was a little more active in the area where it occurs, which gave to the surface a little better drainage, and prevented the accumulation of the dark carbonaceous residual plant material to an equal degree.

The yellow silt loam was formed in places where erosion has been still more effective than in the areas of brown silt loam, and where the dark, imperfectly decomposed plant debris is removed by erosion and leaching as rapidly as it is formed.

The brown loam soil differs in origin from the type described above in that it receives from time to time accessions of new material. It lies on the flood plain within reach of high water, so that a thin film of sediment is deposited more or less uniformly over it at every time of overflow. The resulting soil is usually somewhat sandy, and loose textured.

The sand soil is found only over small areas of flood plains, or on the hills bordering the east bank of Mississippi River. This soil is granular, porous, and thin, and is the least fertile of the soil types in the area.

Water Resources

SHALLOW WELLS AND SPRINGS

An abundant supply of excellent water for domestic use can be obtained at shallow depths throughout this area. Rain and snow water is readily absorbed by the loess and percolates downward until it reaches the underlying comparatively impervious boulder clay. Much of it accumulates at the top of this clay, though near the borders of the upland a part moves laterally until it reaches the surface on the valley sides, where it issues as springs. A part percolates down into the boulder clay, commonly reaching and saturating lenses of sand which are in many places enclosed in the till.

WELLS IN THE GLACIAL DRIFT

Many of the farm wells obtain water from the base of the loess, which until recent years has been one of the important sources of water in the shallow wells on the uplands. On account of the general lowering of the ground-water level during the last fifty years, this source of water supply has been gradually weakened, and wells have more and more been drilled into sands lying within the glacial drift. Many wells from 80 to 140 feet deep obtain their water from sand and gravel beneath the boulder clays. Wells of this kind are common in the areas of deep drift in Black Hawk, Bowling, Edgington, Preemption, Perryton, Buffalo, Prairie, Drury, Eliza, and Duncan townships. Where the sand or gravel bed lying within or beneath the till is more than a few inches thick, it yields an abundant supply of water for farm wells.

WELLS IN HARD ROCK

Where abundance of water is not obtained in the porous beds associated with the drift, it is sometimes found in the Pottsville sandstones, either those near the base of the formation or those occurring at higher levels. Borings into the Pottsville are often put down to the top of the Devonian limestone.

The sandstones of the Pottsville are so irregular in their development and distribution that in some places well drillers have been obliged to drill a distance of 50 to 100 feet into the Niagaran limestone before obtaining a strong water supply. The upper part of the Niagaran limestone is usually porous, and seldom fails to furnish a generous supply of water. This water-bearing horizon is found about 475 feet above sea level in the northern part of the area, but declines to about 325 feet above sea level, or lower, in the south part of the quadrangles. On low places over the Mississippi flood plain the Niagaran limestone has yielded an artesian flow.

The shallowest source of water for flowing wells in this region is the Galena dolomite. The water from this horizon usually has a strong odor of hydrogen sulphide, and in most wells that have penetrated to or below this horizon the water has been cased off to prevent its mingling with the water from deeper sources. The only well known to be supplied from this horizon alone is the deep well at Linwood, the flow from which is known as the "sulphur springs."

The St. Peter sandstone is the most reliable source of good deep-well water in the quadrangles. The original head of the water from the St. Peter sandstone in the quadrangles was about 645 feet above sea level, but in recent years this head has been reduced by the many wells that have been bored into the St. Peter sandstone in the cities of Rock Island, Moline, and Davenport, so that at present it does not much exceed 580 feet. The water from wells tapping the St. Peter sandstone will probably flow everywhere in the flood plains of the Mississippi and Rock rivers in this region. The supply of water from the sandstone is abundant, and the quality excellent, as shown by the analyses made by the State Water Survey, Table 3.

The St. Peter sandstone is the main source of water supply in the Atlantic Brewery well, in Rock Island, in the paper mill well in Moline, and in the city well in Milan.

The deepest artesian water supply in this region is from the sandstones of Upper Cambrian age. The head of this water is higher than that of the St. Peter sandstone. A test made in the well of the Rock Island Brewing Company on Elm Street in Rock Island, in 1905, showed that when the well was cased down to 1,604 feet the water rose to a height of 596 feet above sea level. By the use of an air-lift this well has yielded 450 gallons per minute. The water from the Cambrian sandstone in the Prospect Park well in Moline and the Mitchell and Lynde well in Rock Island was somewhat more salty than that coming from the St. Peter sandstone. From a well said to be 2,000 feet deep, on the edge of the flood plain of the north side of sec. 2, T. 16 N., R. 5 W., water flows constantly in a stream nearly three inches in diameter. The altitude of the top of the well is 549 feet. This water is also strongly mineralized and not good to drink. In this region the head of the water from the Cambrian sandstone is not so high now as it was when the first wells were put down into the formation.

Surface-water Supplies

The supply of surface water in this area is abundant for all ordinary purposes, but the water contains so much sediment, and other impurities that filtering is necessary before it is safe for domestic use. Since good well water is easily available everywhere in the region, stream water has not been much utilized except by the larger cities, which require large amounts. The city of Moline obtains its water supply from Mississippi River, the water being filtered through Jewell filters, lime, and iron also being used in the treatment. Sanitary analyses of the unfiltered and filtered river water from which the Moline city supply is obtained were made by the State Water Survey. The results are shown in tables 4, 5, and 6.

TABLE 3.—*Mineral analyses of St. Peter sandstone water from wells in the Milan and Edington quadrangles*

Town	Rock Island (3rd Avenue and 14th Street)	Rock Island (1st Avenue and 6th St.)	Moline (Power Plant)	Moline	Moline	Milan (4th and West Sts.)
Owner	Moline Plow Co.	Rock Island Plow Co.	Deere Plow Co.	Deere and Co.	Dr. R. C. J. Meyer	City
Depth of well . . . . feet	1581	1404	1467	1490	1028	1157
Depth of casing . . . . feet	....	....	250	850	....	700
Rate of pumping *gals. per min.*	....	....	78	36	....	100
Date sample was collected	July 24, '11	April 25, '11	April 23, '12	April 23, '12	Feb. 20, '07	Aug. 8, '18
Determinations made (parts per million)						
Potassium	12.4	30.	27.8	16.1	....	....
Sodium	338.3	318.4	297.7	228.	304.6	351.5
Ammonium	2.	.4	2.1	2.3	1.7	1.9
Magnesium	21.	21.	25.3	30.5	28.5	21.18
Calcium	46.7	50.	57.2	71.5	58.6	41.31
Iron	.1	2.	1.6	.8	.3	1.9
Alumina	1.6	1.2	.0	1.2	6.	0.3
Nitrite	....	....	.0	....	....	....
Nitrate	.4	2.2	.0	....	.5	.35
Chlorine	205.	295.	280.	270.	300.	185.2
Sulphate	378.5	244.8	313.5	189.3	307.8	371.8
Silica	7.2	18.8	6.4	5.6	6.4	14.6
Bases	5.2	2.8	5.6	4.	....	....
Hypothetical combinations (parts per million)						
Potassium nitrate	.6	3.6	....	....	....	....
Potassium chloride	23.2	54.5	53.	30.7	....	....
Sodium nitrate	....	....	....	....	.7	.5
Sodium chloride	320.1	444.1	420.5	421.5	495.1	305.9
Sodium sulphate	560.2	362.2	407.1	190.9	337.	549.6
Sodium carbonate	20.2	59.8	....	....	....	120.3
Ammonium sulphate	....	....	7.7	8.4	....	....
Ammonium carbonate	5.3	....	....	....	....	4.9
Magnesium sulphate	....	....	41.1	65.7	100.4	....
Magnesium carbonate	72.7	72.7	58.9	65.8	28.4	73.4
Calcium carbonate	116.6	124.8	142.8	178.5	146.3	103.2
Iron carbonate	.2	....	3.3	1.7	.6	3.8
Iron oxide	....	2.	....	....	....	....
Alumina	1.6	1.2	....	1.2	6.	.3
Silica	7.2	18.2	6.4	5.6	6.4	14.6
Bases	5.2	2.8	5.6	4.	4.4	....
Total	1183.1	1145.9	1146.4	974.	1125.3	1177.1
Hypothetical combinations (grains per U. S. gallon)						
Potassium nitrate	.03	.21	3.09	....	....	....
Potassium chloride	1.35	3.18	....	1.79	....	....
Sodium nitrate	....	....	....	....	.04	.03
Sodium chloride	18.67	25.90	24.51	24.58	28.87	17.71
Sodium sulphate	32.68	21.12	23.74	11.13	19.64	31.18
Sodium carbonate	4.09	3.49	....	....	....	6.98
Ammonium sulphate	....	....	.44	.48	....	....
Ammonium carbonate	.31	....	....	....	....	.29
Magnesium sulphate	....	....	2.44	3.83	5.88	....
Magnesium carbonate	4.24	4.24	3.43	3.84	1.66	4.25
Calcium carbonate	6.80	7.28	8.32	10.40	8.53	5.81
Iron carbonate	.01	....	.19	.09	.03	.22
Iron oxide	....	.11	....	....	....	....
Alumina	.09	.07	....	.06	.34	.01
Silica	.42	1.06	.37	.32	.37	.85
Bases	.30	.16	.32	.23	.26	....
Total	68.99	66.82	66.85	56.75	65.62	68.01

TABLE 4.—*Sanitary analyses of water from Mississippi River*
City Supply of Moline, Illinois
Filtered

Serial number	Date of collection	Appearance			Residue on evaporation	Chlorine	Oxygen consumed	Nitrogen as:				Alkalinity	Bacteria per c.c.	Colon bacillus		
								Ammonia								
		Turbidity	Color	Odor				Free	Albuminoid	Nitrites	Nitrates			10 c.c.	1 c.c.	0.1 c.c.
13841	12/18/05	Decided	.4	3 Earthy	162.	1.5	9.10	.068	.240	.000	.28	86.6	....	1+	2−	2−
13919	1/15/06	do	.2	.000	155.	1.5	7.45	.096	.192	.001	.360	107.2	238	1−	2 ?	1+1−
14026	2/19/06	do	.2	.000	183.	2.0	7.4	.112	.136	.003	.32	128.6	1,690	......	2+	2−
14232	4/16/06	Clear	.1	2 Earthy	104.	1.1	3.8	.080	.176	.005	.80	40.0	1,550	1−	2+	2−
14367	5/14/06	do	.00	.000	127.	2.0	5.2	.064	.174	.006	.20	52.0	7	1−	2−	2−
14787	8/13/06	Slight	Muddy	.000	164.	2.0	7.85	.024	.184	.000	.48	104.7	61	1 ?	2+	2−
14953	9/10/06	Clear	.00	.000	214.	2.0	8.3	.024	.192	.000	.200	109.4	13	?	1+1−	2−
15302	11/ 5/06	do	.3	.000	107.	1.0	7.85	.032	.160	.002	.320	73.0	2,400	1+	2−	2−
15398	11/26/06	do	.6	.000	130.	3.0	7.80	.056	.160	.000	.410	82.0	270	1+	1+1−	1+1−

TABLE 5.—*Sanitary analyses of water from Mississippi River*
City Supply of Moline, Illinois
Unfiltered

Serial number	Date of collection	Appearance			Residue on evaporation	Chlorine	Oxygen consumed	Nitrogen as:				Alkalinity	Bacteria per c.c.	Colon bacillus		
		Turbidity	Color	Odor				Ammonia		Nitrites	Nitrates			10 c.c.	1 c.c.	0.1 c.c.
								Free	Albuminoid							
13840	12/18/05	Decided	.6	3 Earthy	216.	1.5	12.9	.088	.272	.000	.28	136.0	....	1 ?	2+	......
13918	1/15/06	do	.4	.000	245.	1.0	11.65	.088	.240	.001	.440	88.0	1,000	1+	1+	1+
14025	2/19/06	do	.5	.000	264.	2.5	11.25	.112	.216	.003	.24	171.4	8,100	1−	1+	1+
14231	4/16/06	Distinct	Mud	2 Earthy	202.	1.7	6.00	.080	.280	.001	.04	62.0	12,500	1+	1 ?	2−
14366	5/14/06	Decided	.4	.000	391.	1.5	14.75	.176	.428	.006	.24	93.0	4,800	1+	2+	2−
14786	8/13/06	do	Mud	.000	508.	2.0	16.00	.024	.560	.050	.27	128.0	320	1+	2+	2−
14952	9/10/06	do	do	2 Earthy	384.	2.0	15.9	.016	.480	.010	.230	124.8	900	1 ?	2+	2+
15299	11/ 5/06	do	.8	.000	195.	1.0	13.9	.056	.264	.002	.320	117.1	*133,000	1+	1+	1+
15300	11/ 5/06	do	.8	.000	192.	1.0	9.95	.056	.312	.002	.240	119.0	*272,000	1+	2+	1+
15301	11/ 5/06	do	.8	.000	200.	1.0	13.7	.064	.344	.002	.280	126.7	*690,000	1+	2+	2−
15397	11/26/06	do	Mud	.000	235.	2.0	12.35	.048	.280	.002	.680	130.6	8,200	1−	2−	2−
15399	11/26/06	do	do	.000	221.	2.0	12.65	.040	.280	.001	.440	126.7	5,500	1+	2+	1−
15400	11/26/06	do	do	.000	201.	2.0	12.7	.080	.264	.001	.440	126.7	6,700	1−	2−	2+

*First set of plates were lost, second set plated after samples had stood at room temperature for ten hours.

TABLE 6.—*Results of an analysis of the mineral content of water from Mississippi River*
City Supply of Moline, Illinois
Laboratory No. 14366 and No. 14367, July 3, 1906

Ions		Parts per million		Hypothetical combinations		Parts per million		Grains per U.S. gal.	
		Raw 14366	Filtered 14367			14366	14367	14366	14367
Sodium	Na	5.9	8.7	Sodium nitrate	$NaNO_3$	1.5	1.2	.09	.07
Ammonium	NH_4	.2	.1	Sodium chloride	NaCl	2.5	3.3	.15	.19
Magnesium	Mg	11.0	4.7	Sodium sulphate	Na_2SO_4	13.9	21.9	.81	1.27
Calcium	Ca	28.7	23.3	Ammonium sulphate	$(NH_4)SO_4$	.7	.4	.04	.02
Iron	Fe	6.1	....	Magnesium sulphate	$MgSO_4$	1.1	5.9	.06	.34
Alumina	Al_2O_3	12.4	1.5	Magnesium carbonate	$MgCO_3$	37.4	12.1	2.18	.71
Nitrate	NO_3	1.1	.9	Calcium carbonate	$CaCO_3$	71.6	58.2	4.18	3.39
Chloride	Cl	1.5	2.0	Iron carbonate	$FeCO_3$	12.6	....	.73	....
Sulphate	SO_4	10.8	19.8	Alumina	Al_2O_3	12.4	1.5	.72	.09
Silica	SiO_2	104.1	31.7	Silica	SiO_2	104.1	31.7	6.12	1.85
Bases	....	42.0	.4	Bases	....	42.0	.4	2.45	.02

The city of Rock Island also obtains its water supply from Mississippi River. The sanitary and mineral analyses of the water from the Rock Island supply gave results similar in a general way to those of the Moline city water, as would be expected from the short distance between the intake of these cities.

Water Power

Water power is developed by a dam across a branch of Rock River between Milan and Sears. Much greater amounts of water power could be made available on Mississippi River in this region but no effort has been made to develop power from this source.