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Subsurface Geology and Coal Resources of the Pennsylvanian System in De Witt, McLean, and Piatt Counties, Illinois

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SUBSURFACE GEOLOGY AND COAL RESOURCES OF THE PENNSYLVANIAN SYSTEM IN DE WITT, MC LEAN, AND PIATT COUNTIES, ILLINOIS

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ABSTRACT

Pennsylvanian stratigraphy and structure were investigated in De Witt, McLean, and Piatt Counties, Illinois; special attention was given to that part of the Pennsylvanian System that contains possible reserves of minable coal.

Because of the complete absence of known bedrock outcrops, it was necessary to apply subsurface methods in the study. More than 90 percent of the data used were electrical logs of borings made for petroleum exploration and development and in search of underground gas-storage structures. Remaining data came from records of five coal mines that operated in the area in past years and from three diamond-drill core tests.

The general character of the Pennsylvanian strata is discussed, with emphasis on the Carbondale Formation because it includes all the known commercially important coal beds in the area. Older Pennsylvanian strata, that is, all of the Caseyville Formation and probably all of the Abbott Formation, are absent from the study area because Pennsylvanian deposition did not advance that far northward until later in the period. A considerable portion of younger Pennsylvanian strata also is missing, but this absence results from removal by post-Pennsylvanian subaerial erosion that in some localities has removed beds down through the Springfield (No. 5) Coal Member of the Carbondale Formation.

Structures in the report area appear to be an integral part of the La Salle Anticlinal Belt. The most pronounced structure is the Downs Anticline, which is characterized by the presence of several domes throughout its course. Other major structures include the Clinton Syncline, the Colfax Syncline, and the Osman Monocline. In the report, major structure is described and discussed, and

structural and stratigraphic cross sections and structure contour maps on the tops of the Danville (No. 7) Coal Member and the Colchester (No. 2) Coal Member have been constructed to show the location and general nature of individual structural features.

Reliable coal thickness data are very limited. Therefore, no attempt was made to compute estimated tonnages of possible coal reserves, but those parts of the area that appear to offer the best prospects for further coal exploration have been pointed out. On the basis of present knowledge, it appears that the Springfield (No. 5) Coal Member offers the best possibility of having large reserves of minable coal, but this prospect could be changed by coal test drilling in the several localities from which data are essentially absent. The Danville (No. 7) Coal is probably also present in minable thickness over sizable areas. The Danville, Springfield, and Colchester Coals all have been mined in McLean County.

The study has resulted in a clearer understanding of Pennsylvanian stratigraphy and structure in a heretofore little known area and has provided subsurface information that should be useful in planning a coal test drilling program.

INTRODUCTION

This report of the subsurface geology and coal resources of the Pennsylvanian System in De Witt, McLean, and Piatt Counties, Illinois, is one of a series of similar reports designed to present in useful form all available information in the files of the Illinois State Geological Survey about coal reserves in Illinois.

De Witt, McLean, and Piatt Counties are in the central part of Illinois (fig. 1). They have a maximum north-south extension of approximately 66 miles and a maximum east-west extent of about 42 miles. Taken together, they cover an area of 2,009 square miles.

Geologically the area is located along and immediately west of the La Salle Anticlinal Belt, elements of which have exerted considerable influence upon the structure of rock strata along the eastern and northeastern two-thirds of the area.

Stratigraphic and structural study was limited mainly to strata included in the Carbondale, Modesto, and Bond Formations of the upper part of the Kewanee and the lower part of the McLeansboro Groups of the Pennsylvanian System because it is within this stratigraphic interval that the more significant key strata and the minable coals are located. Data relative to depth and areal extent of coals were obtained mainly from electrical logs. In local areas information was also available from records of abandoned coal mines and from diamond-drill core records; these types of records usually provide the most reliable coal thickness information available.

Many of the coals mined in other parts of Illinois are present in De Witt, McLean, and Piatt Counties, and maps have been prepared showing the structure

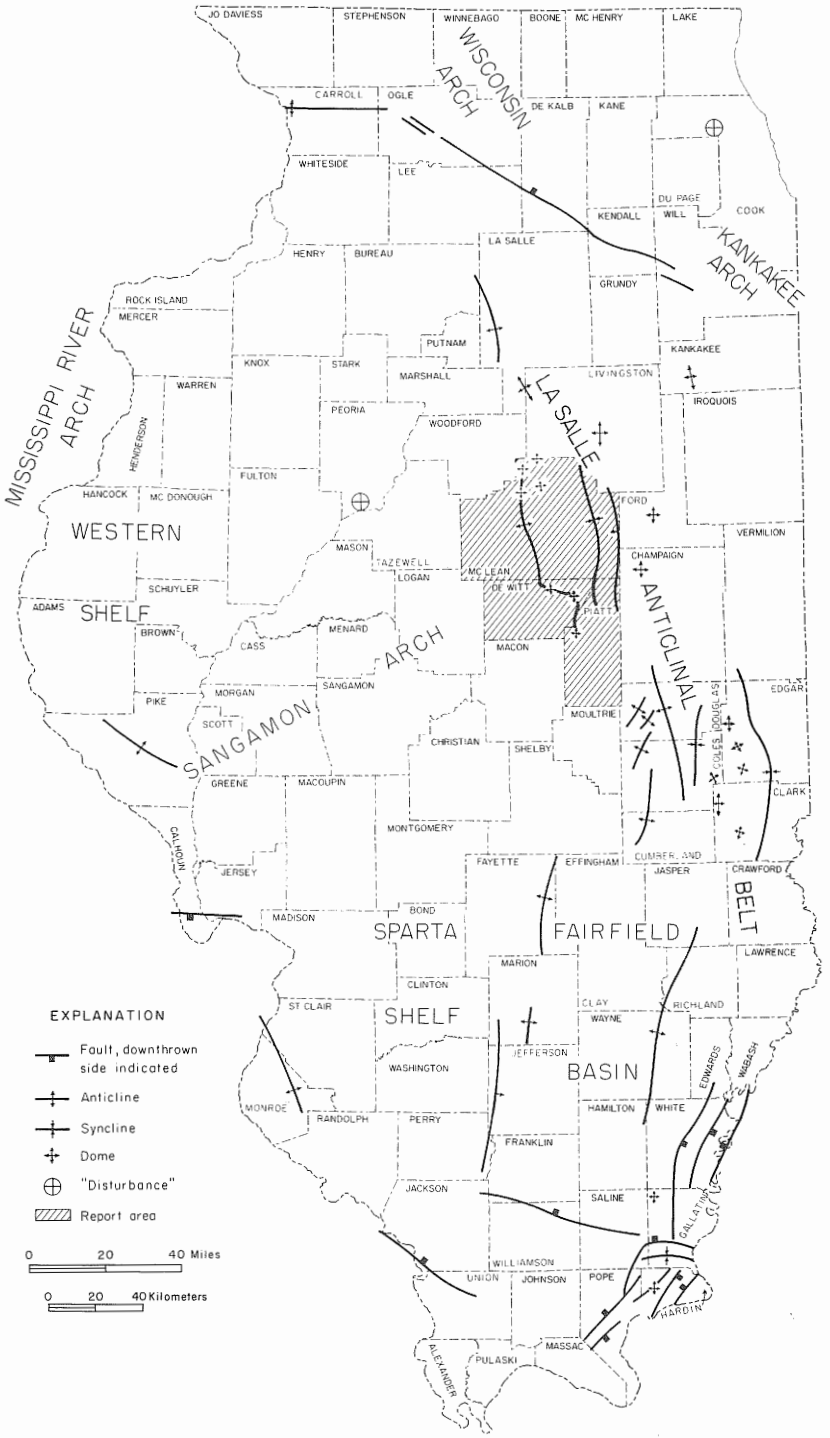

Fig. 1 - Index map showing location of the report area in relation to major geologic structures of Illinois. Modified from Clegg (1970).

and areal extent of the Danville (No. 7) and Colchester (No. 2) Coals in these counties (plates 1 and 2). Unfortunately, scant coal thickness data for the area make an accurate quantitative evaluation of reserves impractical. Good electrical logs, however, do permit limited but useful estimates of coal thickness to be made. But, even though thickness data are limited, a knowledge of which part of the area is underlain by coal and of the depths at which coal will be encountered in drilling and an awareness of the stratigraphic position of key beds that may serve as guides in coal test drilling all serve a useful purpose when a program of coal test drilling is undertaken.

This report, therefore, has two major objectives: (1) to organize and present in useful form all available information concerning possible reserves of coal in the area, and (2) to provide stratigraphic and structural data that will aid in planning and conducting a program of prospecting.

This additional information about structural and stratigraphic relationships of strata in the three counties, when considered with what is known about the same strata in other areas of Illinois, will also help provide a better understanding of the Pennsylvanian geology of the state as a whole.

Previous Investigations

Because there are no known bedrock outcrops of the Pennsylvanian in De Witt, McLean, and Piatt Counties and there is only a limited amount of subsurface data, no detailed report dealing with the Pennsylvanian geology of the three counties has previously been undertaken.

Brief references to the coal mines of McLean County were made from time to time in a few early publications of the Illinois State Geological Survey, and occasionally a log from a water well or another type of bore hole in McLean County has been published by the Survey. A generalized structure map of the Springfield (No. 5) Coal in De Witt and McLean Counties was included as part of a report by Cady (1921) covering a much larger area. Smith (1970) included the study area in a brief discussion of the Francis Creek Shale Member of the Carbondale Formation in a report that encompassed several counties of northern and western Illinois. An estimate of minable coal reserves of each of the three counties based upon the limited data available at that time was made by Cady and others (1952).

Johnson (1954) in a master's thesis gives an interesting, though generally nontechnical, account of some of the problems encountered by some of the citizens of Colfax in their attempt to open two coal mines during the early history of that community.

However, it was not until relatively recently that the discovery of oil near Wapella and Parnell in De Witt County and near De Land in Piatt County and the interest in underground gas-storage structures in all three counties concerned produced sufficient subsurface information to permit a meaningful geological study of the area as a whole.

STRATIGRAPHY

Wanless (1955) demonstrated that Pennsylvanian sedimentation in the Illinois Basin began in the lowest part of the basin, in southeastern Illinois and adjacent parts of Indiana and Kentucky. He estimated that more than 1200 feet

of Pennsylvanian sediments had accumulated in some parts of this area before the beginning of deposition in the La Salle County area of northern Illinois.

Following Mississippian sedimentation a long period of erosion and weathering left a deeply eroded and very uneven topography, upon which earliest Pennsylvanian sediments were deposited. In Illinois this erosion surface was made up of rocks ranging in age from Mississippian to Ordovician. It probably was not until about the time of the deposition of the Colchester Coal that all irregularities of the original eroded surface were completely buried, allowing the Colchester Coal to be deposited upon a relatively level and even surface. Bristol and Howard (1971) made an intensive study of that part of the erosion surface that includes Chesterian (Upper Mississippian) strata; a detailed paleogeologic map and two sets of matching structural and stratigraphic cross sections accompany their report.

Another long period of erosion followed Pennsylvanian deposition and resulted in the removal of an unknown thickness of younger Pennsylvanian rocks. If no strata younger than Pennsylvanian were ever deposited in this part of Illinois, this second erosional period could have continued without interruption until the advance of Pleistocene ice sheets from the north, northeast, and northwest. Additional Pennsylvanian and, in some parts of the state, older strata were removed by ice scour and meltwater wash during Pleistocene time.

Final retreat of the Pleistocene ice left a varying thickness of unconsolidated drift, filling bedrock valleys and blanketing the eroded bedrock surface so that rock outcrops in the glaciated areas of Illinois now can be found only where the drift layer was thin and has subsequently been removed by stream erosion or, locally, by artificial excavation.

As a consequence of erosion both before and after deposition and consolidation of Pennsylvanian sediments, the uppermost and lowermost surfaces of the Pennsylvanian in Illinois are very uneven and therefore youngest and oldest strata now have limited and irregular areal distribution.

As shown on plate 3, youngest Pennsylvanian strata are present in the southern part of the report area. The Millersville Limestone Member has not been identified in subsurface farther north than the south part of Township 18 North, Range 6 East, about four miles south of Monticello in Piatt County. Its original northward extent before post-Pennsylvanian erosion can only be conjectured. As also indicated on plate 3, the oldest Pennsylvanian rocks in the study area are situated in southern Piatt County in the structurally lowest part of the area.

In De Witt, Piatt, and McLean Counties Pennsylvanian rocks lie upon strata ranging in age from Mississippian at the south through Devonian to Silurian at the north (fig. 2).

No known surface outcrops of rock strata occur anywhere in the area and drill-hole data show that drift thickness ranges from about 50 feet to more than 400 feet; the thinner drift is limited to northeastern McLean County and a very small area in the southwest corner of De Witt County (fig. 3).

In Illinois the Pennsylvanian System has been divided into three rock-stratigraphic groups—McCormick, Kewanee, and McLeansboro, listed from oldest to youngest (Kosanke et al., 1960). Each group is subdivided into formations, which in turn are partially divided into members, only the more important and readily identifiable of which are indicated in a much simplified diagrammatic columnar section of Pennsylvanian strata present in the study area (fig. 5). It will

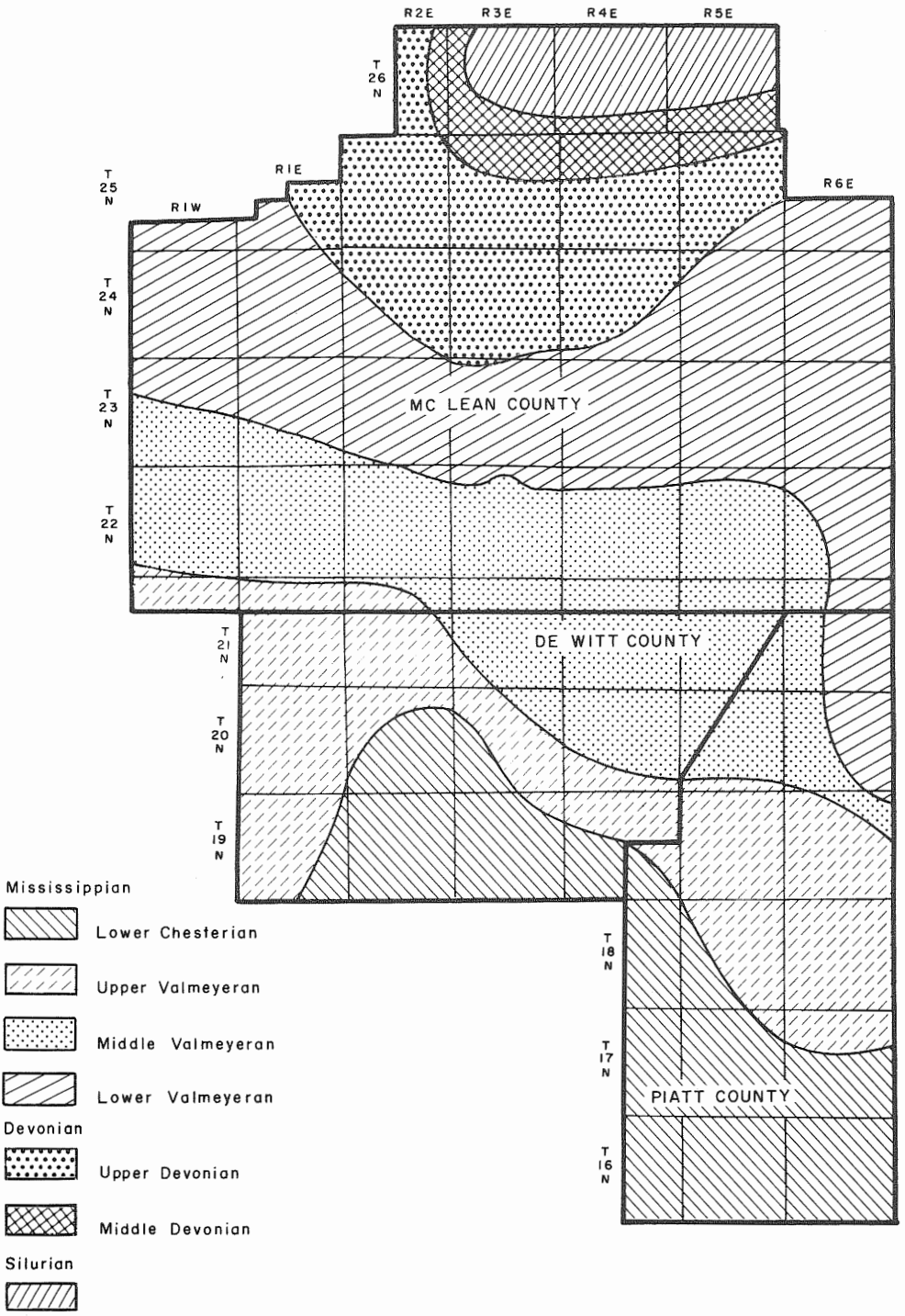

Fig. 2 - Sub-Pennsylvanian geology of De Witt, McLean, and Piatt Counties showing the progressively northward increase in age of the strata upon which initial Pennsylvanian sediments of the area were deposited. Adapted from Willman and others (1967) and Bristol and Howard (1971).

be noted that the more prominent limestones are members of the Bond and Modesto Formations while the more important coals are limited to the Carbondale Formation. During Carbondale deposition, periods of accumulation of thicker coals were more common than during Bond and Modesto times, when periodic more open-marine conditions favored the formation of relatively thick carbonates.

Members of formations both above and below the Bond and Carbondale also are present in parts of the study area, but because of the limited amount of subsurface data concerning them, they are not included in figure 5 or in the following discussion.

Pleistocene Series

In this investigation of Pennsylvanian subsurface geology, no attempt was made to study Pleistocene deposits. (More complete information on Pleistocene geology can be found in Willman and Frye [1970].) Note was taken, however, of the overall thickness of these unconsolidated materials because in this part of Illinois they are much thicker than in most areas of coal mining in the state and they can be an important factor in selecting shaft sites and in anticipating problems likely to be encountered in shaft sinking.

Wisconsinan moraines form the most conspicuous topographic features of large parts of the three counties. They are present as linear lobate belts (fig. 4) rising in some instances 60 feet or more above the intermorainal areas. Although readily noticeable as one traverses those areas where they are present, they exert considerably less influence upon overall thickness of glacial drift than does the buried topography of the bedrock surface.

Upon examination and comparison of figures 3 and 4, it becomes immediately apparent that the main factor determining overall drift thickness is the eroded bedrock surface. Greatest drift thickness, more than 400 feet, occurs in two small areas within the Danvers Bedrock Valley, which traverses northwestern McLean County in a northeast to southwest direction. Thicknesses between 300 and 400 feet are limited to this channel and to the Mahomet (Teays) Valley, which enters Piatt and McLean Counties from the east and then swings northwestward, leaving the area in Township 22 North, Range 1 West in western McLean County.

Pennsylvanian System

McLeansboro Group

Bond Formation

Millersville Limestone Member

The highest prominent marker unit in the study area is the Millersville Limestone Member of the Bond Formation. It is the uppermost member of the formation and its uneroded upper surface marks the boundary separating the Bond from the overlying Mattoon Formation.

The Millersville has been encountered in the subsurface of the report area only in the southern part of Piatt County. It has never been reported in drilling north of the Mahomet (Teays) Bedrock Valley. Its northern limit is represented in figure 6 as the boundary separating the Bond and Mattoon Formations. Stratigraphically it lies about 200 feet above the Shoal Creek Limestone Member and from 450 to 475 feet above the Danville (No. 7) Coal Member.

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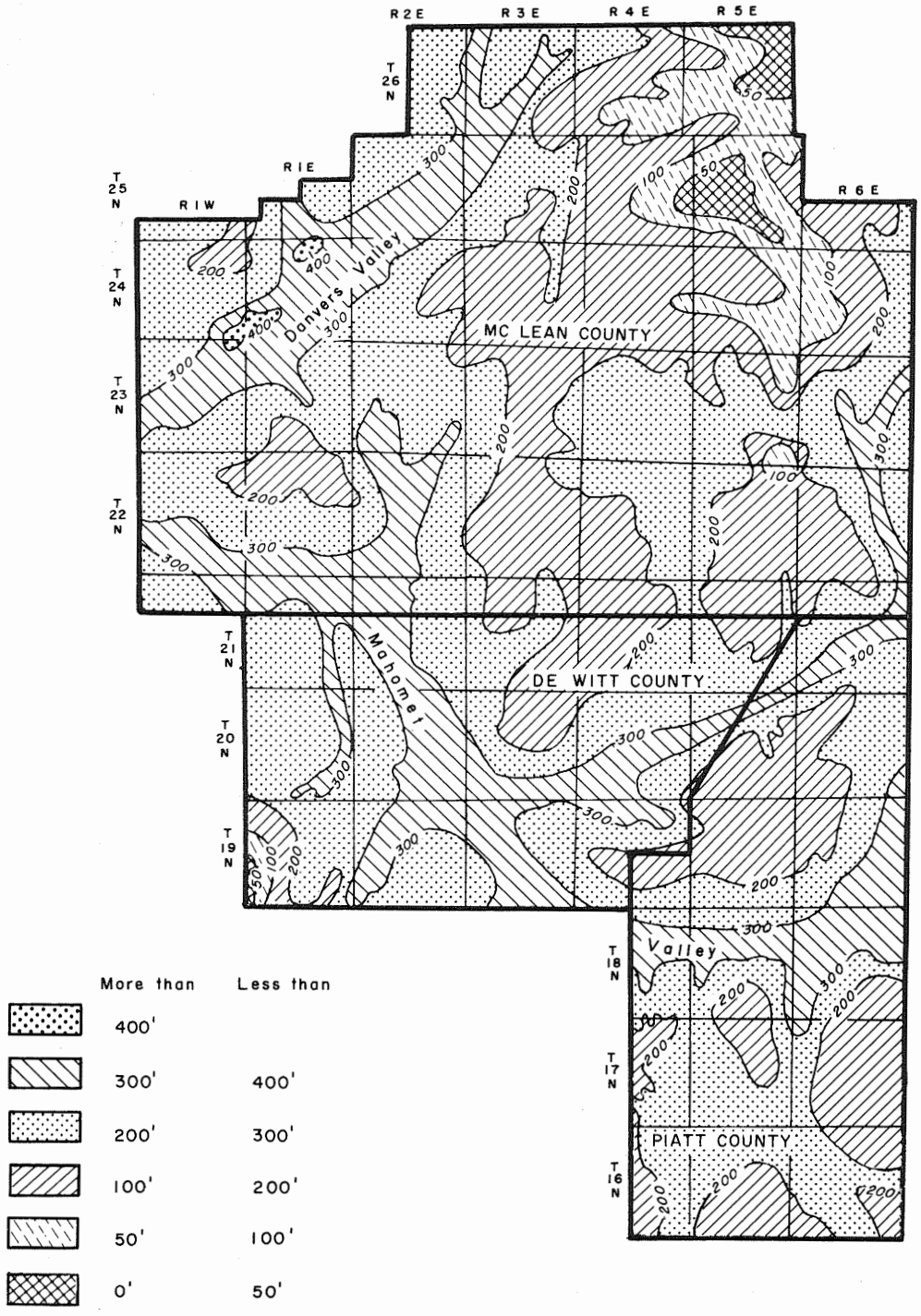


Fig. 3 - Map showing thickness of unconsolidated glacial drift in De Witt, McLean, and Piatt Counties, Illinois. From Piskin and Bergstrom (1967).

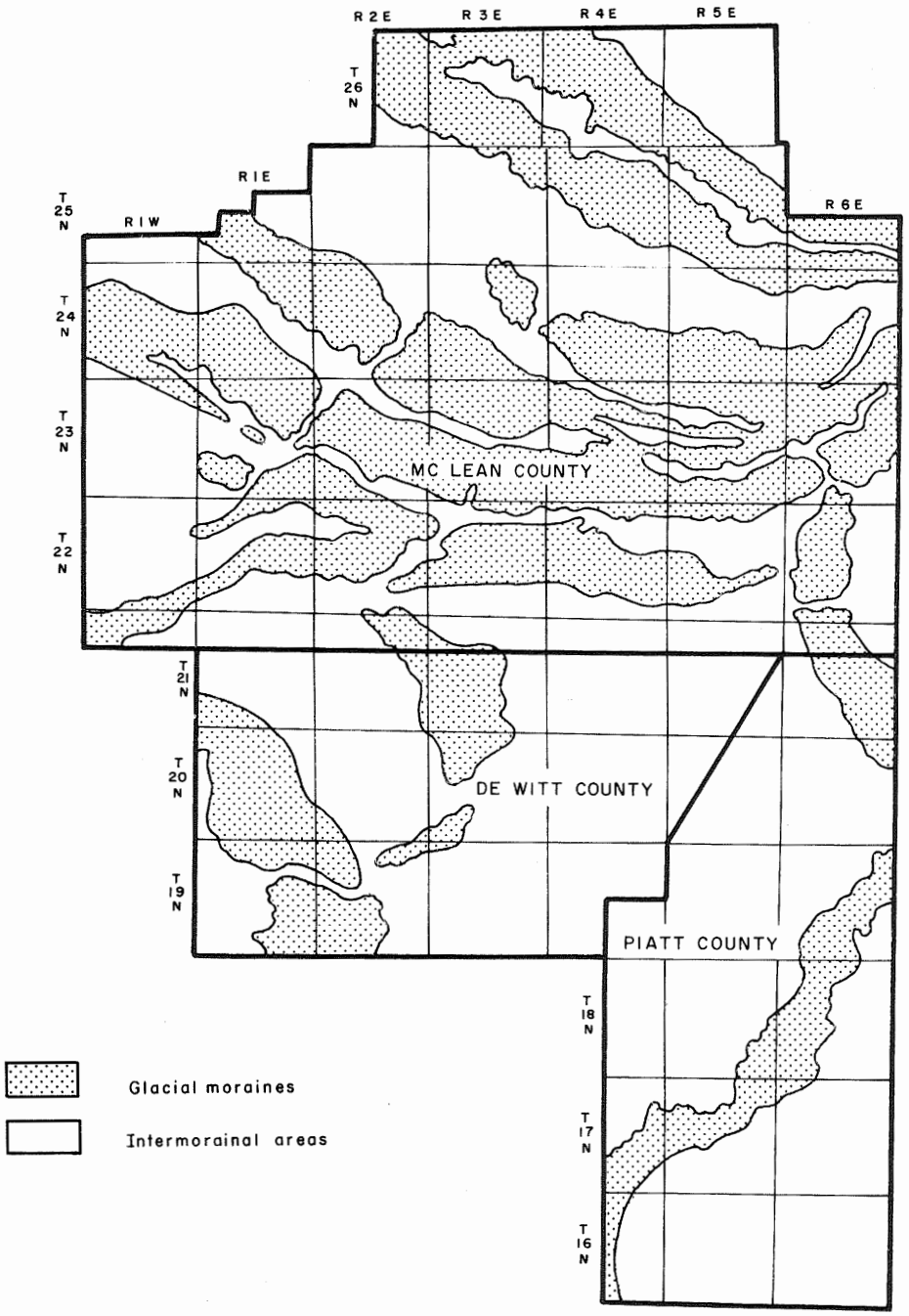


Fig. 4 - Glacial moraines in De Witt, McLean, and Piatt Counties. Though prominent topographic features, these moraines exert comparatively minor overall influence upon total drift thickness. After Willman and Frye (1970).

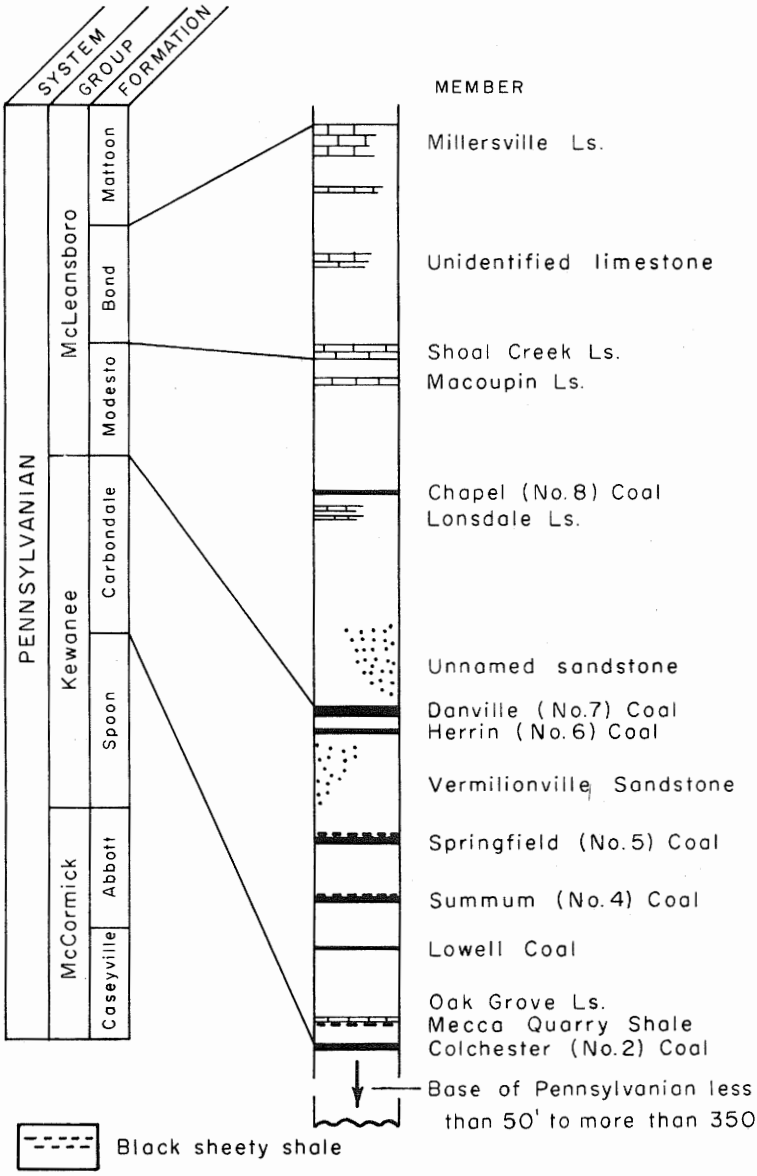


Fig. 5 - Simplified diagram of the Pennsylvanian System showing the more important formational members present in De Witt, McLean, and Piatt Counties.

A very prominent deflection of the resistivity curve of electrical logs makes the position of the Millersville readily recognizable and shows its thickness to be about 25 feet in Piatt County (plate 3). In drill cuttings it is light gray to buff and usually very fossiliferous.

Farther south in Illinois this limestone attains thicknesses of 50 feet or more and is quarried in several localities in east central and central Illinois.

In northeastern McLean County, generally north of Township 24 North and some 50 miles north of the farthest known extension of the Millersville Limestone,

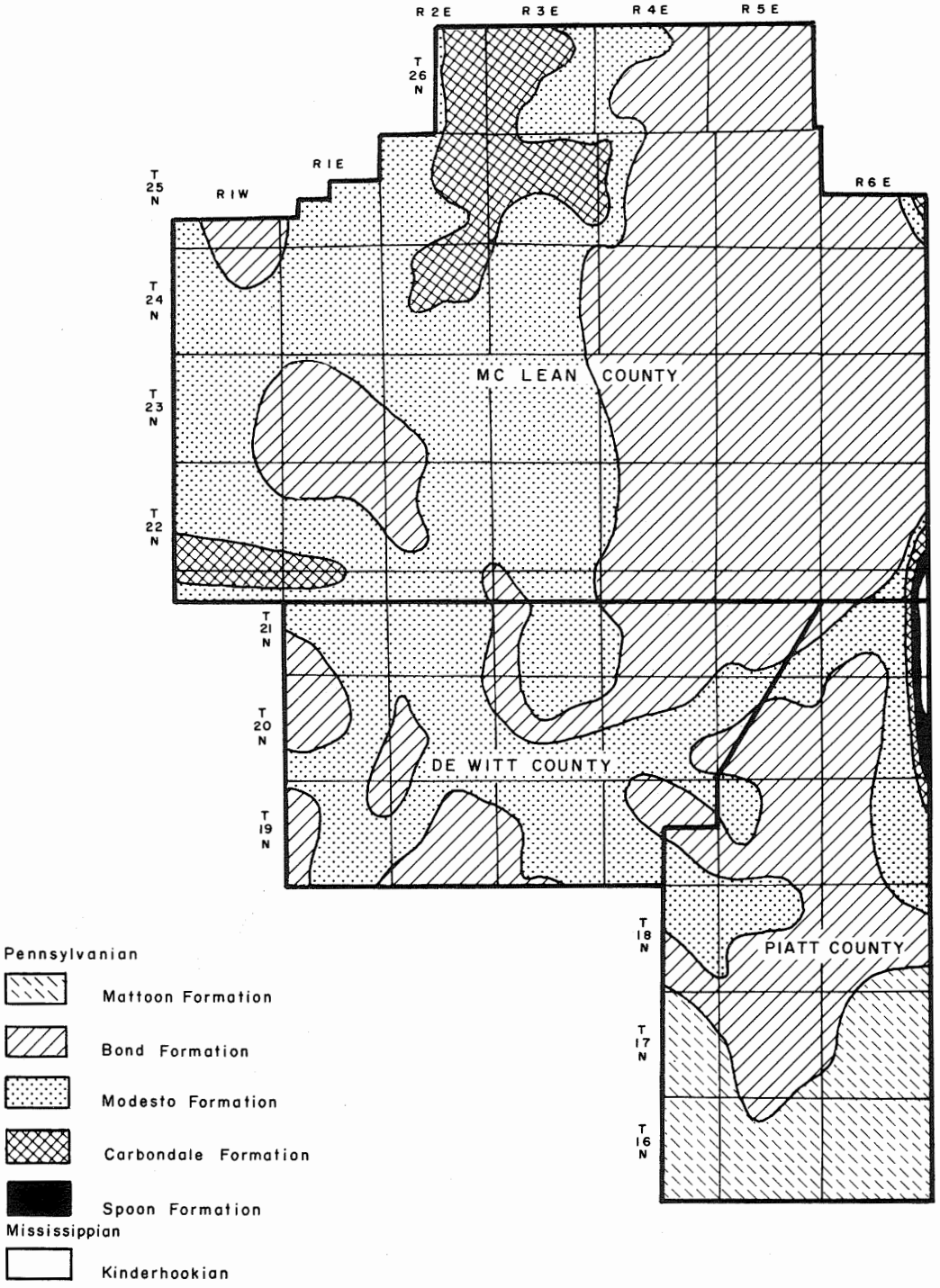


Fig. 6 - Geologic map of De Witt, McLean, and Piatt Counties, Illinois. Modified from Willman and others (1967).

a prominent limestone of up to 20 feet in thickness has been encountered in a few drill holes at depths of slightly more than 100 feet, which places it close to the top of bedrock in the area. The proper correlation of this limestone is as yet undetermined. It is displayed very prominently on electrical logs, and in drill cuttings it appears to be very similar to the Millersville. Its stratigraphic position in McLean County is about 65 feet above the Shoal Creek Limestone.

In the Pontiac area of Livingston County, immediately north of McLean County, two limestones are being quarried at several localities. The lower of the two has been correlated with the Shoal Creek and the upper is currently believed to be the equivalent of the unidentified limestone encountered in the subsurface of northeastern McLean County.

The possibility that this unidentified limestone is the correlative of the Millersville cannot be unequivocally denied. However, where the Millersville and the Shoal Creek can both be identified on the same record of drillings in Piatt County, they are separated by at least 200 feet whereas the interval separating the Shoal Creek from the unidentified limestone in northeastern McLean County is about 65 feet. The interval separating the Shoal Creek Limestone from the Danville Coal is about 230 to 250 feet in Piatt County and about 140 to 150 feet in northeastern McLean County. The entire stratigraphic section of the Pennsylvanian does become progressively thinner toward the north (plate 3), but since that part of the section below the Shoal Creek does not thin by more than 40 percent it is difficult to account for the greater amount of thinning, up to 70 percent, that would be required to bring the Millersville down to within 65 feet of the Shoal Creek. Until more data are available, the proper correlation of this limestone in northeastern McLean County must remain an open question.

Shoal Creek Limestone Member

The base of the Shoal Creek Limestone Member marks the bottom of the Bond Formation. Its position ranges from some 250 feet above the Danville Coal in Piatt County to slightly less than 150 feet where it is present in northeastern McLean County. Areal distribution of the Shoal Creek throughout the three-county area is indicated in figure 6 by the area underlain by the Bond and Mattoon Formations.

The position of the Shoal Creek is readily recognizable on electrical logs by its pronounced resistivity curve. Its thickness throughout most of the area appears to be about 10 to 12 feet, and where present it is an excellent marker unit. However, throughout much of the area it has been removed by post-Pennsylvanian erosion. Drill cuttings are similar in appearance to those of the Millersville (fig. 6).

The Shoal Creek occurs persistently throughout most of the Fairfield Basin; east of the La Salle Anticlinal Belt in east-central Illinois; in much of the Sparta Shelf; and throughout sizable areas of Woodford, Marshall, Putnam, La Salle, and Livingston Counties in northern Illinois. It attains considerable thickness, occasionally exceeding 20 feet, in some of these areas and, like the Millersville, is quarried in several localities where it lies at shallow depths.

Modesto Formation

The Modesto Formation does not contain any formational members that can be used as dependable marker beds in the study area.

The Macoupin Limestone Member is present about 20 feet below the Shoal Creek but is not always sufficiently well developed to be readily identified in drill records. Its areal distribution is about the same as that of the Shoal Creek; but the Shoal Creek, being higher and more prominent, is the better marker unit of the two.

The Chapel (No. 8) Coal Member near the middle of the Modesto Formation is a thin coal, easily overlooked in drill cuttings and frequently not identifiable on electrical logs in this area.

The Lonsdale Limestone Member a few feet below the Chapel (No. 8) Coal is likewise undependable as a marker unit because of its erratic distribution. It appears to be generally a multiple-benched limestone, usually associated with variegated clay. A sandstone of varying thickness is often present at the stratigraphic position of the Lonsdale.

Carbondale Formation

Danville (No. 7) Coal Member

The top of the Danville Coal defines the upper boundary of the Carbondale Formation. It is the Carbondale Formation that contains most of the minable coals in Illinois and all that are known to be of minable thickness in the report area.

The Danville Coal obtains its name from the city of Danville in Vermilion County, Illinois, where it has been extensively mined by both shaft and strip mining methods. It also has been mined locally in areas of western Illinois west of the Illinois River and in parts of northern Illinois, especially in the La Salle County area.

As shown in figure 6, the Danville Coal is everywhere present in the three counties except locally in northwestern and southwestern McLean County and east of the Osman Monocline in the east edge of the area. In the northwestern part of McLean County, tectonic uplift over the Gridley, Lake Bloomington, Lexington, and Hudson Domes and post-Pennsylvanian bedrock erosion in the Danvers Bedrock Valley combined to expose the coal to subaerial erosion and removal before and/or during Pleistocene time. In the southwestern part of McLean County, it is thought to be absent in a linear section where the lower reaches of the Mahomet (Teays) Valley have cut deeply into the bedrock surface.

The Danville Coal was formerly mined at Colfax and Chenoa in McLean County and near the village of Fairbury in Livingston County just northeast of McLean County. Average thicknesses reported from the mines at these locations were about 4.5 feet.

At Colfax two mines operated periodically between 1885 and 1924. Available information indicates that difficulty was encountered in shaft sinking at both sites owing to the presence of a considerable thickness of unconsolidated glacial drift (Johnson, 1954). According to Illinois Bureau of Labor Statistics, Annual Coal Reports for the years 1889 to 1903, nine of eleven fatal accidents in the Colfax mines resulted from roof falls; roof failure was also listed as a common cause of nonfatal accidents (Johnson, 1954). The roof was reported to be a weak gray shale that was difficult to hold by the timbering methods used in room and pillar mining.

At Chenoa the coal was mined through the years 1889 to 1907, with final abandonment in 1907. Longwall mining methods were used in this mine, and

coal thicknesses ranging from 3.6 to 4.8 feet were reported. No information concerning roof or other mining conditions is available.

Reports from one of the mines near Fairbury indicates that in some parts of the workings the roof consisted of sandstone that sometimes extended well down into the coal. A few electrical logs from eastern McLean County show a considerable thickness of sandstone above the Danville Coal; the possible presence of this channel sandstone could be a consideration in determining the minability of this coal in McLean County.

With the exception of the thickness data reported from the mines and from one core drill hole near Monticello in Piatt County and one near Wapella in De Witt County that recorded respective coal thicknesses of 3 feet, 8 inches and 2 feet, 9 inches, there is no information available that will permit an accurate estimate of overall reserves of the Danville Coal in the three counties.

Cady and others (1952) estimated known reserves of 405,199,000 tons of Danville Coal for McLean County and no known reserves in either De Witt or Piatt Counties. The estimate for McLean County was based on information from only five localities. Since no additional thickness data have been made available to the Illinois State Geological Survey since that time, it is still not possible to change that figure if the same criteria for estimating reserves are applied.

Though of limited reliability, electrical logs of bore holes can frequently be used to make tentative estimates of coal thickness; but unless they are supported by some reliable control, such as diamond-drill core tests or mine information, they must be used with considerable caution. Examination of electrical logs from the three counties suggests that, as indicated in figure 7A, the Danville Coal probably averages no more than 3 feet in thickness throughout the report area except for in and around a roughly triangular shaped area in McLean County with the towns of Colfax, Chenoa, and Fairbury as apices. There are very limited data from within this triangular area, but those which are available suggest that the 4.5 foot average thickness of coal prevailing at mines located in these three communities persists throughout and around the triangular area separating them.

Drilling and logging designed for determination of coal thickness would be necessary, however, before any factual statement concerning thickness and reserves of minable coal other than those arrived at by Cady and others (1952) could be justified.

Herrin (No. 6) Coal Member

The Herrin (No. 6) Coal is the most widely mined coal in Illinois and is present in De Witt, McLean, and Piatt Counties in essentially the same areas as the Danville Coal. Since its stratigraphic position throughout the three counties usually is no more than 30 feet below the Danville, the Herrin, like the Danville, has been removed by post-Pennsylvanian erosion in a part of northwestern McLean County and east of the Osman Monocline. It may also be eroded from local areas within the Mahomet (Teays) Valley in southwestern McLean County.

Other than what can be interpreted from electrical logs, there is no dependable information available about the thickness of this coal in the report area. Southwest, in Macon, Menard, and most of Sangamon Counties, the Herrin (No. 6) Coal is generally too thin for mining and it may not be any thicker in the three counties of this report.

A factor making electrical log interpretation of coal thickness of the Herrin even more questionable than it would be normally is that throughout some parts of Illinois the Brereton Limestone Member may be present at a position very near the top of the coal. Where this situation prevails, the electrical log resistivity pattern is usually recorded as a single deflection and it is not always possible to determine what portion of the peak reflects coal and what portion reflects limestone.

The electrical resistivity curves of logs indicate a thickness of about 4 feet throughout most of Piatt County and a varying thickness ranging from 3 feet to as much as 6 feet in a part of McLean County extending southward from Bloomington (fig. 7B). If this record is a result of coal thickness alone, these areas bear consideration as suitable sites for further investigation. Close examination of many of the electrical logs, however, shows that the spontaneous potential curve reflects an irregularity that suggests the presence of two different rock lithologies at the position of the coal. The rather wide range in the size of the resistivity curves, coupled with the abruptness of change from hole to hole, also tends to cast doubt upon the reliability of the curve as a measure of coal thickness alone. There is also the fact that a log of the Bloomington Coal Company mine shaft at Bloomington shows about 4 feet of Brereton Limestone underlain by clay. It seems that if the coal is present here in any significant thickness, its presence would have been noted and recorded in this log.

Considering all these factors, no attempt has been made to classify these areas as localities of minable reserves of the Herrin Coal. Cady and others (1952) also considered the available data insufficient to warrant classifying Herrin Coal as minable in this area.

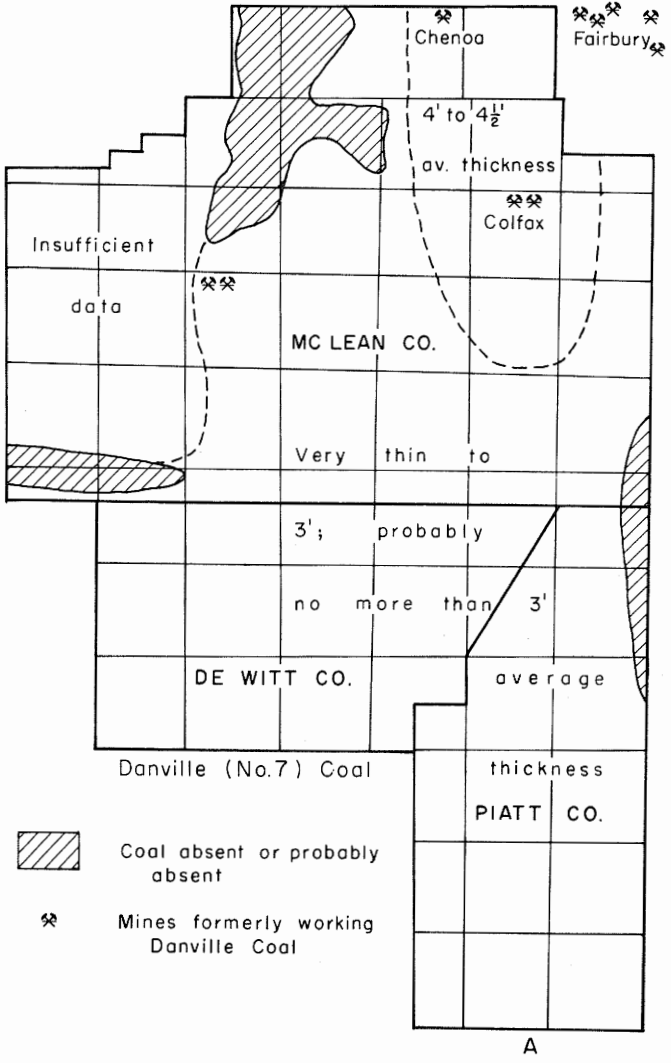
Springfield (No. 5) Coal Member

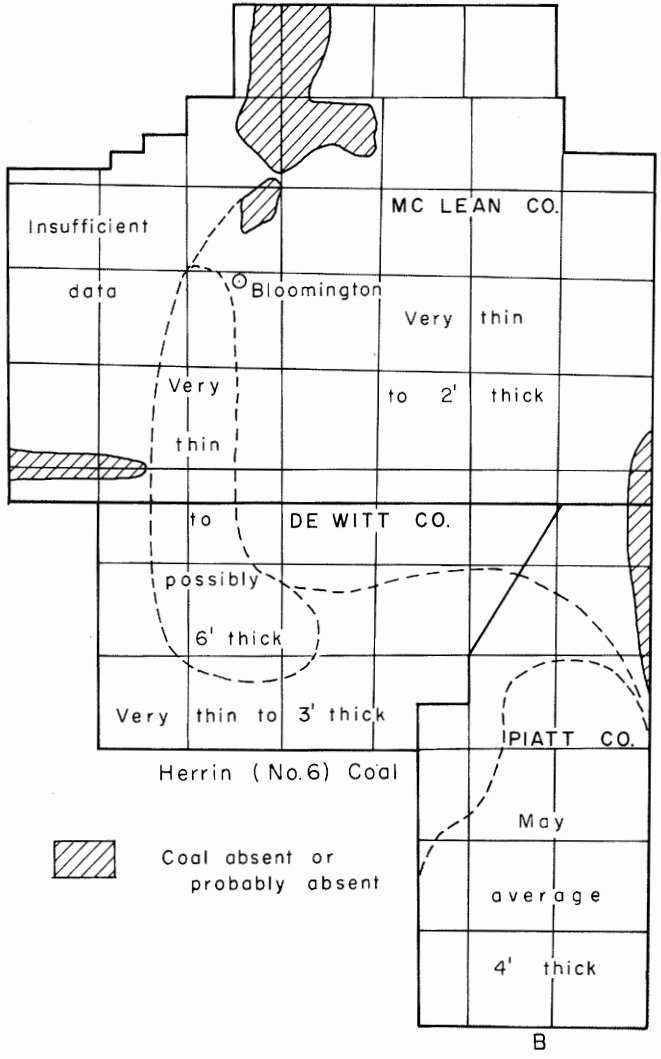
The Springfield (No. 5) Coal, called Harrisburg (No. 5) in southern Illinois, is everywhere present in the report area except locally in parts of western and northwestern McLean County and east of the Osman Monocline in northeastern Piatt and southeastern McLean Counties.

This coal derives its names from the areas of Springfield in Sangamon County and Harrisburg in Saline County, where it has been extensively mined. In De Witt, McLean, and Piatt Counties its stratigraphic position ranges from less than 50 to as much as 80 feet below the Herrin Coal.

The record of a diamond-drill hole near Monticello in Piatt County reported a split coal consisting of two 1-foot beds of coal separated by several inches of shale at the position of the Springfield Coal. Electrical log records from most of the county indicate that the average thickness is no greater than 4 feet.

The coal was mined by the McLean County Coal Company at Bloomington prior to 1920. Records report that there is no limestone "caprock" and that the roof consists of black shale; these conditions are characteristic of this coal throughout much of Illinois. At the Bloomington shaft site, the coal was encountered at a depth of 380 feet and had an average thickness of about 4 feet. "Horsebacks," or clay veins, were reported as being very common (every 25 to 30 feet) and though they usually were only a few inches thick, much coal appears to have been wasted as a result of their presence. "Sulfur (pyrite) veins" also were reported as being numerous in this mine. The coal was mined by the long-wall method.


Chenoa
Fairbury
4' to 4½'
av. thickness
Colfax
Insufficient
data
MC LEAN CO.
Very thin to
3'; probably
no more than 3'
DE WITT CO.
average
thickness
PIATT CO.
Danville (No.7) Coal
Coal absent or probably absent
Mines formerly working Danville Coal
A


Insufficient
data
MC LEAN CO.
Bloomington
Very thin to 2' thick
Very thin to
DE WITT CO.
possibly 6' thick
Very thin to 3' thick
PIATT CO.
May average 4' thick
Herrin (No.6) Coal
Coal absent or probably absent
B

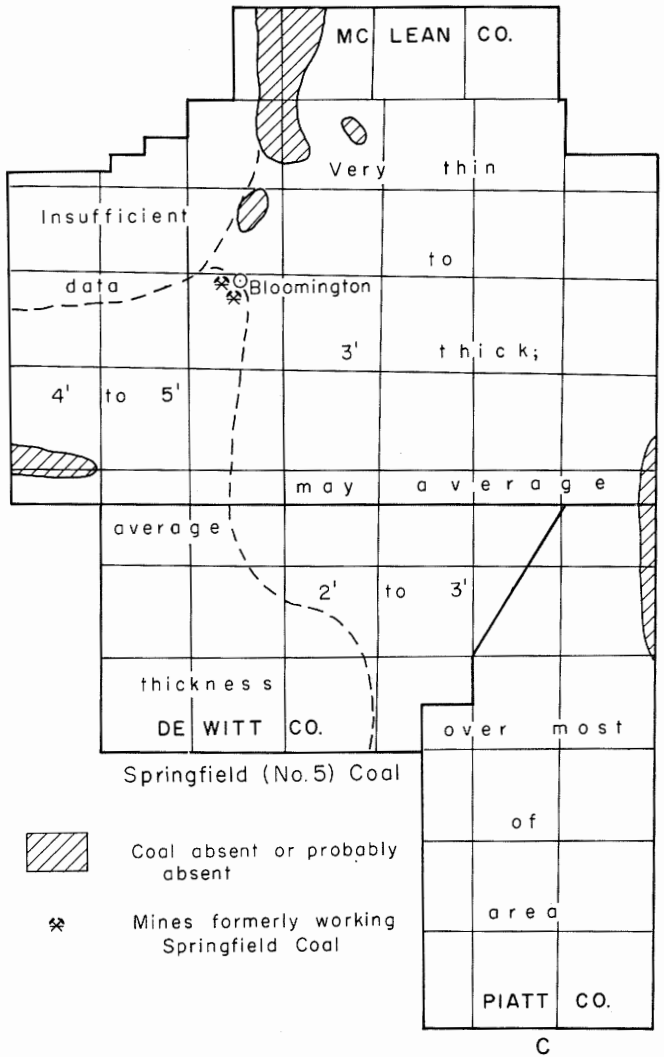


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Fig. 7 - Distribution and estimated thicknesses of coals that appear to have the most likely potential as minable reserves in De Witt, McLean, and Piatt Counties.

After the Springfield Coal was mined for a time, a slope was driven downward to a depth of 513 feet to the Colchester (No. 2) Coal, which was then also mined. Reportedly the Springfield Coal was let down the slope to the level of the Colchester, from whence both coals were hoisted to the surface.

As is true with all coals in the report area, it is not possible to arrive at a meaningful estimate of minable reserves. The Springfield Coal has been mined in Macon and Menard Counties and is known to be quite extensively present there at average thicknesses of 5 to 5.5 feet (Clegg, 1961). The sparse scattering of electrical logs in western De Witt and southwestern McLean Counties suggests that it may extend in minable thickness northeastward throughout most of the area west and southwest of the Downs Anticline, at least as far as Bloomington (fig. 7C).

The possible presence and deleterious effects of horsebacks, or clastic dikes, cannot be ignored in evaluating the Springfield Coal. These clay intrusions have been found to be common in the Springfield Coal in counties immediately southwest and west of the report area. They are a troublesome feature during mining because of the roof problems they create and because of the additional expense and effort required to remove the clayey material from the coal (Cady, 1921). Horsebacks have been discussed in some detail in earlier reports dealing with coal in western and northwestern Illinois (Cady, 1921 and Damberger, 1970).

Cady and others (1952) estimated a total for the three counties of slightly more than 500,000,000 tons of minable Springfield Coal in the four categories of reliability used in their investigation; most of this coal is in McLean County. If the same criteria were applied now, it still would not be possible to enlarge that estimate because no additional thickness data have become available since that time. Indeed there is now reason to seriously question the reliability of the core record of the bore hole shown by Cady and others (1952), located near Saybrook in Township 23 North, Range 6 East, McLean County.

However, considering general geologic probability supported by electrical log data in the southwestern part of the report area, it does seem that significant additional minable reserves may be present. Generally speaking, current geologic knowledge of the report area suggests that there probably are greater reserves of the Springfield (No. 5) Coal than of any of the others but that they are generally restricted to the western and southwestern parts of De Witt and McLean Counties.

Colchester (No. 2) Coal Member

The base of the Colchester (No. 2) Coal marks the base of the Carbondale and the top of the underlying Spoon Formation. The Colchester Coal is the most widespread coal in the Pennsylvanian System of Illinois; it is practically universally present throughout that part of the state underlain by Carbondale and younger Pennsylvanian strata, and its stratigraphic equivalents have been recognized in neighboring states to the east and west. It is known as the Croweburg Coal in Missouri, the Schultztown Coal in western Kentucky, and as the Colchester Coal Member (IIIa) of the Linton Formation in western Indiana.

In Illinois it is not as generally present in minable thickness as are some of the higher coals previously discussed, but its widespread occurrence makes it the most valuable state-wide marker unit for structural mapping of the Pennsylvanian System in the state. Even though it may be only a few inches thick in many areas, its registration on electrical logs is almost always recognizable, making it easy to identify from one bore hole to the next.

With only a few exceptions, mining of the Colchester Coal in Illinois has been limited to the northern half of the state. Formerly it was mined underground in longwall operations in La Salle County, where it was known as the "Third Vein" (Cady, 1915). It has been, and is currently being, strip mined in the Fulton and Peoria County area of western Illinois and in Will County in northern Illinois, and it is a major coal reserve in several counties of northern and western Illinois (Cady and others, 1952).

In the area of this report, the stratigraphic position of the Colchester Coal ranges from as much as 200 feet to as little as 140 feet below the Springfield Coal; the greatest interval is in Piatt County and the shortest occurs over some of the dome structures in northwestern McLean County.

The Summum (No. 4) Coal, the Lowell Coal, and the Oak Grove Limestone Members are persistently occuring marker beds in the interval separating the Springfield Coal from the Colchester Coal (fig. 5). Because they are easily identifiable on electrical logs, these strata serve a very useful purpose in correlation. They are somewhat limited as drilling guides, however, because they may be easily overlooked by a driller and because their vertical position relative to the Springfield and Colchester Coals may vary greatly from place to place. Neither the Summum nor the Lowell Coal appears to be thick enough to be a potential reserve of minable coal within the study area.

As mentioned in the discussion of the Harrisburg (No. 5) Coal, the McLean County Coal Company drove a slope from the level of the Harrisburg down to the Colchester Coal in its mine at Bloomington. Records indicate that the Colchester Coal there had an average thickness of about 44 inches, becoming somewhat thinner under large concretions that were frequently encountered in those parts of the mine where the immediate roof was black shale. The presence of the concretions appears to have had only a slight effect upon mining operations, however. The coal was mined by the longwall method and some of the clay reportedly was used for brick production in a nearby plant. Some heaving of the floor was reported, but the mine was generally quite dry and the minor heaving gave little or no trouble.

The Colchester Coal does not appear to offer great potential as a minable reserve in the three counties of this report. However, since extremely little is known of its thickness except from electrical logs, it may warrant further investigation. Electrical log data do not suggest that the 44 inch average thickness reported in the Bloomington mine persists very far eastward from the mine. There are scant data to the west, but the mine's position relative to the Downs Anticline indicates deepening in that direction (plate 2).

Cady and others (1952) estimated a total of only 296,406,000 tons of Colchester Coal for McLean County, on the basis of the amount of coal in the mine at Bloomington. No estimates were made for De Witt and Piatt Counties. Until more thickness data are available, it remains impractical to alter Cady's estimate.

STRUCTURES

Axes and centers of currently known structures in the De Witt, McLean, and Piatt County area are diagrammatically illustrated in figures 1 and 8 and are shown in greater detail in contour maps drawn on the tops of the Danville and Colchester Coals (plates 1 and 2). Plates 3 and 4 show some of these structures

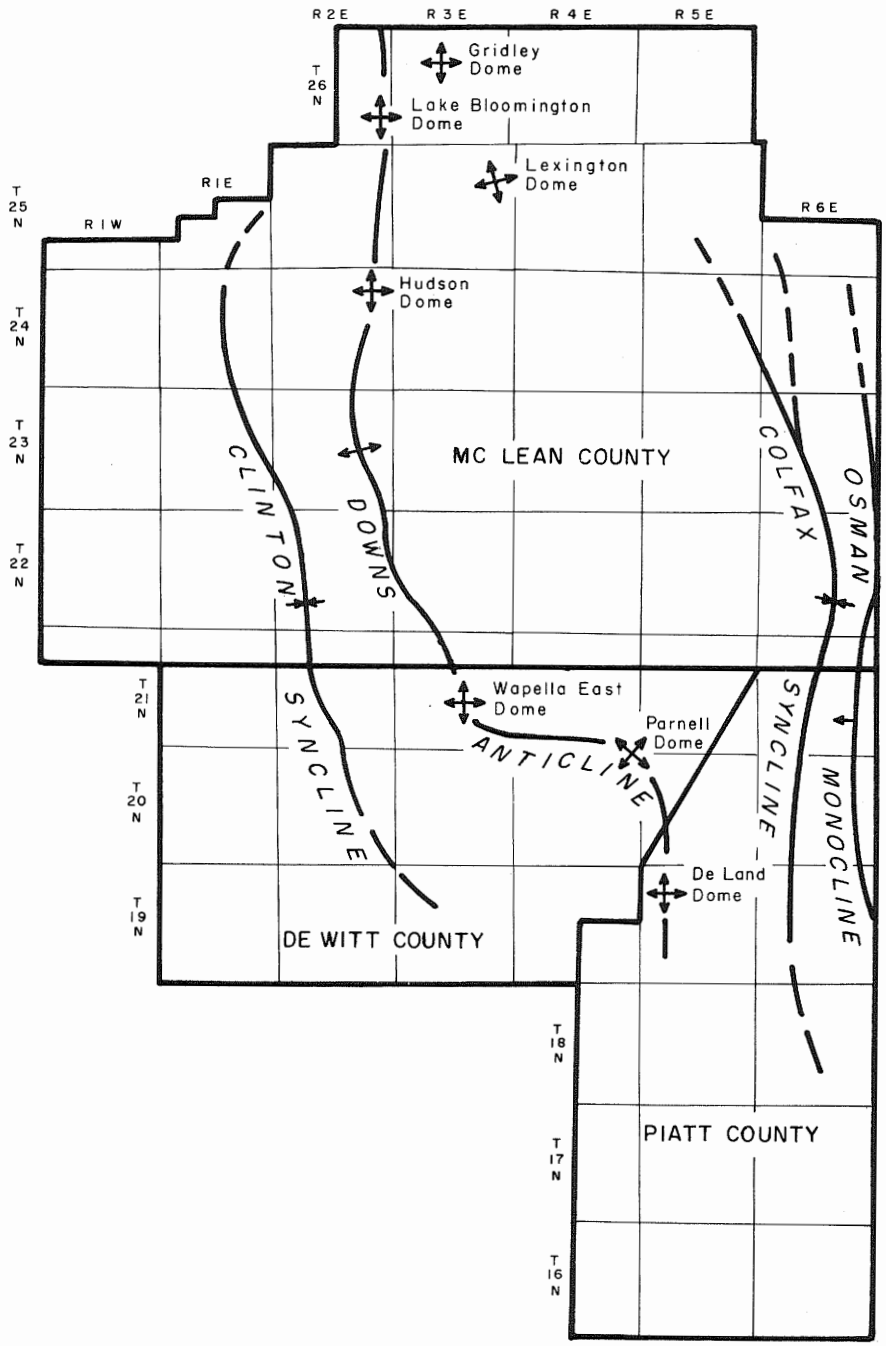

Fig. 8 - Major geologic structures known in De Witt, McLean, and Piatt Counties, Illinois.

in cross section and illustrate the manner of thickening and thinning of stratigraphic intervals between key beds as structures are traversed. Structures in the report area appear to be an integral part of the La Salle Anticlinal Belt, a complex trend of en echelon folds extending from La Salle County on the north through Lawrence County on the south.

Probably the most pronounced structure of the area is the Downs Anticline, an asymmetrical fold that enters McLean County from the north in Township 26 North, Range 2 East (fig. 8). It traverses McLean County in a generally north-south direction into northern De Witt County, where it swings sharply eastward from the Wapella East Dome. In the vicinity of the Parnell Dome the trend again turns southward into Piatt County, where the fold terminates near the De Land Dome.

The Downs Anticline is a very asymmetrical, almost monoclinal, fold with a steeply dipping west limb. It is characterized by the presence of several domes throughout its course. The three at the south have yielded moderate amounts of petroleum. Those at the north are currently used for or being developed for underground gas storage and have been referred to as Hudson, Lexington, Lake Bloomington, and Gridley "structures" by personnel of the Northern Illinois Gas Company who mapped them during geologic investigations relative to underground gas storage. In this report they are accorded the status of "dome," and the geographical name of each as applied by Northern Illinois Gas Company is retained. Thus they are respectively named Hudson Dome, Lexington Dome, Lake Bloomington Dome, and Gridley Dome (fig. 8).

Adjacent to and generally paralleling the Downs Anticline on the west is an asymmetrical syncline whose steep east flank is common with the west flank of the Downs Anticline. Sparse subsurface data do not permit detailed mapping of the north part and the west flank of this fold. The west limb appears to dip irregularly eastward to southeastward, and the north extremity seems to be in southeastern Woodford County in the general area of Township 26 North, Ranges 1 and 2 East. The syncline appears to become generally broader and less asymmetrical in southeastern De Witt and northeastern Macon Counties south of the eastward swing of the Downs Anticline. The name "Clinton Syncline" is here applied to this fold from the town of Clinton, which is situated near its structural axis in central De Witt County.

East of the Downs Anticline is another asymmetrical syncline, the Colfax Syncline, which, as shown on plates 1 and 2, extends from northern McLean County southward into Piatt County. Although available data are too scant to permit detailed mapping in much of McLean County, the Colfax Syncline appears to bifurcate in the general area of Townships 23 and 24 North, Ranges 5 and 6 East. The east branch, however, extends only a few miles northward into southern Livingston County. The west branch can be traced at least as far as Township 27 North in central Livingston County but cannot be mapped in detail there with the limited data currently available. At its south end the syncline widens and loses its identity in Piatt County southeast of the De Land Dome. There is some indication that it merges with the south end of the Clinton Syncline in Macon and Piatt Counties south of the De Land Dome and at the north end of the Fairfield Basin.

The easternmost structure of the three-county area is the Osman Monocline. Its steep west flank is common with the east limb of the Colfax Syncline. Present knowledge indicates that it does not extend much farther north than does the east

branch of the Colfax Syncline, but it is possible that the Pontiac Dome in eastern Livingston County may lie on a northward projection of the Osman Monocline.

To the south there is some indication of an eastward swing of the Osman Monocline into western Champaign County, but data are scarce and the exact nature of this eastward bending and the possible relationship of the Osman Monocline to the Tuscola Anticline in Douglas County are not yet clear. The rather sparse subsurface data available in the area indicate that the fold again swings southward in Township 18 North, Range 8 East in Champaign County and assumes a trend generally in line with that of the Tuscola Anticline.

STRUCTURAL HISTORY

An understanding of the general history of tectonic activity that brought about the present structural configuration of rock strata in the area may be obtained through examination of plates 1, 2, 3, and 4.

Thinning of Mississippian stratigraphic units over the Wapella East Dome as shown in the stratigraphic cross section of plate 3 indicates that the dome had its origin during or prior to Mississippian time. Upward folding of Mississippian strata, best displayed in the structural section of plate 3, shows that further uplift of the dome took place after deposition of Mississippian sediments. That the structure underwent further folding during and/or after Pennsylvanian time also is shown by similar though somewhat less thinning of the overlying Pennsylvanian strata. The Mississippian beds over the dome are upwarped to a greater degree than the Pennsylvanian beds, showing that the Mississippian strata have undergone more total folding than have the overlying Pennsylvanian.

Similar thinning and folding of Pennsylvanian and pre-Pennsylvanian rocks at the east end of these cross sections as the Osman Monocline is approached points to tectonic activity along the axis of the monocline during the same times of tectonics as in the area of the Wapella East Dome.

On plate 4, a north to south stratigraphic cross section, beveling of Mississippian strata shows that prior to deposition of Pennsylvanian strata, Mississippian and older beds had undergone basinward (southward) downwarping and a period of uplift and subaerial erosion. The subaerial erosion obviously took place after deposition of Mississippian and before deposition of Pennsylvanian sediments.

Progressive northward overlap of the beveled erosion surface by Pennsylvanian sediments in the area followed the period of erosion. Basinward downwarping evidently occurred throughout Pennsylvanian time as evidenced by the presence of thicker Pennsylvanian strata in the south part of the area. The history of pre-Pennsylvanian folding and subaerial erosion is also shown in figure 2, where the sub-Pennsylvanian depositional surface is shown to be made up of rocks ranging in age from Chesterian to Silurian.

Perhaps the best portrayal of post-Pennsylvanian tectonic activity is displayed in plates 1 and 2. Indeed the noticeably sharper folding of the Colchester Coal than of the Danville Coal is indicative of minor folding that probably continued through the entire time of Carbondale deposition.

A history of tectonic folding before, during, and probably after Pennsylvanian time in this part of Illinois is consistent with the tectonic history of the state farther south.

Siever (1951) and Clegg (1965) both demonstrated through the use of cross sections and isopachous maps that folding took place in and along the east boundary of the Fairfield Basin at least as early as Ordovician time. Their studies showed continued folding throughout Mississippian time, followed by a period of strong uplift and erosion at the end of Mississippian time. A history of continued though minor folding during Pennsylvanian time, with a period of relatively strong tectonic activity in late Pennsylvanian, or more likely, post-Pennsylvanian time, was also demonstrated by these studies.

The maps and cross sections accompanying this report, though not designed for the specific purpose of interpreting the structural history of the report area, are sufficiently detailed to indicate that the tectonic history of De Witt, McLean, and Piatt Counties was concurrent with and similar to that of counties farther south.

COAL RESERVES AND PRODUCTION

A general discussion of coal production and possible reserves was included with previous remarks about individual coal beds. Cady and others (1952), in a comprehensive survey of minable coal reserves of Illinois, estimated a total of 2,320,136,000 tons of minable coal in four categories of classification in the three counties discussed here. This total can be broken down into 603,370,000 tons of Danville Coal, 500,654,000 tons of Springfield Coal, and 1,216,112 tons of Colchester Coal. Inasmuch as no additional reliable thickness data have become available since the time of Cady's study, it does not seem practical to alter his estimates at this time if the same criteria for judging are applied.

A considerable amount of drilling for petroleum and for gas-storage structures has been done since 1952, however, and good electrical logs have been shown to be usable for estimating coal thickness if there is at least a moderate amount of core or mine thickness information available for control. Unfortunately, core and mine data are not plentiful in the three counties discussed here, and though estimates throughout local areas may be attempted, they must be considered very tentative. Therefore, no attempt has been made to arrive at a revised summary of coal reserves for the area. In this report speculations based upon electrical log data have been made in discussing individual coals, but these have been limited to areas where such information indicates that coal test drilling might be best justified.

There is a good possibility, as mentioned in the section on stratigraphy, that the Springfield Coal may extend in minable thickness from Macon and Logan Counties into western De Witt and southwestern McLean Counties. The information currently available indicates that this general area is a good one for more detailed investigation in the search for large acreages of minable Springfield Coal.

Table 1 contains proximate analyses, total sulfur, and heating values of the Springfield and Colchester Coals from the McLean County Coal Company mine at Bloomington and of the Danville Coal from the Fairbury Coal Company and the Fairbury Cooperative Coal Company mines at Fairbury in Livingston County just beyond the northeast boundary of McLean County. No analyses of the Danville Coal from the mines at Colfax and Chenoa in McLean County are available, but with the exception of local variations in the amount of ash and sulfur, the general quality of a particular coal is usually fairly persistent over

TABLE 1 — COAL ANALYSES — MINE AVERAGES
(from Cady, 1935)

Samples		Proximate and sulfur					Heat values			
County Mine name Mine location Coal name No. of samples	Condition*	Moisture (%)	Volatile matter (%)	Fixed carbon (%)	Ash (%)	Sulfur (%)	Calories	Btu	Rank index	Unit coal index
LIVINGSTON CO.	1	13.8	35.8	38.9	11.5	3.2	6,028	10,850	—	—
Fairbury C. C.	2	—	41.5	45.2	13.3	3.7	6,991	12,580	—	—
5-26N-6E	3	—	47.9	52.1	—	4.2	8,067	14,520	—	—
Danville (No. 7)	4	16.1	39.1	44.8	—	—	6,919	12,460	125	—
3 samples	5	—	46.6	53.4	—	—	8,242	14,840	—	148
LIVINGSTON CO.	1	12.5	33.9	39.1	14.5	3.2	5,906	10,630	—	—
Fairbury Coop.	2	—	38.7	44.7	16.6	3.7	6,756	12,160	—	—
11-26N-6E	3	—	46.4	53.6	—	4.4	8,094	14,570	—	—
Danville (No. 7)	4	15.1	38.1	46.8	—	—	7,044	12,680	127	—
Composite of 3	5	—	44.8	55.2	—	—	8,312	14,960	—	150
McLEAN CO.	1	13.3	38.0	36.2	12.5	3.7	5,878	10,580	—	—
McLean Co. C. C.	2	—	43.8	41.8	14.4	4.3	6,781	12,210	—	—
5-23N-2E	3	—	51.2	48.8	—	5.0	7,920	14,260	—	—
Springfield (No. 5)	4	15.8	42.0	42.2	—	—	6,835	12,300	123	—
3 samples	5	—	49.9	50.1	—	—	8,114	14,610	—	146
McLEAN CO.	1	11.3	42.2	37.7	8.8	3.0	6,426	11,570	—	—
McLean Co. C. C.	2	—	47.6	42.5	9.9	3.4	7,242	13,040	—	—
5-23N-2E	3	—	52.8	47.2	—	3.8	8,039	14,470	—	—
Colchester (No. 2)	4	12.7	45.4	41.9	—	—	7,139	12,850	129	—
6 samples	5	—	52.0	48.0	—	—	8,176	14,720	—	147

*Type of analysis noted as follows:

1 - as received at laboratory
2 - moisture free
3 - moisture and ash free
4 - moist mineral matter free
5 - dry mineral matter free

a sizable geographic area and it is probable that analyses from the two Fairbury mines reflect the general quality of the Danville Coal in northeastern McLean County.

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