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**SUBSURFACE GEOLOGY AND
COAL RESOURCES OF THE
PENNSYLVANIAN SYSTEM IN
Douglas, Coles, and Cumberland
Counties, Illinois**

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ABSTRACT

Pennsylvanian strata of east-central Illinois were studied to determine the geologic structure and coal resources of Douglas, Coles, and Cumberland Counties.

The general character of the Pennsylvanian strata is reported, with emphasis on the interval that includes the commercially important coal beds (lower McLeansboro and Carbondale Groups). The more useful "key beds" are discussed in both regional and local aspect, and tops of three of them, No. 7, No. 6, and No. 2 Coals, were used as datum surfaces for structure contour maps.

The major structural feature of the three counties is the LaSalle Anticlinal Belt, which separates the Bellair-Champaign Uplift on the east from the deep part of the Illinois Basin on the west. Each of these two areal segments is characterized by smaller structures.

Coal production of the area has been limited in the past, and an evaluation of coal reserves based on available information does not indicate that coal in the three counties is ever likely to attain the economic importance it has achieved in other parts of Illinois. More data on thickness of coal are needed, however, for an accurate evaluation of coal reserves.

INTRODUCTION

Cumberland, Coles, and Douglas Counties, in east-central Illinois, lie partly within and partly northeast of the deep part of the Illinois Basin (fig. 1). The three counties are divided structurally into two segments of approximately equal size by the LaSalle Anticlinal Belt, which strikes north-northwest to south-southeast through the entire length of the area (fig. 2). The area east of the anticlinal belt is the Bellair-Champaign Uplift, a segment structurally high in relation to the deep basin area on the west.

Investigation of the coal resources of the three counties has been limited, for the most part, to those beds below the top of the Millersville Limestone. Except for a few exposures of the Millersville and adjacent beds, no outcrops of the strata discussed are known. Subsurface geologic tools and methods were therefore used to obtain and evaluate the data. Most of the information was obtained from electric logs of oil test holes. Records of only nine or ten diamond drill holes in the area were available, but a considerable number of sample study logs from oil



Fig. 1 - Index map showing location of Douglas, Coles, and Cumberland Counties with reference to the deep part of the Illinois Basin.

test holes were used. Geological Survey control wells were an important aid in interpreting the electric logs. Control wells are wells on which one- or two-foot drilling time and five-foot samples were taken by members of the Coal Section of the Illinois State Geological Survey at the time of drilling. These data were normally studied with reference to the electric log of the well.

The data were evaluated from structure contour maps based on the tops of three coal beds, from a contour map of the pre-Pennsylvanian erosional surface, and from numerous cross sections. The maps and one cross section that shows the structure and stratigraphic relationship of strata across the LaSalle Anticlinal Belt are included as illustrations (pls. 1, 2, and 3) and are discussed in the text.

Among previous investigations that have dealt with various parts of the three-county area, or have included it within a broader study, are those of Mylius (1927), Newton and Weller (1937), Taylor and Cady (1944), Horberg (1950), and Wanless (1955). Of these, the most intensive study was that of Mylius, which covered all of Douglas County, but only the east half of Cumberland and Coles

Counties. The previous reports either included the three counties only incidentally or dealt with different aspects of their geology than does the present one. Hence this study is neither a duplication nor a revision of earlier work.

This report is one of a series of similar reports on coal resources published by the Illinois State Geological Survey. Reports on counties adjacent to Cumberland, Coles, and Douglas have been published or are in preparation. DuBois (1951) reported the Pennsylvanian geology and coal resources of Moultrie, Shelby, and northeast Fayette Counties, and the north and east parts of Effingham County, the counties that form almost the entire western boundary of the three discussed here. Similar studies were reported by Williams and Rolley (1955) for Jasper County to the south, and by Potter (1956) for Crawford and Lawrence Counties to the southeast. A study of Clark and Edgar Counties to the east is in progress.

STRATIGRAPHY

The Pennsylvanian System in Illinois consists of the McLeansboro, Carbondale, Tradewater, and Caseyville Groups, named in order of increasing age. Strata of all four groups are present in Cumberland, Coles, and Douglas Counties, but not all groups are represented throughout the entire area. As shown by Wanless (1955), a large part of the Bellair-Champaign Uplift appears to have remained structurally high at the beginning of the Pennsylvanian Period, so that no Pennsylvanian sediments were deposited thereon until after Caseyville time.

The absence of older Pennsylvanian sediments in the higher areas of the uplift and the shortening of the Carbondale and McLeansboro geologic sections show that conditions of sedimentation upon the uplift were very different from those in the deeper part of the basin throughout the whole of Pennsylvanian time. Well records show that strata as young as No. 7 Coal transgressed upon Osage rocks of Mississippian age by progressive overlap near the Coles-Douglas county line in T. 14 N., R. 9 E.

The marked change in stratigraphy and lithologies encountered in tracing a horizon upon and across the Bellair-Champaign Uplift adds greatly to the complexities of correlation and structure interpretation. The problem is further compounded

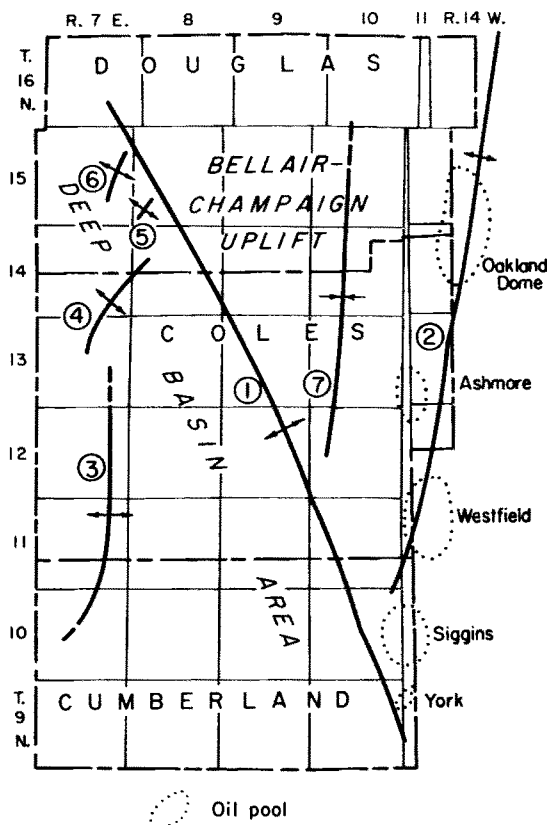


Fig. 2 - Index map showing location of principal structural features in Douglas, Coles, and Cumberland Counties.

- 1 LaSalle Anticlinal Belt
- 2 Oakland Anticlinal Belt
- 3 Mattoon Anticline
- 4 Cooks Mills Anticline
- 5 Chesterville structure
- 6 Bourbon structure
- 7 "Murdock Syncline"

by the scarcity of drill holes on the uplift. Local structures also appear to have exerted enough influence upon sedimentation to have affected lateral continuity and lithology within limited areas.

In the segment of the three counties lying in the deep part of the Illinois Basin, the stratigraphic section of the Pennsylvanian strata is similar to that in the rest of the deep Illinois Basin, and a great many horizons are identifiable in Cumberland, Coles, and Douglas Counties that have been mapped in counties to the south and west (fig. 3). There is also better over-all continuity of the strata, and better control because the intensive search for petroleum in the deep basin area has produced many well logs and samples from which data can be collected. Correlation problems throughout the deep basin area are therefore less complicated than on the uplifted area.

One of the most complete records of the Pennsylvanian strata in the deep part of the three-county area is the log of the abandoned coal mine shaft at Mattoon, Coles County (Worthen, 1883), shown in table 1. The original shaft extended to the base of No. 7 Coal, and a diamond drill hole was later sunk an additional 203 feet to the base of No. 4 Coal (Worthen, 1890). A diagrammatic log of the mine shaft and drill hole records, when compared with electric logs from nearby wells, shows excellent correlation of key beds. Such records are an important factor in verifying electric log correlation.

Key Beds

Discussion of Pennsylvanian stratigraphy in the Illinois Basin is facilitated by the selection of a few relatively thin but unusually persistent and easily recognizable strata as key beds. Limestones and coals are usually selected because they are generally more distinctive in electric log pattern than other strata, and more readily identifiable in well cuttings. Such key beds are only a minor part of the entire rock succession, and their lateral continuity may apply only to a certain area, such as a county. However, most beds designated as key beds in one county are readily recognized in another, and many of them can be traced throughout the basin.

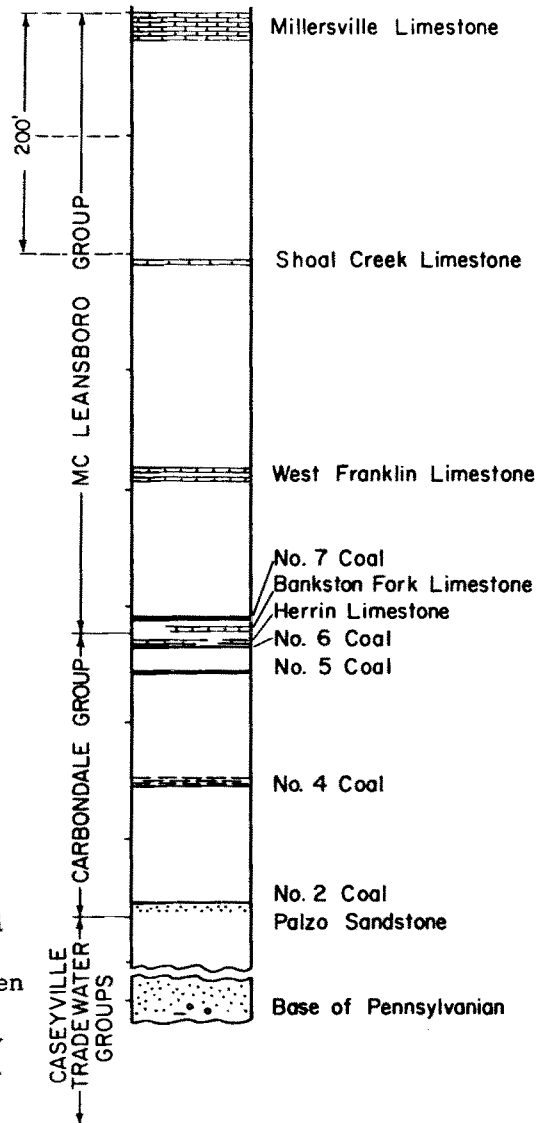


Fig. 3 - Generalized columnar section of the Pennsylvanian strata below the Millersville Limestone in the deep basin area of Cumberland and Coles Counties.

Strata selected for key beds in the Cumberland, Coles, and Douglas area are those found to be most distinctive and readily recognizable in electric logs and drill cuttings, and that have the greatest lateral continuity.

Table 1. - Log of Mattoon Mining Company's Mine Shaft and Core Drill Hole from Bottom of Shaft. On the Peoria, Decatur, and Eastern Railroad at the intersection of 23rd Street and Harrison, Mattoon, Coles County, Illinois. (Modified from Worthen, 1883.)

Log of shaft	Thickness		Depth	
	(ft.)	(in.)	(ft.)	(in.)
Surface soil.	5		5	
Yellow clay	8		13	
Blue sand	3		16	
Hard-pan	35		51	
Sand and gravel	17		68	
Blue clay and gravel	38		106	
Green clay shale	15		121	
Limestone.	1	6	122	6
Clay shale	23		145	6
Limestone.	2		147	6
Coal	0	4	147	10
Fire clay	4		151	10
Clay shale	83		234	10
Black shale and coal.	5		239	10
Red shale	20		259	10
Sandstone and limestone	108		367	10
Coal	1	6	369	4
Fire clay	3	6	372	10
Clay shale	66		438	10
Coal	0	8	439	6
Fire clay	3		442	6
Sandstone	6		448	6
Coal	0	7	449	1
Fire clay and shale	11		460	1
Coal	0	11	461	
Fire clay	4		465	
Limestone, upper part shaly (Millersville).	37		502	

Table 1. - Continued

Log of shaft	Thickness		Depth	
	(ft.)	(in.)	(ft.)	(in.)
Coal	0	4	502	4
Sandy shale	79		581	4
Clay shale	28		609	4
Coal 1'6" to	2	6	611	10
Dark clay shale	2	6	614	4
Coal	0	2	614	6
Fire clay	3		617	6
Gray shale	12		629	6
Limestone (Shoal Creek)	15		644	6
Black slate 2 feet, coal 1 inch	2	1	646	7
Clay shale	36		682	7
Coal	1	1	683	8
Sandstone and shale	72		755	8
Coal	0	11	756	7
Fire clay	2	5	759	
Limestone	8		767	
Blue Shale (West Franklin)	2		769	
Hard gray limestone	12		781	
Sandy shale	58		839	
Sandstone and shale	46		885	
Gray shale	19		904	
Coal (No. 7)	4		908	
Bottom of mine				
Log of drill core				
Fire clay	15		923	
Gray shale	70		993	
Black slate	1		994	
Coal (No. 6)	1	8	995	8
Fire clay	3	4	999	
Dark shale	4		1,003	
Coal No. 5	0	4	1,003	4
Fire clay	1	8	1,005	

Log of shaft	Thickness (ft. in.)	Depth in.)
Light shale	12	1,017
Hard sand rock	4	1,021
Sandy shale	27	1,048
Dark shale	45	1,093
Black slate (No. 4 Coal horizon).	9	1,102
Dark green shale	6	1,108
Limestone	3	1,111
Total thickness drilled, feet	203	
Depth of mine and drill hole	1,111	

Because of the two different structural and stratigraphic segments into which the three counties have been divided by the LaSalle Anticlinal Belt, the problem of selecting key beds that could be traced throughout both areas was more difficult than that presented by some Illinois counties.

Limestones and coal beds other than those selected as key beds have been recognized in the few available diamond drill core logs and sample studies and are identifiable on some electric logs. They have little or no economic significance in any of the three counties, and, as they are not prominent in well records and are of limited or sporadic lateral extent, they have been referred to only incidentally and have not been considered key beds.

Strata between the key beds have not been considered in detail. From the scattered data available it appears that these beds are generally similar to those of the rest of the Illinois Basin, and in the event sufficient detailed information is available to permit more intensive examination, it is quite likely that the cyclical sedimentary pattern will be found to be as well developed in this part of Illinois as it is elsewhere.

Strata selected as key beds for this study are: 1) Millersville Limestone, 2) Shoal Creek Limestone, 3) No. 7 Coal, 4) No. 6 Coal, 5) No. 5 Coal, 6) No. 4 Coal, and 7) No. 2 Coal, named in downward sequence (pl. 3). The West Franklin Limestone, which occurs between the Shoal Creek Limestone and No. 7 Coal, also is generally distinctive throughout most of the area. It is especially readily identifiable in core and sample studies because of a persistent variegated shale and clay horizon. The West Franklin Limestone may be present in as many as three benches, but where only one or two are found it is not always possible to determine which bench is present. It therefore was not generally relied upon as a key bed.

McLeansboro Group

The base of the McLeansboro Group is the base of the Anvil Rock Sandstone. The key beds of the McLeansboro Group are the Millersville Limestone, Shoal Creek Limestone, and No. 7 Coal.

Millersville Limestone

The Millersville Limestone receives its name from exposures near the village of Millersville in Christian County, where the limestone is rather poorly

exposed in secs. 28 and 34, T. 12 N., R. 1 W. (Taylor and Cady, 1944). It is the most prominent limestone of Pennsylvanian age in Coles, Cumberland, and Douglas Counties, and appears to be better developed in the basin area of the three counties than anywhere else in Illinois.

The Millersville is present throughout the deep basin area of the three counties and at places is 50 feet or more thick. It also is present, though not quite so well developed, on the southern part of the Bellair-Champaign Uplift. Its northward and eastward extent cannot be delineated accurately in this area because information from drill holes is limited. It crops out in the banks of the Embarrass River northeast of Charleston, where it is quarried in sec. 32, T. 13 N., R. 10 E., Coles County. Its general dip from there is southward, and the outcrop is probably close to the limestone's maximum northern limit on the uplift. The Millersville does not extend up over the Westfield and Ashmore structures along the eastern margin of Cumberland and Coles Counties.

Stratigraphic sections based on electric logs from Cumberland County to northern Crawford County, made during the early phase of the present investigation, have substantiated previous correlation of the Millersville Limestone with the Livingston Limestone in Crawford County.

The Millersville Limestone also has been identified in counties south and west of Cumberland, Coles, and Douglas Counties. DuBois (1951) found it throughout Moultrie and Shelby Counties but he could not trace it to the southern boundary of Effingham County. The limestone also was identified by Williams and Rolley (1955) in Jasper County where it consisted of limestone benches from 2 to 8 feet thick separated by shale beds of approximately equal thickness. They, too, found that the limestone disappeared southward by gradual transition into shale and siltstone. In Crawford County, where it is called Livingston Limestone (Potter, 1956), it was found to consist of two benches separated by 30 to 40 feet of shale and to be restricted to the northern part of the county. Irregular occurrences of limestone and shale beds at the approximate position of the Millersville were recognized by Lowenstam (1951) in the northern part of Clay County. He reported that the limestone beds thinned rapidly southward, became increasingly argillaceous and sandy, and could not be positively identified as the Millersville.

North and east of Cumberland and Coles Counties the Millersville Limestone is limited in areal extent by post-Pennsylvanian erosion. Southward, however, a change of sedimentary environment appears to have resulted in gradual transition from limestone to argillaceous and silty sediments.

In the deep basin part of Coles, Cumberland, and Douglas Counties, the stratigraphic position of the Millersville Limestone ranges from 450 to 525 feet above No. 7 Coal, the thinner interval being to the north in Douglas County. (The top of No. 7 Coal is used in this report as a datum plane of reference to the position of other strata because it is the most widely recognized of all the key beds.) The interval between the Millersville and No. 7 Coal also thins over the flanks of the LaSalle Anticlinal Belt. In northern Coles and Douglas Counties the limestone has been truncated along the crest of the fold by post-Pennsylvanian erosion. In the southern part of the three counties it extends over the fold and onto the Bellair-Champaign Uplift. In the same area, the interval between the Millersville and the No. 7 Coal thins gradually northward and is only 300 to 325 feet thick near its outcrop boundary in T. 13 N.

From studies of well cuttings, the Millersville Limestone is generally described as a gray to buff, dense, crystalline, and richly fossiliferous rock. Its

electric log pattern in its area of maximum development is characterized by prominent resistivity. More frequently than not the pattern consists of two peaks. The upper peak is much thinner than the lower and indicates a thickness of 5 feet or so of limestone separated by a foot or two of shale from the limestone indicated by the lower peak. On the Bellair-Champaign Uplift the electric log pattern suggests gradual transition of the limestone into a more shaly facies consisting of limestone benches separated by shale.

Shoal Creek Limestone

The Shoal Creek Limestone derives its name from Shoal Creek, Clinton County, along which it crops out. In Coles, Cumberland, and Douglas Counties it is well developed and generally persistent, lying about 100 feet below the Millersville Limestone. Like the Millersville, it is best developed in the deep basin area of the three counties. Its maximum thickness is about 15 to 20 feet. Judging by its electric log pattern, it grades laterally into a calcareous sand and silt section in some localities, but, on the whole, within the three counties it is a reliable marker over approximately the same lateral extent as the Millersville Limestone. It, too, is limited on the north and northeast by post-depositional erosion. South and southwest of Cumberland, Coles, and Douglas Counties, it has been identified in almost every county of the deep part of the Illinois Basin.

Stratigraphically the Shoal Creek Limestone is about 325 to 350 feet above the No. 7 Coal in the deep basin area, but, like the Millersville - No. 7 Coal interval, the Shoal Creek - No. 7 interval thins gradually towards the north and upon the flanks of the LaSalle Anticlinal Belt. On the Bellair-Champaign Uplift the interval between the Shoal Creek Limestone and the No. 7 Coal thins northward to no more than 100 feet.

The Shoal Creek Limestone, as described from study of drill cuttings, is commonly gray to white, sometimes buff, dense, fine- to medium-grained, and fossiliferous in the area where it is well developed. Locally it appears to become very argillaceous and its position in some places is occupied by clastic sediments. The electric log pattern for the well developed limestone is characterized by a single pronounced resistivity peak that generally is well defined at the base.

No. 7 Coal

No. 7 Coal is the most persistent and widespread key bed used throughout the three counties (pl. 1A). It has been correlated with the Danville (No. 7) Coal of Vermilion County and the Cutler Coal of southwestern Illinois. It extends up over the LaSalle structure in all of Coles County and in the southern part of Douglas County. On the Bellair-Champaign Uplift the No. 7 Coal was identified in drill records northward through the southern third of T. 16 N. in Douglas County. How far north of Murdock it extends cannot be determined because of the limited amount of data available. On the structurally higher part of the Bellair-Champaign Uplift (immediately west of the Murdock Syncline) the No. 7 Coal extends northward beyond the limit of the No. 6 Coal and other lower beds as a result of progressive overlap onto the southeastward plunging LaSalle Anticlinal Belt.

In the deep basin part of the three-county area No. 7 Coal has been recognized in drill records beyond the north boundary of Douglas County and was present in a diamond drill core taken from sec. 18, T. 17 N., R. 7 E., near Ivesdale in Champaign County. It is also present in minable thickness in northern Illinois, and

is almost universally present in the deep part of the Illinois Basin south and southwest of Cumberland, Coles, and Douglas Counties.

In the record of a petroleum test well in the north part of sec. 1, T. 15 N., R. 7 E., Douglas County, No. 7 Coal was absent. At this location a sand zone of considerable vertical extent occupies the normal position of the No. 6 Coal and other lower coals over quite a wide area (pl. 1B), but the No. 7 Coal was found to have been affected in only the one well record cited above.

No. 7 Coal is the only coal that ever has been commercially mined in any of the three counties. It was formerly mined in the city of Mattoon where, according to available records, it had an average thickness of about 42 inches and was reached at a depth of 904 feet. It is currently being mined near Murdock in Douglas County where its thickness ranges from 6 to 7 feet. These thicknesses may give a misleading impression of the average thickness of the coal throughout the three counties as a whole. Coal thickness cannot be determined with much accuracy from electric logs, but the small resistivity peak that generally represents the No. 7 Coal suggests that the thicknesses encountered at Mattoon and Murdock are greater than the average. The impression of thin coal is substantiated by evidence from the few scattered control wells wherein thicknesses of a foot or two, and at some places even less, are indicated. The coal was reported to be 27 inches thick in a core taken near Ivesdale in Champaign County, but only 7 inches thick in a diamond drill core from sec. 36, T. 16 N., R. 7 E., Douglas County, near Ficklin.

Carbondale Group

The Carbondale Group of strata includes those beds between the base of the Anvil Rock Sandstone and the base of the Palzo Sandstone. Included in the group are the Herrin (No. 6), the Harrisburg (No. 5), the Sumnum (No. 4), and the Colchester (No. 2) Coals. No. 6, No. 5, and No. 2 Coals probably are the most commercially important coals of Illinois, and the No. 4 Coal is significant in stratigraphic studies and correlation problems because it is consistently present throughout wide areas and easily identified in well cuttings and electric logs.

All four of these coals are persistent throughout the deep basin area of the three counties. Coals below the No. 6 Coal, however, can be traced with certainty over only the southern half of the Bellair-Champaign Uplift. The entire stratigraphic section thins toward the north, and there appears to be good evidence that the lower coals, including the No. 2 Coal, were never present on the north half or over some of the structurally higher parts of the central part of the uplift.

Herrin (No. 6) Coal

The Herrin (No. 6) Coal lies below the No. 7 Coal at a depth that ranges from 25 to 35 feet in southern Cumberland County to as much as 100 feet in the deep basin area of Coles County. The interval thins to about 50 feet in Douglas County as the LaSalle structure is approached. On the Bellair-Champaign Uplift the interval from No. 7 Coal to No. 6 Coal thins from about 40 or 50 feet in the south to 25 feet or less in Douglas County. The interval is quite variable within short distances on the uplift, however, and appears to be strongly influenced by local structural irregularities.

Although it is one of the most economically important coals in Illinois, the No. 6 Coal is not well developed in Cumberland, Coles, and Douglas Counties. Its electric log resistivity peak is sometimes so poorly defined that it is difficult

to differentiate between it and the No. 5 Coal, which may be less than 10 feet below the No. 6 Coal in some localities. An example of the proximity of the No. 6 and No. 5 Coals is given in the log of a diamond drill hole sunk below the bottom of the Mattoon Mining Company shaft in Mattoon (table 1). There the two coals are shown to be separated by an interval of only 7 feet 4 inches (bottom of No. 6 Coal to top of No. 5 Coal).

No. 6 Coal was found to be thin or absent in localized areas of Moultrie and Shelby Counties to the west (DuBois, 1951), and it may not be present in those parts of the basin area of Cumberland and Coles Counties where it cannot be identified with certainty on electric logs. It must be remembered in this connection, however, that a small electrical anomaly does not necessarily mean that the coal is poorly developed or absent; the small resistivity peak can well be a function of logging methods or other unexplainable factors.

In parts of Ts. 14 and 15 N., R. 7 E., Coles and Douglas Counties, several electric logs show a sand section that occupies the normal stratigraphic sequence from above the No. 6 Coal through the No. 4 Coal, and one electric log, already described, shows the No. 7 Coal also was absent (pl. 1B). A diamond drill core taken from sec. 16, T. 14 N., R. 7 E., Douglas County, contains a sand section that extends from about 10 feet below the No. 7 Coal to about 30 feet above the No. 2 Coal.

Except for these local areas of absence or extreme thinness, however, the No. 6 Coal has approximately the same lateral extent in Cumberland, Coles, and Douglas Counties as does the No. 7 Coal. A local and notable exception occurs in T. 14 N., R. 9 E., just north of the Coles-Douglas county line, where the McLeansboro and Carbondale beds were deposited on the Mississippian rocks by progressive overlap. Here the No. 7 Coal extends beyond the northern limit of the No. 6 Coal, but lack of sufficient detailed information does not permit accurate delineation of the boundary of either coal (pls. 1A, 1B).

No. 6 Coal appears to be generally thinner than the No. 7 Coal throughout most of the three counties. Illinois Geological Survey control wells sometimes indicate a thickness of less than one foot. In the Mattoon shaft and diamond drill record, the No. 6 Coal was found to be only 20 inches thick. Although reliable thickness data are scarce, the existing information indicates that the No. 6 Coal is probably less than 3 feet thick throughout the greater part of the three counties, and in a considerable portion of the area may well be less than one foot thick.

Harrisburg (No. 5) Coal

The Harrisburg (No. 5) Coal, another of the more economically important coals of Illinois, is, like the No. 6 Coal, poorly developed in Cumberland, Coles, and Douglas Counties. The No. 5 Coal is the most important commercial coal of the Springfield and Peoria districts, where it is called the Springfield (No. 5) Coal. The name Harrisburg (No. 5) is derived from the city of Harrisburg in Saline County. The No. 5 Coal has a wide distribution in the deep part of the Illinois Basin. It is of workable thickness in most of southern Illinois east of the DuQuoin Monocline but may be only sporadically present west of the monocline.

In Cumberland, Coles, and Douglas Counties, the No. 5 Coal lies so closely below the No. 6 Coal that their structural contour maps would be very similar. The lateral extent of the No. 5 Coal also appears to be almost the same as that of No. 6 Coal. Few well records on the north part of the Bellair-Champaign Uplift reach

No. 5 Coal and no attempt was made to map its lateral extent. Its close relationship with No. 6 Coal, however, would naturally tend to keep the truncated boundaries of the two coals confined to rather narrow limits. Sandstone occupies the stratigraphic position of the No. 5 Coal in an area of northwest Coles and southwest Douglas Counties - practically the same area in which sandstone occupies the position of the No. 6 Coal.

Few reliable data on the thickness of the No. 5 Coal are available from the three counties, but all evidence indicates the coal is thin. It was recorded as only 4 inches thick in the diamond drill core sunk from the bottom of the Mattoon Mining Company shaft in Mattoon. Sample studies from Illinois State Geological Survey control wells and the few churn drill sample study records indicate that nowhere in the three counties does it attain sufficient thickness to be of economic significance.

Summum (No. 4) Coal

The Summum (No. 4) Coal or its position is consistently recognized in the deep basin area of Cumberland, Coles, and Douglas Counties. It was selected as a key bed because its persistence made it a useful datum of measurement for determining the position of the No. 2 Coal when the position of that coal is locally occupied by clastic sediments.

No. 4 Coal is equivalent to the Indiana IV-A Coal. The No. 4 Coal generally is not thick enough to be of commercial value in the southern half of the deep Illinois Basin, although the coal or its position is sufficiently persistent here also to serve as a useful marker for correlation. In western Illinois, the No. 4 Coal is a lenticular bed of infrequent occurrence, but locally in Fulton County small lenses have been mined near Summum and Ipava, as well as near Roodhouse and Greenville in Greene County. In Knox County the No. 4 Coal has been mined near Soper-ville. The coal derives its name from the town of Summum, Fulton County.

The No. 4 Coal lies about 200 feet or more below the No. 7 Coal in the deep basin area of Cumberland and Coles Counties. This interval tends to thin slightly over the Mattoon and Cooks Mills Anticlines and northward into Douglas County as the west flank of the LaSalle Anticlinal Belt is approached. It thins to as little as 150 feet over the crest of the LaSalle Anticlinal Belt and northward over the Bellair-Champaign Uplift.

The position of the No. 4 Coal is distinguished on electric logs by a resistivity peak on the normal curve and a more pronounced reverse deflection of the third curve. The opposing deflections are especially noticeable because they generally occur at the base of a monotonous shale-silt section 50 to 75 feet thick that normally separates the No. 4 and No. 5 Coals in most of the deep basin area of the three counties.

The meager data available indicate that the No. 4 Coal is poorly developed. Where it is absent, its position is at the contact between black fissile shale and the underclay of the No. 4 Coal.

Colchester (No. 2) Coal

The Colchester (No. 2) Coal is the lowest stratum given the status of key bed from the Cumberland, Coles, and Douglas Counties study. It derives its name from the town of Colchester in McDonough County. It is present in minable thickness along the Illinois River between Beardstown and Peoria and southward from

Beardstown as far as Edwardsville, Madison County, and also is mined in the northern Illinois mining district. No. 2 Coal is one of the most widespread coals of Illinois, but, except for the districts just cited, it seldom attains minable thickness. It is, however, useful in stratigraphic studies because it is so widespread.

In the deep basin area of Cumberland, Coles, and Douglas Counties, the No. 2 Coal lies about 250 to 275 feet below the No. 7 Coal. Progressive thinning of this interval takes place northward and upon the flanks of the LaSalle Anticlinal Belt. No. 2 Coal is present consistently in the deep basin area of Cumberland, Coles, and Douglas Counties except where indicated on plate 2A. It could be traced over only the southern part of the Bellair-Champaign Uplift, however. In view of the structural and sedimentary history of that area it seems likely that parts of the uplift, especially toward the north and over local high structures, probably were too high to receive Pennsylvanian sediments until after the time of deposition of No. 2 Coal.

No. 2 Coal was selected as a key bed because it was the traceable marker bed closest to the base of the Carbondale Group. The Palzo Sandstone, the base of which marks the basal limit of the Carbondale Group, lies just below the No. 2 Coal. The Palzo Sandstone appears to be of sporadic occurrence in much of the area, however, and does not form a dependable datum horizon.

STRUCTURE

The geology of Cumberland, Coles, and Douglas Counties is considerably more complex both stratigraphically and structurally than that of many counties in the deep part of the Illinois Basin. Two major and several minor structural features have had a pronounced effect upon the sedimentational history of the three counties, and have added to the complexity of correlation and interpretation of geologic history (fig. 2).

The most prominent structural feature is the LaSalle Anticlinal Belt, an asymmetrically folded anticlinal structure that traverses the entire area in a north-northwest to south-southeast direction and plunges south-southeast. The western flank is the steeper and its intensity of folding decreases from north to south. A local interruption in the folding of the Pennsylvanian beds near the south boundary of Coles County results from the draping of these strata over what appears to be an east-facing scarp eroded into the underlying Mississippian strata (pl. 3). The LaSalle structure is readily identifiable on the three coal structure maps (pls. 1 and 2A) and on the map of the pre-Pennsylvanian erosional surface (pl. 2B). The anticlinal belt divides the three counties into two areas of approximately equal size, the structurally higher Bellair-Champaign Uplift on the east and the deep basin area on the west.

The LaSalle Anticlinal Belt is folded most steeply through Coles County, where its west flank becomes progressively steeper northward until it is interrupted by junction with another major fold trending north-south. The gently dipping east flank of the LaSalle Anticlinal Belt forms the west flank of the Murdock Syncline in Douglas and Coles Counties.

The Bellair-Champaign Uplift is compounded by several minor structural features. The Murdock Syncline appears to have its northern limit in northeast Douglas County and extends south and somewhat westward until it joins the LaSalle Anticlinal Fold south of Charleston in Coles County. The Oakland Anticlinal Belt, a series of roughly aligned domes - Siggins, Westfield, Ashmore, and Oakland - which extend more or less eastward beyond the boundaries of Cumberland, Coles,

and Douglas Counties, borders the uplift on the east. The structurally highest part of the Bellair-Champaign Uplift is in central Douglas County at the broad crest of the fold where rock strata as old as Devonian form the bedrock surface.

The most prominent structural feature of the deep basin area of Cumberland, Coles, and Douglas Counties is an anticlinal fold that extends north and south along the west side of the three counties. This structural trend may more accurately be described as a series of irregular folds separated by intervening saddles. The southernmost and longest element, the Mattoon Anticline, extends from a few miles north of Mattoon southward into Cumberland County. It then swings southwestward into Shelby County and becomes progressively less prominent toward the south.

North of the Mattoon Anticline, and separated from it by a low saddle, is the Cooks Mills Anticline. It appears to have a distinctive character of its own, trending in a southwest to northeast direction instead of the more general north-south direction of the folds north and south of it. The Cooks Mills Anticline extends into the west flank of the LaSalle Anticlinal Fold with a slight saddle marking the zone of merge.

The Chesterville structure, to the north of the Cooks Mills Anticline, impinges on the west flank of the LaSalle Anticlinal Belt. It is structurally lower than the Cooks Mills Anticline on the south and separates it from the Bourbon structure to the north.

The Bourbon structure appears to be an irregular nose, trending southward from the west flank of the LaSalle Anticlinal Belt. At its southern limit it tends to swing slightly westward, but loses its identity south and west of the town of Chesterville.

The Bourbon structure is more prominent and shows more westward displacement on the No. 7 Coal than on the No. 2 Coal (pls. 1A, 2A) or on the pre-Pennsylvanian erosional surface (pl. 2B). As I mentioned in discussing the No. 6 Coal, a considerable thickness of sandstone occupies the normal rock succession in part of this area, and it may be that the position and prominence of the Bourbon structure as reflected on the No. 7 Coal owes some of its character to differential compaction over and around the sandstone body.

Comparison of the structure maps of the No. 7 and No. 2 Coals (pls. 1A, 2A) shows that, although generally similar throughout the three counties, the structural features increase somewhat in intensity with depth. Plate 3 contains two cross sections, one of which shows the stratigraphic relationship and the other the structural relationship of the strata in a line trending generally east-west across Coles County.

COAL PRODUCTION

Commercial production of coal in the three counties has been limited to the No. 7 Coal by two mines operating in widely separated areas. The older, now abandoned, was that of the Mattoon Mining Company in the SE $\frac{1}{4}$ sec. 14, T. 12 N., R. 7 E., Coles County, in the city of Mattoon. According to available records the mine operated from 1883 to 1887, inclusive. The coal had a reported average thickness of about 42 inches, was reached at a depth of 904 feet, and was mined by the long-wall method (a mining method generally confined to the coal fields in the northern part of the state).

To the northeast, in sec. 34, T. 16 N., R. 10 E., Douglas County, a mile west of the village of Murdock, the No. 7 Coal is being mined by the Moffat Coal

Company. The mine began production in 1946 and has been continuously active since.

A third mine shaft in sec. 18, T. 10 N., R. 7 E., Cumberland County, was sunk to a depth of 200 feet, but according to records no coal was reached and the operation was abandoned.

The Trowbridge Coal, an irregular vein about 400 feet above the Millersville Limestone, occurs locally in outcrop or under cover shallow enough to be strip mined in Shelby County just west of the Cumberland County line. It has a recorded thickness in this area of about 24 inches. It is apparently too deep for strip mining in Cumberland County.

It is probable that local outcrops of some of the stratigraphically higher coals have been mined from time to time by individuals for home use, but none of these coals are known to be thick enough or widespread enough to make commercial production practicable.

COAL RESERVES

Coal reserves of Cumberland, Coles, and Douglas Counties were discussed by Cady (1952), and little can be added to his information. He found that reliable data on thickness of coal was insufficient to permit an estimate of reserves for most of the area. The available information indicated that the coals generally were thin and that they were at greater depths west of the LaSalle Anticlinal Belt than they were on the structurally higher eastern part of the area.

The present investigation has not added appreciably to what was then known about the thickness of the coals but it has substantiated Cady's opinion that the coals generally were poorly developed. The most significant contributions made have been the correlation of the various coals throughout the three counties, a better understanding of the area's structure, a means of determining with reasonable accuracy the depth to coal at any given locality, and a better understanding of the lateral extent and persistence of the individual coals.

One available diamond drill hole record, that of the National Petrochemical Corporation in the NW $\frac{1}{4}$ of sec. 36, T. 16 N., R. 7 E., near the village of Ficklin in Douglas County, shows the No. 7 Coal to be only 7 inches thick. At Mattoon, the No. 7 Coal is of minable thickness, 42 inches, and 904 feet deep, as shown by records of the Mattoon Mining Company. Coals below the No. 7 Coal in the deep basin area of the three counties generally appear to be less than 3 feet thick and to lie at depths greater than any current mining in the state.

On the Bellair-Champaign Uplift, the No. 7 Coal attains a commercial thickness of 6 to 7 feet in part of the Murdock Syncline, but available information suggests that this thickness does not persist throughout the entire uplifted area. Such diamond drill records as are available indicate that the coals below the No. 7 Coal are generally too thin to be of economic value at present.

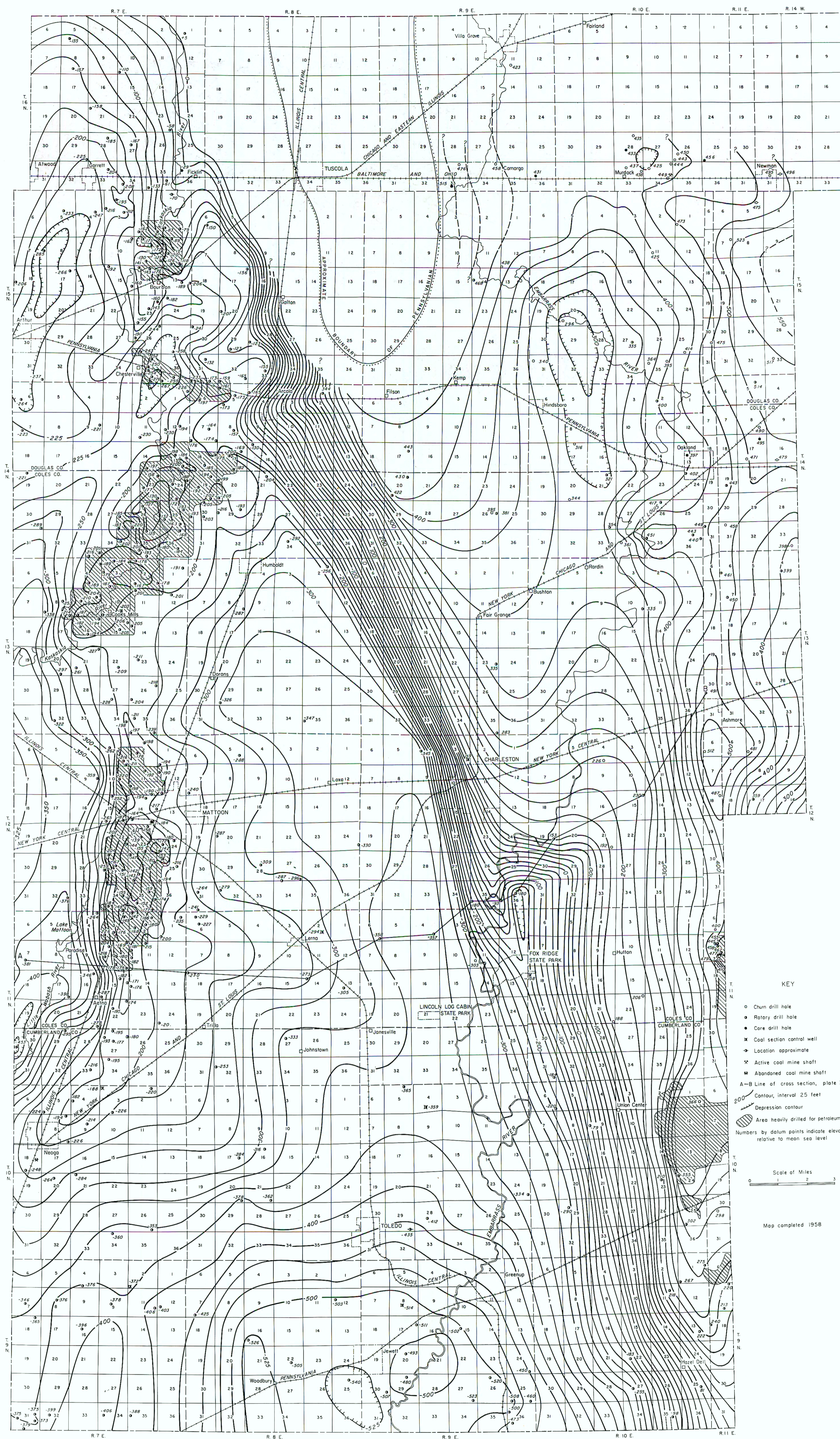
Before any final evaluation of possible coal reserves of Cumberland, Coles, and Douglas Counties can be made, core samples should be obtained to provide additional information on thickness of coal. Sample study of churn drill holes and rotary wells, when combined with drilling time, give indications of coal thickness, but drill cores offer the most reliable basis for accurate evaluation.

It should be remembered that development of new mining methods or other ways of exploitation may in the future make it profitable to use coals that cannot now be considered as economically important.

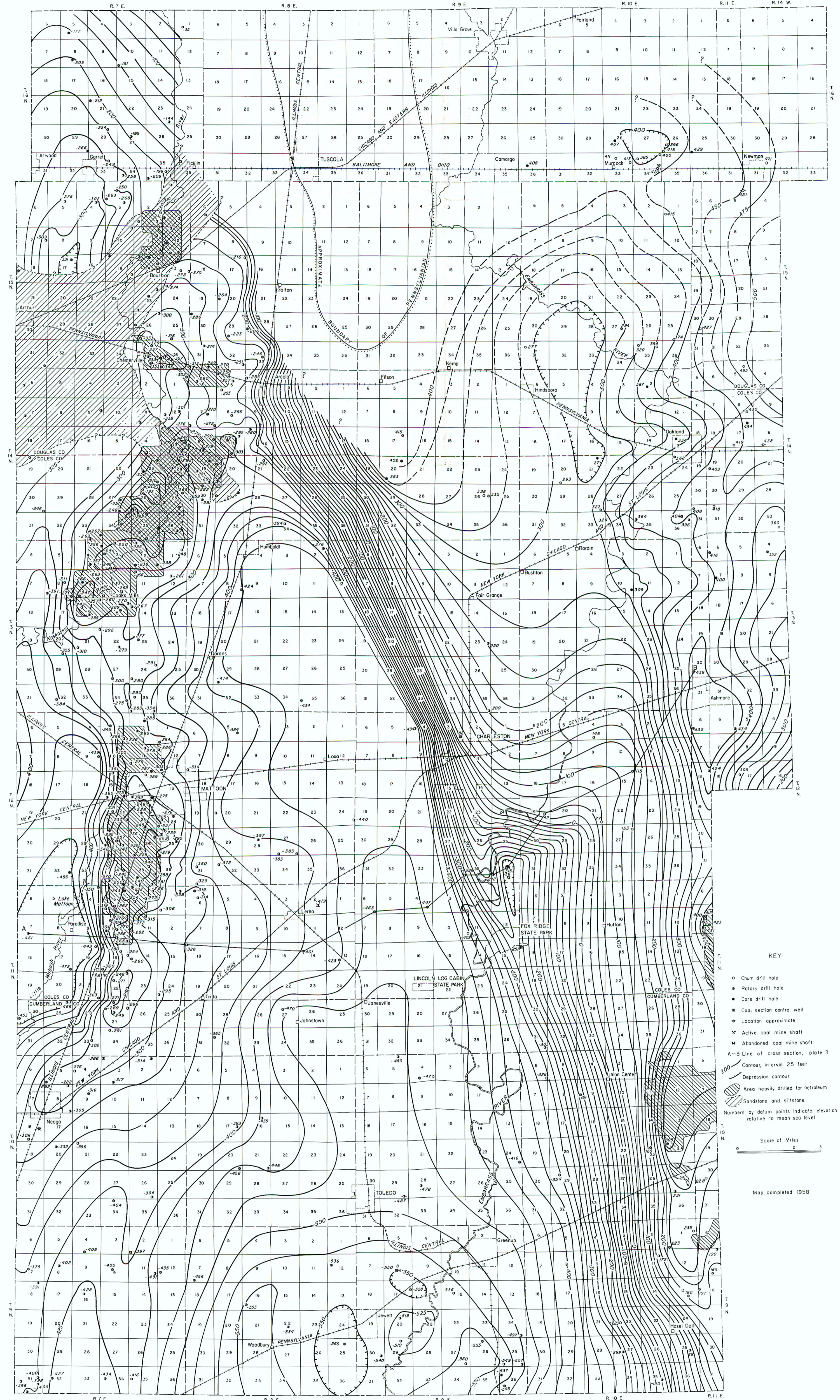
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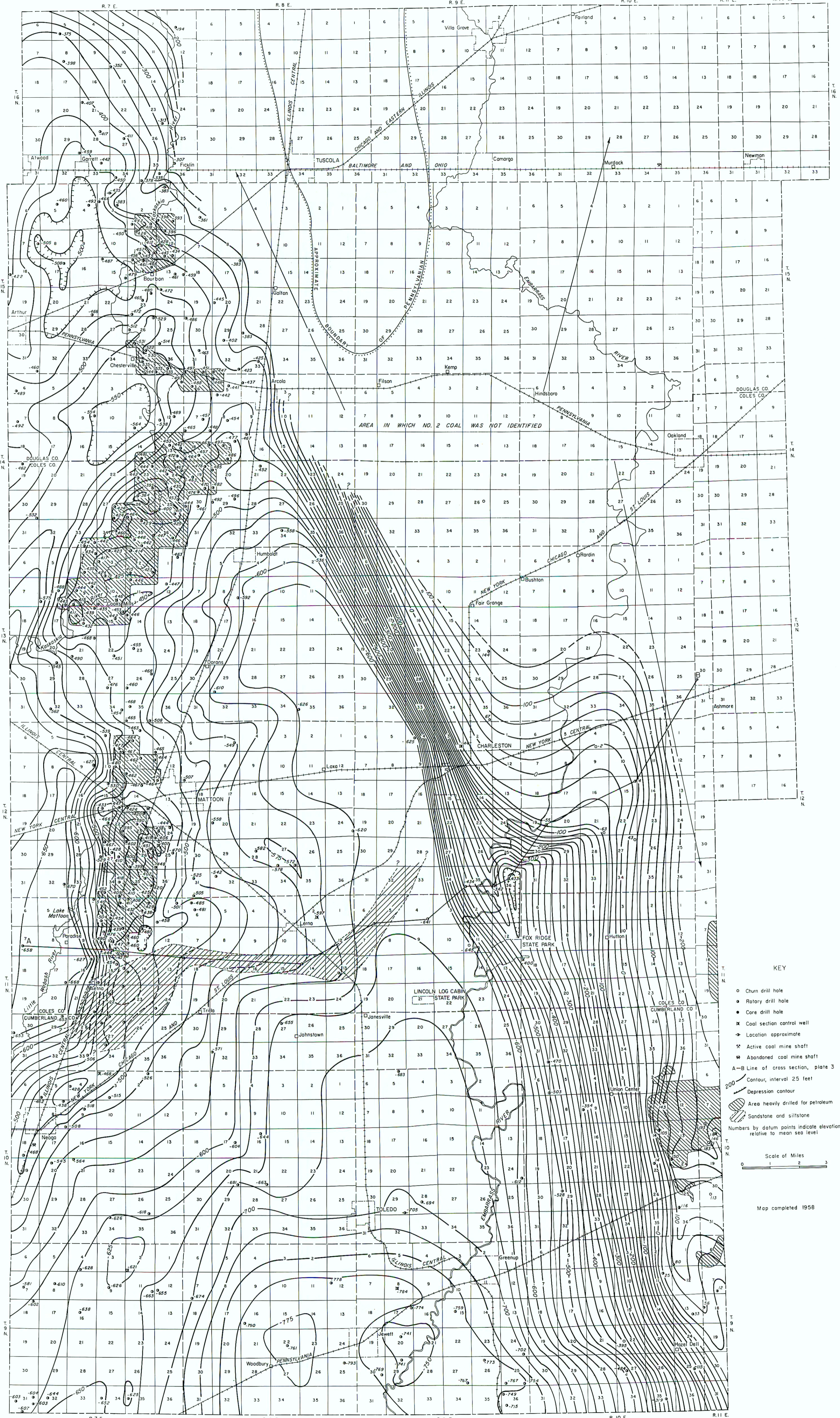
Illinois State Geological Survey



A - STRUCTURE CONTOUR MAP ON TOP OF NO. 7 COAL IN CUMBERLAND, COLES, AND DOUGLAS COUNTIES
KENNETH E. CLEGG

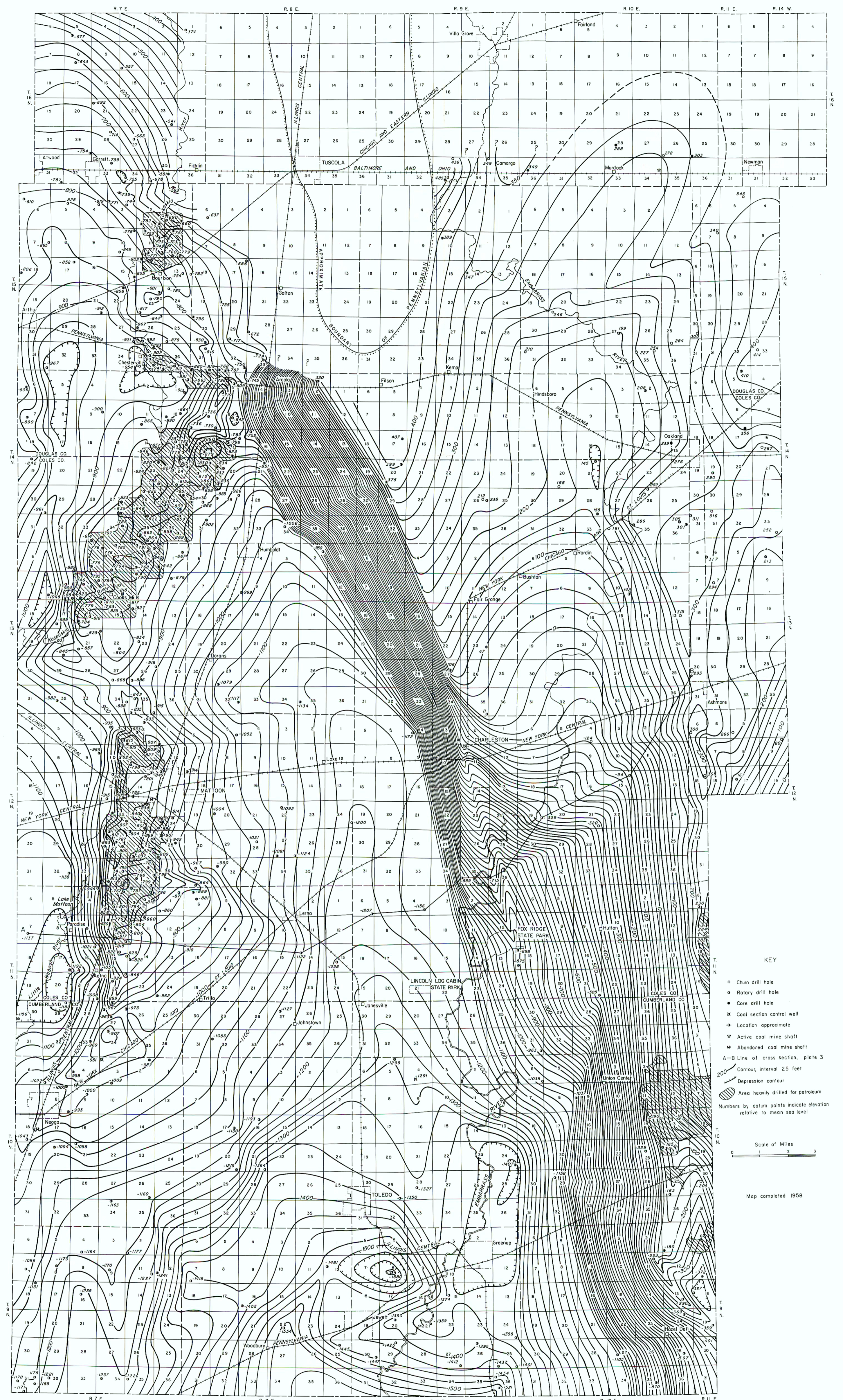


B - STRUCTURE CONTOUR MAP ON TOP OF NO. 6 COAL IN CUMBERLAND, COLES, AND DOUGLAS COUNTIES
KENNETH E. CLEGG



A - STRUCTURE CONTOUR MAP ON TOP OF NO. 2 COAL IN CUMBERLAND, COLES, AND DOUGLAS COUNTIES

KENNETH E. CLEGG



B - PRE-PENNSYLVANIAN EROSIONAL SURFACE, CUMBERLAND, COLES, AND DOUGLAS COUNTIES

KENNETH E. CLEGG

County No. 296
T. L. Smith - L. C. Dole No. 1
7-11N-7E

308
A. J. Slagter Jr. - M. Eichelberger No. 1
18-11N-8E

260
Jarvis Bros. & Marcell, Inc. - Atwell No. 1
6-11N-9E

602
Magnolia Petroleum Co. - M. T. Rodda No. 1
4-11N-9E

276
J. Carlson - R. King No. 1
35-12N-9E

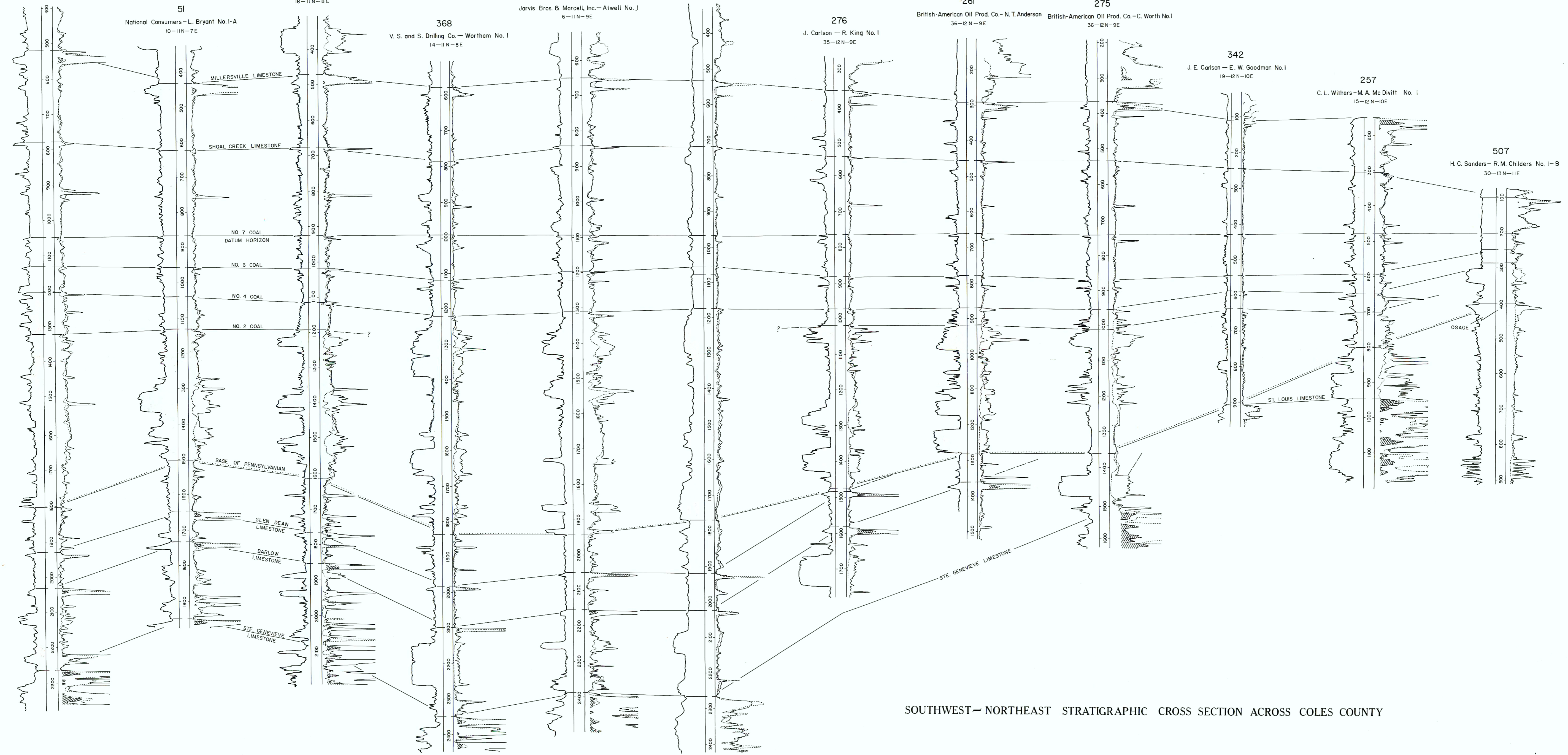
261
British-American Oil Prod. Co. - N. T. Anderson
36-12N-9E

275
British-American Oil Prod. Co. - C. Worth No. 1
36-12N-9E

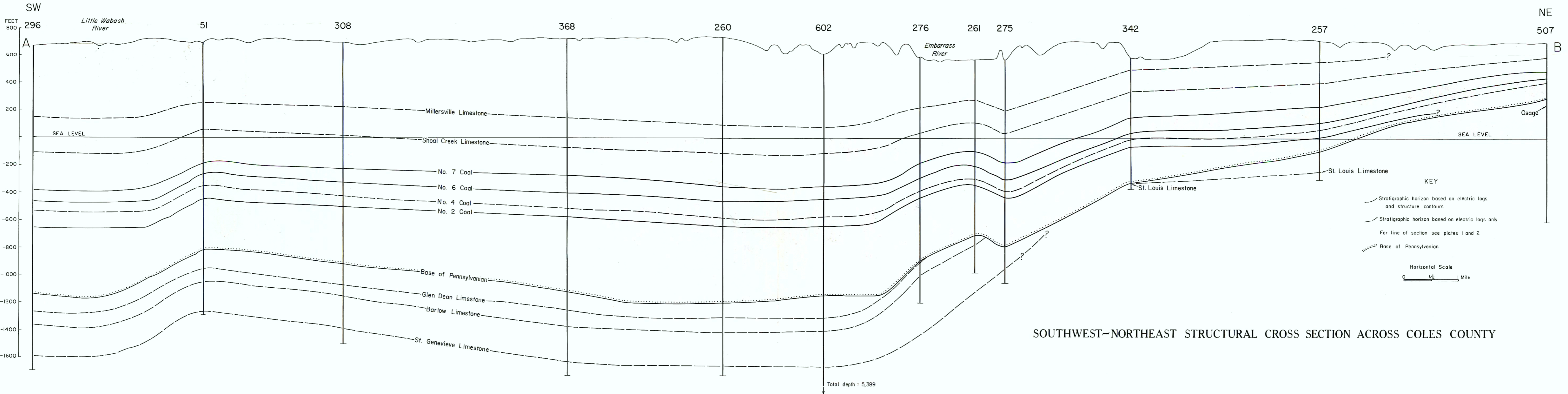
342
J. E. Carlson - E. W. Goodman No. 1
19-12N-10E

257
C. L. Withers - M. A. McDivitt No. 1
15-12N-10E

507
H. C. Sanders - R. M. Childers No. 1-B
30-13N-11E



SOUTHWEST-NORTHEAST STRATIGRAPHIC CROSS SECTION ACROSS COLES COUNTY



SOUTHWEST-NORTHEAST STRUCTURAL CROSS SECTION ACROSS COLES COUNTY



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