

STATE OF ILLINOIS  
ADLAI E. STEVENSON, *Governor*  
DEPARTMENT OF REGISTRATION AND EDUCATION  
C. HOBART ENGLE, *Director*

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

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REPORT OF INVESTIGATIONS—NO. 156

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GEOLOGY AND COAL RESOURCES OF A  
PART OF THE PENNSYLVANIAN SYSTEM IN  
SHELBY, MOULTRIE, AND PORTIONS OF  
EFFINGHAM AND FAYETTE COUNTIES

BY

ERNEST P. DU BOIS



PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

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URBANA, ILLINOIS

1951

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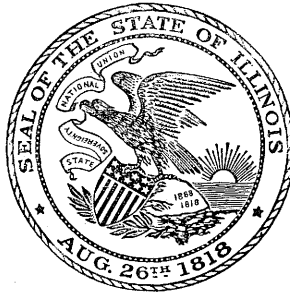
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MANUSCRIPT COMPLETED MARCH 1951

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# GEOLOGY AND COAL RESOURCES OF A PART OF THE PENNSYLVANIAN SYSTEM IN SHELBY, MOULTRIE, AND PORTIONS OF EFFINGHAM AND FAYETTE COUNTIES\*

BY

E. P. DUBOIS

## INTRODUCTION

**T**HIS REPORT describes the structure and stratigraphy of the upper portion of the Pennsylvanian system as reflected by the "key beds" studied, reports observations of the effects of local and regional structure on Pennsylvanian sedimentation, and gives a preliminary evaluation of the coal resources of the area. In part the study is a revision of the structure of the Millersville limestone as interpreted by Taylor and Cady<sup>1</sup> in an earlier report.

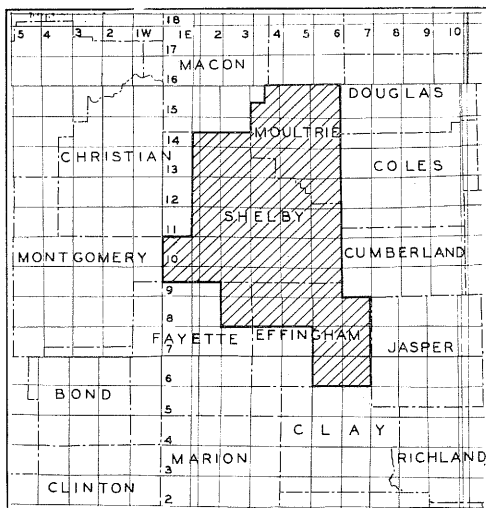


FIG. 1.—Index map of area covered by report.

The area herein considered (fig. 1) includes the whole of Moultrie and Shelby counties, Ts. 8 and 9 N., R. 3 E., of Fayette County, and all of Effingham County

except Ts. 6 and 7 N., Rs. 4 and 5 E. The selection of this area has resulted from the following considerations: partial revision of the Millersville limestone structure map; additional investigation of other key beds within the same area of that partial revision, especially in the vicinity of Loudon pool; and extension of those studies to Ts. 6 and 7 N., Rs. 6 and 7 E., of Effingham County, which had not been previously studied in relation to the problems here considered. The southern and western boundaries of the area thus are limited by or extend into other areas recently studied.<sup>2, 3, 4</sup> Except for Jasper County, on which a report of the distribution and structure of No. 6 coal bed is now partially completed, the area to the east and north has been investigated only with respect to the Millersville limestone.

Geologically, the area lies near the northern margin of the deeper part of the Illinois basin, as indicated by the structure of Mississippian and Pennsylvanian strata. Stratigraphically, the study is limited to those beds between the top of the Millersville limestone above and Coal No. 4, or those beds which commonly accompany it when the coal itself is absent, below.

The tools used to compile the data which follow are those of the subsurface geologist. Electric logs have been used extensively for structural data, and to a lesser extent for stratigraphic. Where electric logs are ob-

\* This report is a contribution of the Coal Division, G. H. Cady, Head.

<sup>1</sup> Taylor, E. F., and Cady, G. H., Structure of the Millersville limestone in the north part of the Illinois basin, in Progress reports on subsurface studies of the Pennsylvanian system in the Illinois basin: Illinois Geol. Survey Rept. Inv. 93, pp. 22-27, 1944.

<sup>2</sup> Lowenstam, H. A., Subsurface geology of Clay County, in Subsurface geology and coal resources of the Pennsylvanian system in certain counties of the Illinois basin: Illinois Geol. Survey Rept. Inv. 148.

<sup>3</sup> Siever, R., Structure of Herrin (No. 6) coal bed in Marion and Fayette counties and adjacent parts of Bond, Clinton, Montgomery, Clay, Effingham, Washington, Jefferson, and Wayne counties: Illinois Geol. Survey Circ. 164, 1950.

<sup>4</sup> Payne, J. N., and Cady, G. H., Structure of Herrin (No. 6) coal bed in Christian and Montgomery counties and adjacent parts of Fayette, Macon, Sangamon, and Shelby counties: Illinois Geol. Survey Circ. 105, 1944.



TABLE 1.—INDEX OF

Company	Farm	Location			Elev.
		Twp.	Rge.	Sec.	
MOULTRIE					
Lovington Coal Co.....		15 N	5 E	27	670
Lovington Coal Co.....		15 N	5 E	27	668
SHELBY					
Moweaqua Coal Co. <sup>1</sup> .....		14 N	2 E	31	628
Century Coal Co.....	Bowman.....	11 N	2 E	22	635
Shelby Coal & Nat. Gas.....		11 N	4 E	18	548
J. A. Loomis.....	H. S. Hargrave.....	10 N	1 E	3	680
J. A. Loomis.....	Hargrave L-3.....	10 N	1 E	5	674
J. A. Loomis.....	Hargrave L-2.....	10 N	1 E	6	655
H. L. Hargrave.....	Vidler.....	10 N	1 E	8	665
Ameling Bros.....		10 N	1 E	17	639
H. Hargrave.....	Land.....	10 N	1 E	29	672
R. H. Durham.....	Rogers.....	9 N	1 E	5	649
A. W. Hargrave.....	Hitchcock.....	9 N	1 E	10	661
A. W. Hargrave.....	Schmitz.....	9 N	1 E	16	668
H. L. Hargrave.....	Rogers.....	9 N	1 E	17	644
H. S. Hargrave.....	Smith.....	9 N	1 E	18	658

<sup>1</sup> Shaft.

scure or lacking, more or less reliance has been placed on examination of drill cuttings, driller's logs, drilling time data, or such other evidence as has been available. For stratigraphic succession, and to aid in interpreting the electric logs, reliance has been placed on the Geological Survey control well<sup>5</sup> records and on diamond drill cores. Electric logs constitute the great majority of data. There are over 700 of them, chiefly from the Loudon pool area but also in some number from the southern portion of Shelby County and Effingham County. Diamond drill cores and control wells are much less numerous. The former are essentially restricted to southwestern Shelby County but the latter are more widely distributed. The number and locations of wells included in these two groups of data are shown in tables 1 and 2.

### KEY BEDS

Because of the complexity of Pennsylvanian stratigraphy in Illinois, it has been

<sup>5</sup> Wells on which one- or two-foot drilling time and five-foot samples were taken by members of the Coal Division of the State Geological Survey at the time of drilling; these data were usually studied later with reference to the electric log.

customary to designate as key beds those lithologic units which are sufficiently distinctive and continuous laterally to serve as reliable markers. In accordance with that policy, the following units (fig. 2) were selected: the Millersville limestone, generally the first massive limestone encountered below the surface; the Shoal Creek limestone, a thin bed about 200 feet below the base of the Millersville limestone; a similar unit about 50 feet lower and erratically developed only in the vicinity of Loudon pool, here tentatively identified as the Carlinville limestone; the West Franklin limestone, about 350 to 400 feet below the base of the Millersville limestone; Coal No. 7, 100 to 150 feet, more or less, below the base of the West Franklin limestone; Coals Nos. 6, 5, and 4 in descending order in the next 100- to 150-foot interval below Coal No. 7. Of these key beds, those above Coal No. 6 have been referred to the McLeansboro group, while those below and including Coal No. 6 have been referred to the Carbondale group.

Any discussion of Pennsylvanian structure must be based upon the structure of

## DIAMOND DRILL HOLES

MV		SC		WF		No. 7 Coal		No. 6 Coal		No. 5 Coal		No. 4 Coal	
Top	Thick.	Top	Thick.	Top	Thick.	Top	Thick.	Top	Thick.	Top	Thick.	Top	Thick.

## COUNTY

372 <sup>a</sup>	26	584	9	732	22	873	4' 6" <sup>b</sup>	903	8' 10"				
354	28	570	6	723	15	849	4' 4"	869	4' 8"				

## COUNTY

52?	33?	289	9	NP <sup>c</sup>		540	5'	566	6' 4"	620	5' 3"		
179	35	419	11	NP		718?	P	740	7' 4"				
173	41	412	10	572	17	635	3'	NP?					
108	56	377	9	NP		675	3' 6"	706	7' 2"	NP?		792?	3"
94	45	361	13	NP		655	3' 4"	685	7' 7"				
72	43	331	11	NP		643	3'	678	7' 3"	NP?		754?	5"
104	37	372	14	NP		663	3' 6"	692	6' 6"				
84	45	360	14	NP		648	3' 6"	683	7' 1"				
111	43	387	9	NP		669	2' 6"	698	7'				
98	48	379	16	NP		660	1'	692	7' 1"				
133	49	398?	8	NP		715	2' 6"	749	7' ?				
182	37	440	14	NP		739	4'	772	6' ?				
98	31	360	14	NP		648	3' 6"	683	?				
131	38	400	11	NP		688	2'	717	7' 11"				

<sup>a</sup> Depths given to nearest foot.<sup>b</sup> Coal thicknesses given to nearest inch.<sup>c</sup> NP = not present.

MV = Millersville.

SC = Shoal Creek.

WF = West Franklin.

key beds, since a large portion of the Pennsylvanian succession, as revealed by electric logs, is very irregular and provides only a few datum planes of reference. Hence the occasional relatively thin beds of unusual but persistent attributes provide the only means of delineating the structural characteristics. It is not necessary to be concerned with the intervening strata for which there is no basis for differentiation on electric logs or on lithologic logs compiled from cuttings. In general, however, it appears that these intervening strata are similar to those described more fully in adjacent Clay County<sup>6</sup> and some of them may be directly continuous with similar groups of beds in that area.

Because of the exclusive dependence upon key beds, the general cyclical sedimentary pattern characteristic of the Pennsylvanian system has not been studied. It is possible that when diamond drill cores of the McLeansboro and Carbondale strata are studied in detail, the usual cyclical pattern described

by Weller<sup>7</sup> and others may be found and the various key beds will each fit into its systematic position in the cyclical sequence. For the present purpose nothing is lost by considering the key beds as individual unrelated but persistent units in the general Pennsylvanian sequence.

## DISCUSSION OF KEY BEDS

## MILLERSVILLE LIMESTONE

The name Millersville has been adopted for certain exposures of limestone in secs. 28 and 34, T. 12 N., R. 1 W., near the town of that name in Christian County, Illinois.<sup>8, 9</sup>

Two descriptions of the Millersville are included here. The first is of the type section and is presented as a matter of record; the second is that of a nearby diamond drill core and represents the full development of the limestone in that area.

<sup>7</sup> Weller, J. M., Cyclical sedimentation of the Pennsylvanian period and its significance: Jour. Geology, vol. 38, pp. 97-135, 1930.

<sup>8</sup> Payne, J. N., and Cady, G. H., *op. cit.*, p. 12.

<sup>9</sup> Taylor, E. F., and Cady, G. H., *op. cit.*, p. 22.

<sup>6</sup> Lowenstam, H. A., *op. cit.*

GEOLOGY AND COAL RESOURCES

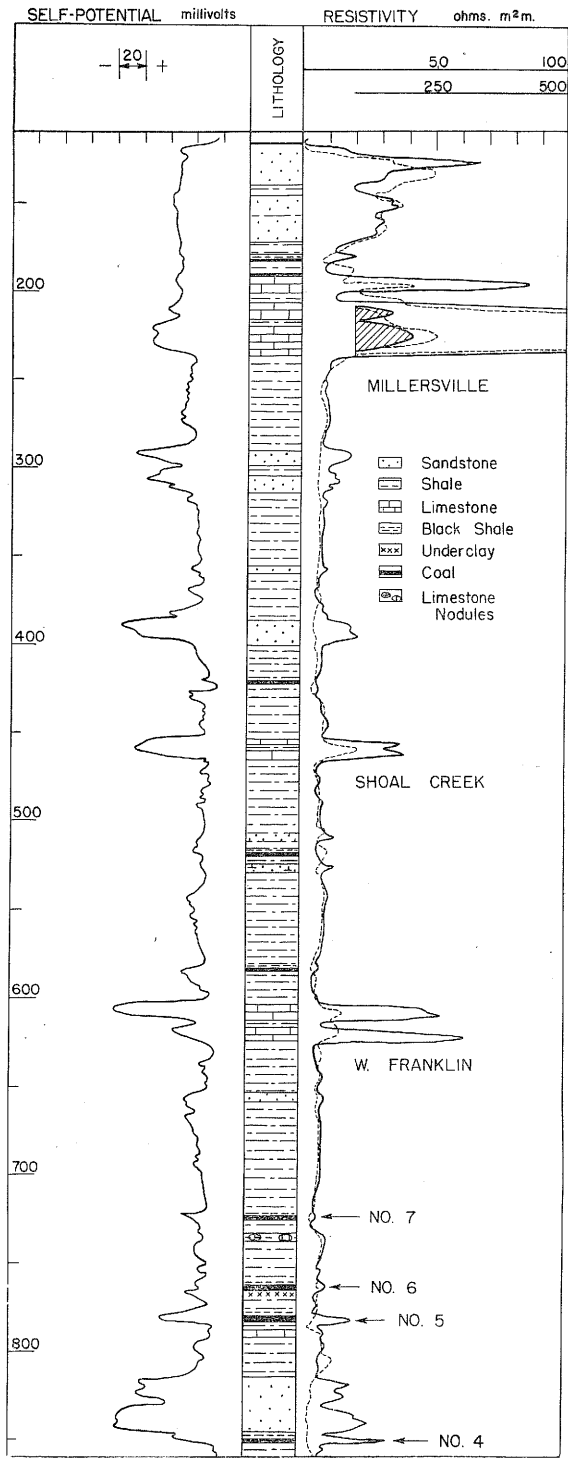


FIG. 2.—Electric and lithologic log of upper portion of Pennsylvanian system of National Associated Petroleum Co., Shelby Loan and Trust Co. No. 1, sec. 17, T. 10 N., R. 4 E., Shelby County, Illinois. (Control well.)

*Millersville Limestone, Outcrop at Type Locality  
SE. ¼ NE. ¼ Sec. 28, T. 12 N., R. 1 W.,  
Christian County*

(Described by G. H. Cady)

	Thickness Feet	
Clay, gray, plastic, with limestone nodules and fragments loosely embedded in clay.....	2	
Limestone, much weathered, white, "algal," very fossiliferous, fusulinids.....	2	
Siltstone, with sandy interbeds, about.....	7	

*Log of Diamond Drill Core of Peabody Coal Co.,  
No. 59, 2250' E. and 10' S. of NW. Corner, Sec. 33,  
T. 11 N., R. 1 E., Christian County*

(Described by G. H. Cady, J. A. Simon, and R. Golden)

	Thickness Ft. In.	
Shale, light gray, smooth, fairly well laminated, uniform, no fossils.....	12	8
Limestone, very argillaceous, carbonaceous, fossiliferous.....	1	2
Coal.....	1	2
Underclay, fragmental, about 4' recovery.....	5	
Clay-shale, recovery poor.....	12	9
Limestone, white, nodular, argillaceous (uppermost bed of Millersville limestone).....	5	3
Limestone, white, nodular, pure, partings in lowest six inches.....	16	5
Shale, dark gray, hard, very fossiliferous.....	5	
Limestone and shale, interbedded, dark gray.....	2½	
Limestone, gray, massive, nodular, fossiliferous, stylolitic.....	4	7
Limestone, gray, massive, nodular.....	11½	
Limestone, gray, massive, dense.....	7	3
Limestone, gray, dense, with a few irregular shale partings (lowermost bed of Millersville limestone); base of limestone shows uneven contact with.....	5	
Shale, dark gray, very silty, fossiliferous, calcareous; grades into.....	8½	
Sandstone, fine, light gray, with thin light gray silty laminae.....	8½	

The total thickness of the Millersville limestone in the Peabody drill hole is 35½ feet. The interval between the base of the limestone and the top of Coal No. 7 is 531 feet, and that between the base of the limestone and the top of Coal No. 6 is 558 feet.

The Millersville limestone extends throughout the area to which this report applies with the exceptions of T. 6 N., Rs. 6 and 7 E., and parts of T. 7 N., and Rs. 6 and 7 E. in Effingham County. The limit of distribution in these townships is indicated on plate 1.

The correlation and lithologic description of the Millersville limestone has been adequately covered in previous reports.<sup>10, 11</sup> In summary, the limestone is gray to buff, crystalline, dense, fossiliferous, and is characterized in some places by the presence of small spheroidal particles with chalky incrustations and fairly numerous minute fossils. The limestone attains a maximum thickness of about 50 feet and, although in some places it is a single bench, it is commonly split into several benches by interbedded thin shales. Near the margins of deposition it may be represented by several thin limestone beds interbedded with thick shales and siltstones (fig. 3). In some areas an additional thin shale and limestone unit may be prominently developed either above or below the main body of limestone. However this may be, the entire complex has been regarded as Millersville limestone.

The Millersville limestone is interpreted from electric logs as the first massive limestone below the surface casing. Resistivities are of the order of 100 ohm-meters, and self-potentials about 40 millivolts negative.

The interval between the Millersville limestone and No. 7 coal is about 450 feet in northern Moultrie County and increases irregularly to as much as 550 feet in southern Shelby and in Effingham counties.

Although previously these beds have been referred to the LaSalle, New Haven, Carthage, and Livingston limestones, it is more proper, pending regional studies, to use the local name. Continuity from the type area to the area dealt with here is considered to have been demonstrated. It appears certain, however, that the limestone does not extend far to the south, inasmuch as regional variation precludes its recognition much beyond the southern limits of the present study. Gradual disappearance in Fayette and Effingham counties appears to be accomplished by thinning of the individual limestone beds while the intervening shale beds become thicker (fig. 3). In this way, in T. 7 N., Rs. 6 and 7 E., where the southern limits of deposition have been studied, the massive Millersville limestone is replaced by shale

<sup>10</sup> Payne, J. N., and Cady, G. H., *op. cit.*

<sup>11</sup> Taylor, E. F., and Cady, G. H., *op. cit.*

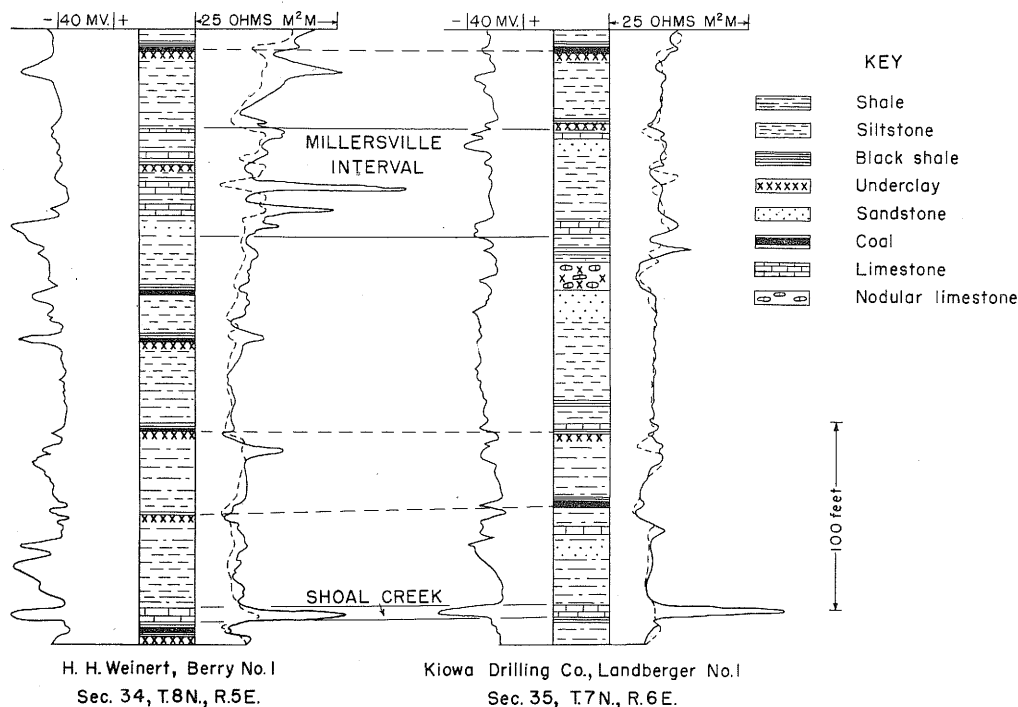


FIG. 3.—Logs of two wells near margin of Millersville limestone. See figure 2 for comparison.

with several thin beds of limestone. Still farther south, strata at the corresponding position apparently consist entirely of shale with siltstone and sandstone lenses. In portions of T. 6 N., Rs. 6 and 7 E., at the position where the Millersville might be expected, there is a sequence of relatively thick sandstones. The precise relationships between the Millersville limestone and the sandstones are not understood.

Apparently in those wells in Clay County in which the Millersville limestone has been tentatively identified,<sup>12</sup> the beds involved represent thin southerly extensions of the main body of limestone. The principal area of distribution in Clay County is in T. 5 N., R. 5 E., and the limestone thins rapidly, or becomes more argillaceous and sandy, to the south and east.

#### SHOAL CREEK AND CARLINVILLE LIMESTONES

The type exposures of the Shoal Creek limestone, as first noted by Engelmann,<sup>13</sup>

are represented by numerous outcrops along Shoal Creek in Clinton County, Ill., and those of the Carlinville limestone, as described by Worthen,<sup>14</sup> are located northeast of the town of the same name in Macoupin County, Ill. Although these exposures have been considered by some workers<sup>15, 16, 17</sup> to represent correlative beds, others<sup>18, 19, 20</sup> have considered them as separate units. Simon<sup>21</sup> has most recently demonstrated Shoal Creek and Carlinville limestones to be separate beds, and the author accepts that conclusion. The area interven-

<sup>14</sup> Worthen, A. H., *Geology of Macoupin County: Geol. Survey of Illinois, vol. V, pp. 290-296, 1873.*

<sup>15</sup> Udden, J. A., *Notes on the Shoal Creek limestone: Illinois Geol. Survey Bull. 8, pp. 117-126, 1907.*

<sup>16</sup> Ekblaw, S. E., *The question of the Shoal Creek and Carlinville limestones: Trans. Ill. Acad. Sci., vol. 25, no. 4, pp. 143-145, 1932.*

<sup>17</sup> Ball, J. R., *Some Pennsylvanian limestones of the Carlinville quadrangle: Trans. Ill. Acad. Sci., vol. 26, p. 97, 1934.*

<sup>18</sup> Lee, W., *Oil and gas in the Gillespie and Mount Olive quadrangles, Illinois: Illinois Geol. Survey Bull. 31, pp. 71-107, 1915.*

<sup>19</sup> Payne, J. N., *Structure of Herrin (No. 6) coal bed in Macoupin County, eastern Greene and Jersey, southeastern Scott, and southern Morgan and Sangamon counties, Illinois: Illinois Geol. Survey Circ. 88, p. 5, 1942.*

<sup>20</sup> Payne, J. N., and Cady, G. H., *op. cit.* pp. 9-12.

<sup>21</sup> Simon, J. A., *Correlation studies of Upper Pennsylvanian rocks in southwest-central Illinois: master's thesis, Univ. of Illinois, 1946.*

<sup>12</sup> Lowenstam, H. A., *op. cit.*, pp. 27, 35.

<sup>13</sup> Engelmann, H., *Geology of Washington County and Clinton County: Geol. Survey of Illinois, vol. III, pp. 148, 159-164, 1868.*

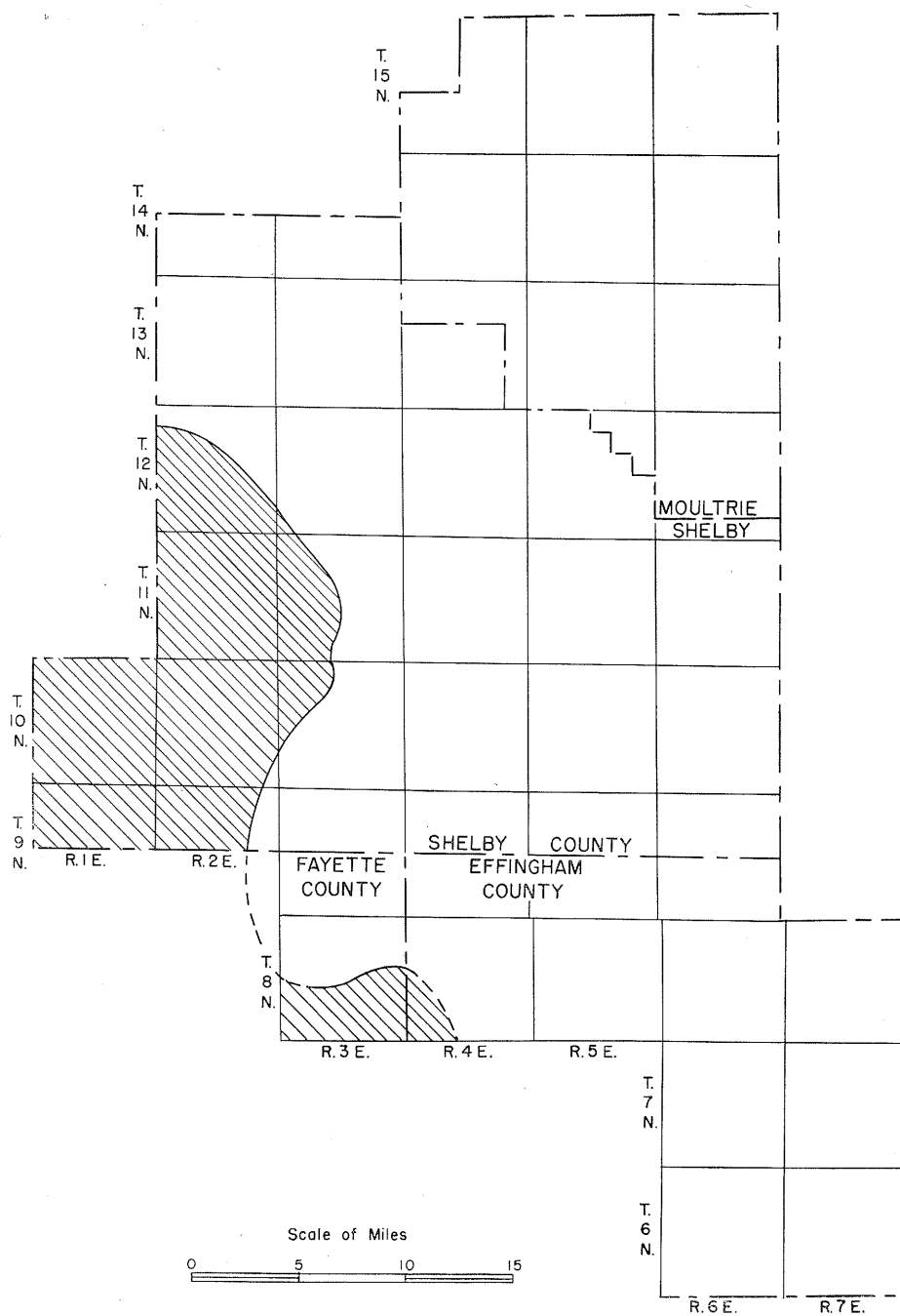


FIG. 4.—Distribution of West Franklin limestone. Shading indicates those areas in which no West Franklin is recognized.

TABLE 2.—INDEX

Company	Farm	Location			Elev.
		Twp.	Rge.	Sec.	
EFFINGHAM					
Carter Oil Co.....	Claggett No. 1.....	8 N	4 E	6	615
H. H. Weinert.....	Berry No. 1.....	8 N	5 E	34	594
H. Luttrell.....	Kroeger No. 1.....	8 N	6 E	27	564
W. I. Lewis.....	Haskenherm No. 1.....	8 N	7 E	10	603
Kiowa Drlg. Co.....	Landberger No. 1.....	7 N	6 E	35	555
Sherman & Lane.....	Niemerg No. 1.....	7 N	7 E	16	579
Robinson-Puckett.....	Barnick No. 1.....	6 N	6 E	36	543
Kingwood Oil Co.....	Wendte No. 1.....	6 N	7 E	21	560
FAYETTE					
Carter Oil Co.....	First State Bank.....	8 N	3 E	3	599
Carter Oil Co.....	B. Fortner 8-D.....	8 N	3 E	10	630
Carter Oil Co.....	Stubblefield No. 3.....	8 N	3 E	22	541
MOULTRIE					
Continental Oil Co.....	Beachy No. 1.....	15 N	6 E	13	665
SHELBY					
H. H. Sims.....	Bauer No. 1.....	11 N	3 E	21	624
P. Doran.....	Whitlach No. 1.....	10 N	2 E	16	634
Ill. Explor. Co.....	Davis No. 1.....	10 N	4 E	8	605
Nat. Assoc. Petr. Co.....	Allan No. 1.....	10 N	4 E	17	607
N. V. Duncan.....	Shuemaker No. 1.....	10 N	6 E	12	629
Nat. Assoc. Petr. Co.....	Shumard Comm. No. 1.....	9 N	5 E	3	646

ing between that studied by Simon and that here under consideration has been examined by Payne and Cady, and it appears that at least the Shoal Creek limestone is continuous between the two regions.

The Shoal Creek limestone is present in most of the area studied but appears to be more discontinuous in the eastern part. It is commonly about 8 feet thick and composed of light gray to gray and buff crystalline and dense limestone. In the area of this report, it is nearly always a single bed and is commonly underlain by black shale and rarely by coal. Locally, 10 to 20 feet of sandstone may occur at the general stratigraphic position of the Shoal Creek. Elsewhere, possibly of different origin, massive sandstones attaining a thickness of as much as 100 feet may be present at a position which would include the horizon where the Shoal Creek might be expected to occur.

A limestone about 50 feet below the Shoal Creek, tentatively identified here as the Carlinville, appears to be principally developed in the vicinity of the Loudon pool. Its thickness and electrical characteristics are essentially identical with those of the Shoal Creek limestone. The Shoal Creek and Carlinville limestones show resistivities ranging from 20 to 50 ohm-meters and self-potentials ranging from 20 to 60 millivolts above the shale base line. When only one bed is present in this general stratigraphic position, its identification is usually based on the interval between it and the base of the Millersville limestone, or, if descriptions of the cuttings are available, the presence or absence of underlying black shale.

The interval between the base of the Millersville limestone and the top of the Shoal Creek limestone is about 200 feet, that between the base of the Millersville and the

## OF CONTROL WELLS

MV		SC		WF		No. 7 Coal		No. 6 Coal		No. 5 Coal		No. 4 Coal	
Top	Thick.	Top	Thick.	Top	Thick.	Top	Thick.	Top	Thick.	Top	Thick.	Top	Thick.

## COUNTY

161	34	413	10	555	16	NR		661	2	680	P	742	P
382 <sup>a</sup>	26	610	8	760	14	904	3	NR		951	4	1022	2
401	31	634	14	sandstone		980	3	994	2	1019	4	1096	P
493	10	701	8	880	14	1017	2	1041	4	1069	5	1143	1
440 <sup>b</sup>	P	694	9	868	16	1018	2	1046	3	1096	4	1160	1
536	12	704	13	sandstone		1052	3	1075	4	1109	3	not logged	
NP	—	668	8	892	4	1006	2	1034	3	1076	2	1154	P
NP	—	764	9	978	6	1107	2	1141	4	1180	6	1254	4?

## COUNTY

114	46	384	4	516	18	?	?	634	2	650	P	722	2
140E	42	376	9	546	18	655?	?	677?	1	681?	1	728	2
69	21	349	7	513	17	564	4?	NR		NR		628	2

## COUNTY

390	35	588	20	720	16	874	1	890	1	926	6"	991	1
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## COUNTY

175	30	412	10	NP		674	1	NR		NR		777	2
206	38	470	10	NP		776	3	not logged		—	—	—	—
189	42	440	14	582	20	Correlation uncertain <sup>c</sup>							
187	46	453	13	605	20	724	2	? <sup>d</sup>		783	5	858	2
436	31	682	6	820	26	952	4	1005	4	1023	5	1115	1
308	42	558	10	704	13	851	1	866	2	890	4?	960	P?

<sup>a</sup> Including 8' shale break.<sup>b</sup> 4' limestone, 42' sandstone and shale, 4' limestone.<sup>c</sup> Coal logged at 719', 762' (2), 780', 790', 801'.<sup>d</sup> Split coal?, coal logged at 760', 767', and 773'.

NP = not present.

NR = not recorded.

E = estimated.

P = position only, usually indicated by black shale and underclay.

MV = Millersville.

SC = Shoal Creek.

WF = West Franklin.

top of the Carlinville limestone is about 250 feet. The interval between the Shoal Creek and the Millersville limestones is fairly constant throughout the entire area, and wells are rare in which it is greater than 225 or less than 175 feet.

## WEST FRANKLIN LIMESTONE

The West Franklin limestone was named for exposures at West Franklin, Posey County, Ind.<sup>22</sup> These exposures appear to be continuous with beds of the same stratigraphic position in White, Wayne, Clay, and Effingham counties, Ill. For this reason, the name has been tentatively applied here to the limestone and associated shale

beds which occur 300 to 400 feet below the base of the Millersville limestone.

The West Franklin limestone is present in most of the area studied. The limestone is absent, however, in parts of western Shelby and northeastern Fayette counties. Wells in which the limestone is not recorded are generally located west of R. 3 E. and south of T. 13 N. The West Franklin limestone is also absent in parts of adjacent townships (fig. 4). In the southern portion of T. 8 N., R. 3 E., massive sandstones extend across the stratigraphic interval in which the West Franklin is encountered elsewhere.

As determined by examination of well cuttings and electric logs, the West Franklin, in the area covered in this report, consists of 15 to 30 feet of light gray to buff,

<sup>22</sup> Collett, J., Indiana Department of Geology and Natural History, 13th Annual Report, pp. 61-62, 1884.



mostly fine, rarely medium or coarse crystalline, occasionally sandy and usually fossiliferous limestone with a 1- or 2-foot shale bed near the middle. Not infrequently these beds are underlain by as much as 10 feet of red and green variegated clay, in turn underlain, especially in parts of northeastern Effingham County, by another thin bed of limestone.

In some areas the interbedded shale may be absent and the limestone appears to be a single massive bed, as indicated by electric logs. Elsewhere, one of the two principal benches of the limestone may be absent. In these cases the West Franklin limestone may be no more than 8 or 10 feet thick.

Within Loudon pool, and in some other restricted areas, the position at which the West Franklin is normally present is occupied by part of a massive sandstone. The sandstone may attain a thickness of 150 feet or more and, especially in the lowermost portion, may be calcareous. Electric logs show this sandstone as a thick series of highly resistive beds, usually with a high self-potential. In certain cases the lowermost of the highly resistive beds shows an abnormally low self-potential, and an abnormally high value for the third curve. In these cases, the lowermost bed is interpreted as being a limestone, and, in the writer's opinion, an integral part of the sandstone sequence above. Less frequently, as indicated by electric logs, zones of calcareous sandstone and limestone may occur within or at the top of the main body of sandstone. In these cases, the writer has chosen not to regard the associated calcareous sandstone or limestone as being continuous with the West Franklin limestone, and the term "West Franklin" is thus more or less restricted to the characteristic expression previously noted. The massive sandstone and associated calcareous beds are referred to as "Trivoli" because they are believed to occupy the same stratigraphic position between Coals Nos. 7 and 8 as does the Trivoli sandstone of northwestern Illinois. Neither direct continuity nor strict correlation is implied in the use of this term.

Although the writer believes that this sandstone originated in a single rather local series of events, it is possible that its devel-

opment may be attributed rather to a series of unrelated events. In some areas of Illinois, several sandstones are developed within the stratigraphic interval between the highest and lowest positions of the "Trivoli" sandstone. It is possible, therefore, that the "Trivoli" sandstone, as here defined, is compound in origin, and that the events related to the deposition of other sandstones (for example, Absher, Anvil Rock, Gimlet) are also involved. Still a third alternative<sup>23</sup> to account for the presence of such a continuous thick sandstone is that the sandstone actually consists of a succession of sandstone members of successive cyclical groups (cyclothems). Resolution of these groups into cyclical units is impossible with the available information.

The precise relationships of the West Franklin limestone and the "Trivoli" sandstone are not completely understood and are discussed in more detail below.

In western Shelby County, as noted above, the West Franklin limestone is absent, or at least not developed in the characteristic manner noted previously. There, the general aspect of the interval between Coal No. 7 and the Shoal Creek limestone, as indicated by diamond drill cores and electric logs, is that of a long sequence of shales interbedded with occasional siltstones and sandstones and generally terminated below by two beds of calcareous shale or very argillaceous limestone. Although it is possible that these two beds are related in some way to the West Franklin limestone, the interval between them and Coal No. 7 below is so reduced from that considered normal as to make any correlation uncertain.

#### COAL No. 7

Coal No. 7 is one of the most widespread and, in diamond drill cores and control wells, one of the most consistently recognizable key beds in the area. The zone in which the coal occurs is generally indicated on electric logs by the first sharp increase in resistivity (of the order of several ohm-meters), which is laterally persistent, below the West Franklin limestone (fig. 2). Because the coal is thin and highly resistive,

<sup>23</sup> Suggested by G. H. Cady, personal communication.

this increase in resistivity is usually accompanied by a negative anomaly of the third curve.

The coal bed thickness, in diamond drill holes, which have the greatest concentration in southwestern Shelby County, averages about 3 feet 4 inches. In this general area the thickest measured section, of 4 feet, is in sec. 16, T. 9 N., R. 1 E. Thicknesses in northern Shelby and Moultrie counties, in diamond drill holes of the Moweaqua and Lovington coal companies, range from 4 feet 4 inches to 5 feet. The cores from these holes indicate that the coal bed in this area is split, however, and of little present economic value. Records of the less reliable but more broadly distributed control wells indicate an average thickness throughout the entire area of little more than 2 feet. The thickest coal recorded in the control wells is in the well of the Carter Oil Co., Stubblefield No. 3, sec. 22, T. 8 N., R. 3 E., Fayette County, in which 4 feet of coal is reported. Although identification of this coal bed in other control wells in Loudon pool is uncertain, it appears that in none of these is the bed more than 2 feet thick. In some areas in the southern portion of T. 8 N., R. 3 E., the coal bed is believed to be absent, apparently owing in part to erosion prior to deposition of the "Trivoli" sandstone, but possibly locally to unfavorable conditions of accumulation.

Correlation of No. 7 coal in the Carter Oil Company's Stubblefield No. 3, sec. 22, T. 8 N., R. 3 E., with the No. 7 coal in the Danville area has been established by analyses of the fossil spore content.<sup>24</sup>

The interval between No. 7 and No. 6 coal beds ranges from 10 to 50 feet. Although no definite regional variation is apparent, the interval appears to be less over structurally high areas (such as Loudon anticline) than elsewhere. This is consistent with the decrease in intervals between Coal No. 4 and Coal No. 7, between the Millersville limestone and Coal No. 4, and between the Glen Dean limestone and Coal No. 4, over the crest of the Loudon structure (figs. 5 and 6).

#### HERRIN (No. 6) COAL BED

Herrin (No. 6) coal bed is the principal coal bed in the area, and it is sufficiently thick and present in large enough areas to permit mining on a commercial basis. Except for a few restricted areas it extends throughout the region studied. The areas in which the coal is indicated as absent (pl. 3, fig. 9) may represent cut-outs by the "Trivoli" sandstone (fig. 8), especially in Loudon pool, or may represent failure of the electric logs to show the characteristic pattern of the coal and its associated beds, e.g., southwest portion of T. 12 N., R. 2 E., and the area south and southeast of Shelbyville. It is of course not certain that this lack of development of the characteristic electric log pattern necessarily indicates the absence of the coal. With a single exception, the diamond drill holes and control wells are located in areas in which No. 6 coal bed is present. The exception is the diamond drill core of the Shelby Coal and Natural Gas Co., sec. 18, T. 11 N., R. 4 E., in which it appears that coal No. 6 was not encountered.

The maximum thickness of Herrin (No. 6) coal bed, based on the log of a diamond drill core of the Lovington Coal Co., sec. 27, T. 15 N., R. 5 E., in Moultrie County, is 8 feet 10 inches. Records of a neighboring diamond drill core in the same section however show only 4 feet 8 inches of coal, and measured sections within the mine<sup>25</sup> give a range in thickness from approximately 3 feet 3 inches to 9 feet 4 inches. It is also reported<sup>26</sup> that the coal decreases to less than workable thickness in the northern portion of the mine. In western Shelby County, Ts. 9 and 10 N., R. 1 E., the normal thickness, as indicated by records of diamond drill cores, is about 7 feet with a range of 6 to 8 feet. The control wells, with their principal distribution in the central part of the report area, indicate thicknesses which range from 1 to 4 feet.

Because Coal No. 6 is the major coal reserve in this area it should be protected

<sup>25</sup> Kay, F. H., Coal Resources of District VII: Illinois Min. Inv. Bull. 11, pp. 204 ff., 1922.

<sup>26</sup> G. H. Cady, personal communication.

<sup>24</sup> R. M. Kosanke, personal communication.

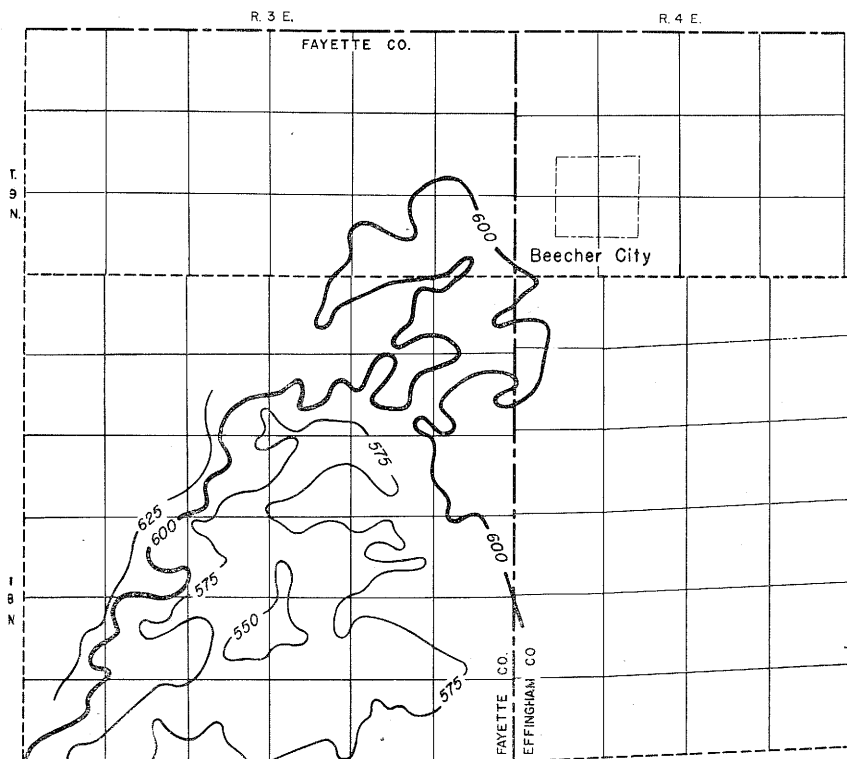
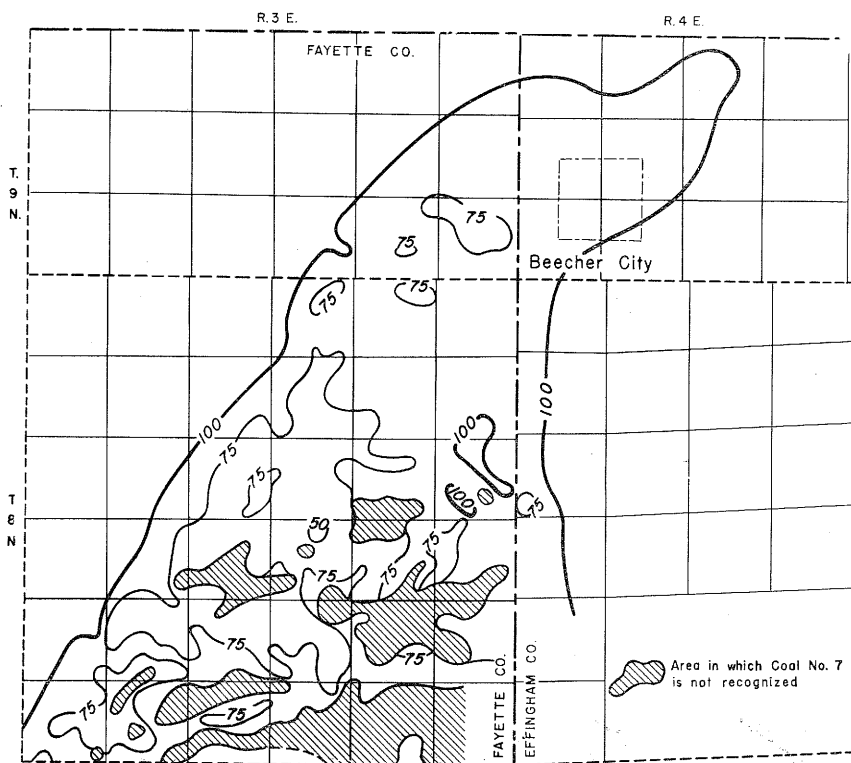


FIG. 5.—*Above*: Thickness of interval between Coal No. 4 and Coal No. 7. *Below*: Thickness of interval between Coal No. 4 and Millersville limestone. Contour interval, 25 feet.

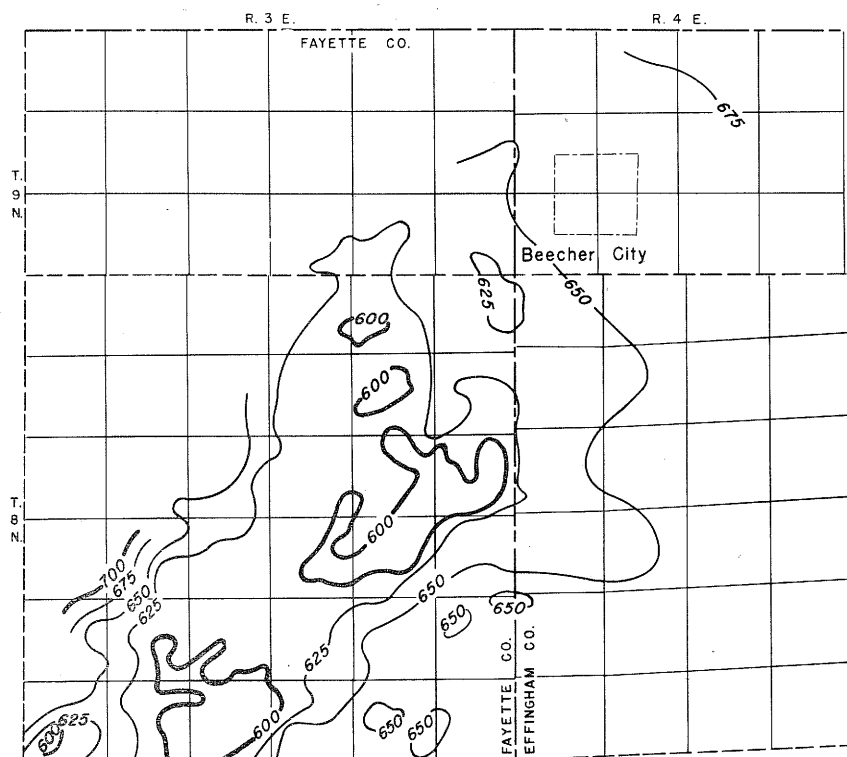
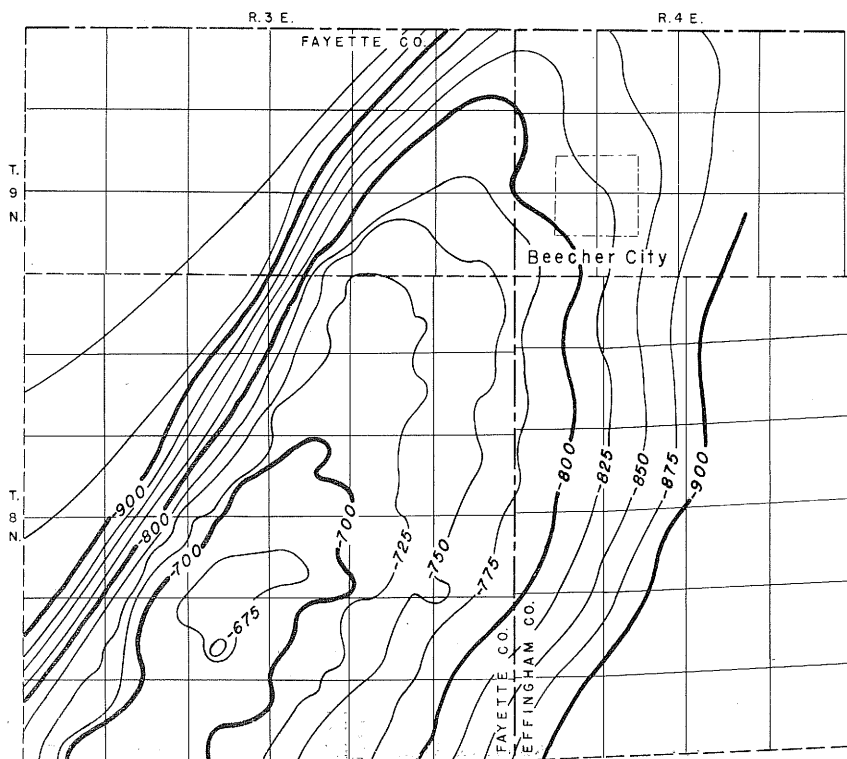


FIG. 6.—*Above:* Elevation of Glen Dean limestone. *Below:* Thickness of interval between Glen Dean limestone and Coal No. 4. Datum, sea level; contour interval, 25 feet.

against fluid invasion when oil wells are drilled or abandoned. Although the thickness of the coal bed is incompletely known, it should be considered to be of economic thickness in all areas except where the contrary can be demonstrated. The Rules and Regulations of the State Department of Mines and Minerals<sup>27</sup> require that wells be plugged when they are abandoned, in such a manner that the coals are protected against fluid invasion. This requires, for Coal No. 6, the setting of a cement plug from a point 50 feet below the coal bed to a point 100 feet above the bed.

Coal No. 6, as indicated by control wells and diamond drill cores, is commonly underlain by underclay and overlain by black shale. Limestone caprock may occur above the black shale or, in some instances, be separated from it by intervening beds of gray shale. Only rarely does the limestone lie immediately upon the coal. This agrees substantially with conditions in Clay County where all the control wells in which No. 6 coal was reported showed the presence of black roof-shale directly over the coal.<sup>28</sup>

Identification of Coal No. 6 in these counties is sometimes difficult because of the variation in the beds above and below it. In diamond drill cores and in wells in which sufficient control can be obtained, the coal is usually identified by its exceptional thickness and by its position as the first coal bed below the more easily recognizable Coal No. 7. Only where there is supporting control can it be surely identified by means of electric logs. In these cases the coal bed is normally identified by an abrupt increase in resistivity accompanied by a reversal of the third curve and commonly followed below by abnormally low resistivity (fig. 2). Where the coal is directly overlain by limestone caprock, the resistivity anomalies of the coal and limestone may be combined so that the contact of the limestone and coal is indicated only by a minute negative anomaly or not at all. Under such conditions, where supporting control is not available, it may be impossible to determine the top of the coal or even whether or not

the coal bed is present. In those areas where additional beds of high resistance may be present above or below the coal, it may be difficult or impossible to interpret the electric log picture accurately.

Normally Herrin (No. 6) coal is from 25 to 50 feet above Coal No. 5. Between the two coal beds are shales interbedded with sandstones and thin limestones.

#### SPRINGFIELD (No. 5) COAL BED

Less is known about the Springfield (No. 5) coal bed than about the Herrin (No. 6) coal bed. Coal No. 5 was formerly mined at Moweaqua, sec. 31, T. 14 N., R. 2 E., in Shelby County, where it is as much as 5 feet 7 inches thick. In Moultrie County, the only reliable record is that of the control well, Continental Oil Co., Beachy No. 1, sec. 13, T. 15 N., R. 6 E., in which the coal bed is believed to be one foot or less in thickness. Two diamond drill holes in southwestern Shelby County, secs. 3 and 6, T. 10 N., R. 1 E., were drilled to depths below that at which the coal bed might be expected but failed to encounter it. Relatively numerous control wells located in eastern Shelby and Effingham counties penetrated Coal No. 5. In that area, the coal was reported to range in thickness from 1 to 6 feet, with an average of about 4½ feet.

Although at the present this coal bed is not being mined, it should be regarded as a possible reserve. For this reason it should be protected against invasion by fluid when any wells are drilled through it or abandoned. Because its distribution and thickness are not accurately known at present, it is believed that a cement plug extending for 100 feet below Coal No. 6 will always cover the face of the coal bed and extend far enough below to prevent infiltration of water from other horizons. The structure map of Coal No. 6 (pl. 3) will help in calculating the position at which the plug should be placed. In the area in which Coal No. 5 is believed to be absent, in southwestern Shelby County, such protection is not necessary except when examination of well cuttings indicates the presence of an additional coal bed a short distance below coal No. 6.

<sup>27</sup> Edition of 1950.

<sup>28</sup> Lowenstam, H. A., *op. cit.*, p. 31.

Of additional aid in identification of the No. 5 coal bed is the usual presence of black shale above and underclay below the coal. Identification by means of electric logs is tentative and in this report has been attempted only in the vicinity of control wells.

Coal No. "5-A," recorded in Clay County<sup>29</sup> and elsewhere, has been tentatively identified only in control wells located in sec. 16, T. 7 N., R. 7 E., and in sec. 35, T. 7 N., R. 6 E., in Effingham County. In both places the coal bed is about 2 feet thick and occurs about 10 feet above Coal No. 5.

Between Coal No. 5 and Coal No. 4, next below, there is occasionally present, especially in parts of northeastern Effingham and southeastern Shelby counties, a massive sandstone which appears from electric logs to be similar in character to the "Trivoli" sandstone of Loudon pool. Although the sandstone seldom if ever cuts below Coal No. 4, in many places it lies directly on the coal bed or just above it and may extend as high as Coal No. 5. Because the sandstone has a different geographic distribution and is not known to be continuous laterally or vertically with the "Trivoli" sandstone, it is considered that the two sandstones differ in age and distribution, although possibly they are similar in origin.

#### COAL No. 4

Like Coal No. 7, Coal No. 4 is widespread in the area studied. Two diamond drill holes in T. 10 N., R. 1 E., Shelby County, have penetrated a thin coal which is believed to be Coal No. 4. Elsewhere reliance is placed on control wells, the records of which indicate the coal is commonly between 1 and 2 feet thick. In places where no coal was recorded, its position has been determined by the presence of black shale and underclay which normally accompany the coal.

The interval between Coal No. 7 and Coal No. 4 ranges from 125 to 175 feet. Although local variations appear to be greater than regional variations, the interval does appear to be somewhat greater in eastern Shelby and Effingham counties.

<sup>29</sup> Lowenstam, H. A., *op. cit.*, p. 38.

As a marker horizon for structural mapping, the horizon of the No. 4 coal bed, like that of No. 7 coal bed, is extremely useful because of the ease with which it may be identified in electric logs. In these, it is characterized by an abrupt increase in resistivity, accompanied by reversal of the third curve. Commonly the reversal of the third curve occurs some few feet higher than the increase in the normal curve. This zone is separated from the group of irregular resistivities, which characterize the horizons of Coals Nos. 5 and 6, by an intervening series of consistently low-resistance shale beds. The beds below Coal No. 4 are generally marked by consistently higher resistivities, reflecting a higher proportion of siltstone and sandstone than those above. This situation is of course altered in those wells in which a massive sandstone is present between Coals Nos. 4 and 5 (fig. 2), in which case the position of the coal may be marked only by a sharp reversal of the third curve at the base of the sandstone. Only in rare instances does the normal curve show the "double kick" noted in Clay and Gallatin counties.<sup>30, 31</sup>

#### MISCELLANEOUS COAL BEDS

Numerous other coal beds are present in the portion of the stratigraphic section dealt with here. No attempt has been made to determine their position and continuity by means of electric logs. They are, however, revealed in diamond drill holes and in control wells. At present of little or no economic significance, they may eventually be utilized by means of underground gasification.

Although some of the coal beds are not known to occur elsewhere, others appear to be more or less persistent. Of these, the following are most noteworthy: a thin coal bed 5 to 10 feet above the Millersville limestone; two coal beds, 80 and 130 feet below the Millersville limestone; a thin coal bed, indicated in most wells only by black shale and underclay, immediately below the Shoal

<sup>30</sup> Lowenstam, H. A., *op. cit.* p. 39.

<sup>31</sup> Pullen, M. W., Subsurface Geology of Gallatin County, in: Subsurface Geology and Coal Resources of the Pennsylvanian System in Certain Counties of the Illinois Basin: Illinois Geol. Survey Rept. Inv. 148, pp. 69-95, 1951.

Creek limestone; and another coal bed, possibly the Ditney, 20 to 30 feet above the West Franklin limestone. Rarely coal is recorded directly below the West Franklin limestone. These coal beds appear to correspond more or less in position with some of those noted by Lowenstam<sup>32</sup> in his detailed study of the McLeansboro strata and are probably continuous with them.

It is believed that more intensive study, especially with electric logs, and by tracing black shale-underclay associations (which normally accompany coal and may indicate the position of a missing coal bed), will serve to define additional coal-bed horizons and will also prove of value in structural and stratigraphic studies.

### STRUCTURE OF THE PENNSYLVANIAN SYSTEM

From the regional standpoint, Shelby and Moultrie counties, and those parts of Effingham and Fayette counties studied, lie near the northern margin of the deeper portion of the Illinois basin.<sup>33</sup> That part of the basin located in southern Illinois lies between the LaSalle anticlinal belt on the east and the DuQuoin monocline on the west. Northward, the DuQuoin monocline blends into the regional dip and no longer defines the western margin of the basin. The surface of any continuous bed in that part of the state may thus be regarded as an irregular structural plane which dips more or less to the east and southeast and terminates abruptly at the steep westward dipping flank of the LaSalle anticlinal belt. The area studied is a portion of the structural province which includes the beds that dip to the east and southeast.

No marked barrier to deposition is known to have been present to the northwest during Pennsylvanian times, and it appears probable that the area studied was characterized by conditions of deposition similar to those which existed in the region now included in Christian and Macon counties. Cross sections (pl. 5) indicate only slight

southeastward thickening between the Millersville limestone and Coal No. 4 and suggest that the beds laid down at that time were deposited under platform rather than true basin conditions. It is therefore believed that this portion of the Illinois basin was characterized throughout most of Pennsylvanian time by great regularity (at any given time) in depositional conditions and by essentially even surfaces of deposition slightly inclined to the southeast. The depositional area gently and periodically subsided, here and there marked by local areas in which subsidence proceeded at a slightly faster or slower rate. These local areas now stand out, at least in part, as the positive and negative structural features described below.

### STRUCTURE MAPS

Plates 1, 2, 3, and 4 show the structure of the Millersville limestone, and of Coal beds Nos. 7, 6, and 4. That of the Millersville is a revision of a portion of the earlier map of Taylor and Cady<sup>34</sup> and differs from it primarily because of the addition of data from wells which have been completed since 1944. In all maps, additional control beyond that used in the earlier map has been used in the closely drilled portions of Loudon oil pool. Because of the limitations of map space, an average of only five datum points per square mile are indicated in that area, whereas sixteen datum points per square mile were actually used. The wells were selected on the basis of general usefulness for the construction of maps of the several horizons contoured rather than for the Millersville limestone alone, and so are not the identical group of wells used in the earlier report. Wells common to both maps are so indicated by the presence of county numbers in addition to the elevations. The paragraphs which follow are based primarily on the structure of Coal No. 7 (pl. 2) inasmuch as this bed is regarded as the most reliable key bed of the several mapped.

The highest area, structurally, within the region is near Moweaqua, in northwestern Shelby County, where Coal No. 7 has an

<sup>32</sup> Lowenstam, H. A., *op. cit.*, pp. 32-41.

<sup>33</sup> Bell, A. H., Subsurface structure of the base of the Kinderhook-New Albany shale in central and southern Illinois: Illinois Geol. Survey Rept. Inv. 92, 1943.

<sup>34</sup> Taylor, E. F., and Cady, G. H., *op. cit.*, 1944.

elevation of about 100 feet above sea level. The lowest area, structurally, is 68 miles southeast in southeastern Effingham County where the same horizon is more than 550 feet below sea level. Regional dips average from 10 to 15 feet to the mile in easterly and southeasterly directions. These regional dips are modified to various extents by the local structural irregularities.

The most pronounced of these irregularities is the Louden anticline, the north end of which extends into T. 8 N., R. 3 E., and into the adjoining townships to the north, northeast, and east. The structural relief of this anticline is greatest for the Glen Dean limestone (fig. 6) and becomes progressively less for higher horizons. In a northeasterly direction from Louden anticline, along its axis, are two small structures in Ts. 10 and 11 N., R. 4 E., which include the Clarksburg and Shelbyville pools. These two structures appear to represent the northern end of the Salem-Louden anticlinal belt which extends from its southernmost point at Dix through the intervening pools of Salem, Tonti, Alma, St. Paul, St. James, and Louden. The structural high southeast of Shelbyville is coincident with an area in which Coal No. 6 (pl. 3) is not recognized and is therefore presumably missing.

The basin southwest of Cowden, T. 9 N., R. 3 E., is probably related genetically to the development of Louden oil pool. This basin is best shown by the structure of coal beds Nos. 4, 6, and 7 (pls. 4, 3, and 2) but is only poorly demonstrated by that of the Millersville limestone (pl. 1).

In much of T. 10 N., Rs. 2 and 3 E., the surface of each of the several key beds is only slightly irregular, the anticline at Lakewood being the only significant feature.

Other conspicuous structural features include the northwest-trending anticline, T. 11 N., Rs. 2 and 3 E., a few miles northeast of Tower Hill, Shelby County, and the dome in the southwest corner of T. 14 N., R. 4 E., Moultrie County. Although the former is only poorly shown by the map of Coal No. 6 (pl. 3), it is well shown by the maps of the Millersville limestone and of Coals Nos. 7 and 4 (pls. 1, 2, and 4).

The dome in Moultrie County is indicated on all maps but, as in the case of the Shelbyville structure, Coal No. 6 (pl. 3) is absent in the immediate area and its assumed stratigraphic position is occupied by a sandstone.

In southeastern Shelby and in Effingham counties the principal structural features include the small dome north of Stewardson and the north-trending arch in the eastern portion of T. 8 N., R. 6 E. Western Effingham County is marked by the conspicuous Effingham basin which is more or less continuous with another to the southeast. These two basins appear as separate features in the maps of Coals Nos. 6 and 7 (pls. 2 and 3), but as a long trough open to the south in the maps of the Millersville limestone and Coal No. 4 (pls. 1 and 4). Several structural irregularities in the southern portion of T. 6 N., R. 7 E., have served as traps for the accumulation of oil and appear to be related to the Bible Grove structural complex which is more completely developed in adjoining Clay County.

#### PENNSYLVANIAN HISTORY OF LOUDEN ANTICLINE

The Louden anticline, located in northeastern Fayette County, is one of the major oil-producing structures of Illinois. It extends in a northeast direction and includes parts of Ts. 6, 7, and 8 N., Rs. 2 and 3 E. That part dealt with here includes only T. 8 N., R. 3 E., and fringing areas in the adjacent townships to the north, northeast, and east.

The structure of the Glen Dean limestone, of Chester age, is depicted in figure 6. Seismic evidence indicates that closure on the Glen Dean limestone is approximately 131 feet.<sup>35</sup> This figure is similar to that suggested by the present study. Closures on the Devonian and Trenton horizons are estimated at 128 and 104 feet respectively.

The convergence (isopach) maps of the intervals between the Glen Dean limestone and Coal No. 4 (fig. 6), between Coal No.

<sup>35</sup> Lyons, P. L., Geophysical case history of Louden field, Illinois: in *Geophysical Case Histories*, vol. 1, p. 461 ff., Soc. of Exploration Geophysicists, 1948.



4 and Coal No. 7 (fig. 5), and between Coal No. 4 and the top of the Millersville limestone (fig. 5) reveal persistent thinning over the crest of the anticline. Structure maps of the Glen Dean limestone (fig. 6), Coal No. 4 (pl. 4), Coal No. 7 (pl. 2), and the Millersville limestone (pl. 1) show that the structural relief of the key beds increases with their depth, being greatest in the Glen Dean limestone and least in the Millersville limestone. It is concluded that the structural development of Loudon anticline extended more or less continuously throughout Pennsylvanian time. It is believed that the movements were initiated at least by early Pennsylvanian time and may have had their origin in late Mississippian time. Movement may have terminated in late Pennsylvanian and possibly Permian times.

The effect of the developing Loudon anticline upon the deposition of sediments on its crests and flanks is not always clear. As noted previously, the deposition of the Millersville limestone appears to have been little affected. The limestone (fig. 7) thins in a southerly direction. Inasmuch as this thinning is characteristic of the limestone off-structure as well as on-structure, it is considered here as regional. It is to be noted that the thickest deposits of the limestone, in secs. 2, 10, and 16, T. 8 N., R. 3 E., mark in a general way the crest of the anticline in that part of the structure, and correspond more or less with those parts of the Millersville limestone which lie more than 500 feet above sea level.

The effect of the Loudon structure upon the deposition of the Shoal Creek and Carlinsville limestones has not been studied in detail. The limestone, here tentatively referred to the Carlinsville, lying 50 feet more or less below the Shoal Creek limestone, is more continuous over the anticline than elsewhere. However, the Shoal Creek limestone itself is more discontinuous in this area than elsewhere and apparently passes laterally into shales. In some instances, sandstone lies at the assumed position of the Shoal Creek limestone. It has still to be determined whether this relationship is accounted for by lateral gradation of limestone into sandstone or by the erosion and removal

of the limestone and subsequent deposition of a stratigraphically higher sandstone, as suggested by Lowenstam.<sup>30</sup>

The origin and distribution of the West Franklin limestone is more complex. In the northeast portion of T. 8 N., R. 3 E., the West Franklin limestone most commonly consists of two massive limestones with an interbedded shale, the three beds constituting a total thickness of 18 to 30 feet. In the southern portion of the township (fig. 7), the "Trivoli" sandstone, which is commonly from 50 to 150 feet in thickness, is present at the approximate stratigraphic position of the West Franklin limestone. The stratigraphic relation of the sandstone and the limestone is obscure. With few exceptions, no significant bodies of sandstone occur above or below the limestone within its limits of distribution in T. 8 N., R. 3 E. Within the area of sandstone deposition, however, sporadic calcareous sandstones and occasional limestones have been noted at the base of the sandstone sequence, less often within the main body of the sandstone, and rarely at the top (fig. 7). Elsewhere, especially in northeastern Effingham County, massive sandstone may occur above beds correlated as West Franklin limestone.

A lateral change from West Franklin limestone deposition to deposition of sandstones and shales is indicated in a north-south cross section (fig. 8) along the western borders of secs. 13 and 24, T. 8 N., R. 3 E. This cross section is typical of others which have been made from secs. 13, 14, and 15 into the adjacent sections to the south. The electric logs are interpreted in the following way. The northernmost well, A, encountered West Franklin limestone similar in character to that in all other wells in the northern part of the township. The West Franklin limestone is absent in well B and shale is present at its stratigraphic position. In the more southerly wells, at the position of the limestone, and of the beds above and below, there is sandstone with thin interbedded shales. The symbols "A" and "4" within the central column of each electric log mark the respective positions of an unknown marker bed (possibly Coal No.

<sup>30</sup> Lowenstam, H. A., *op. cit.*, p. 28.

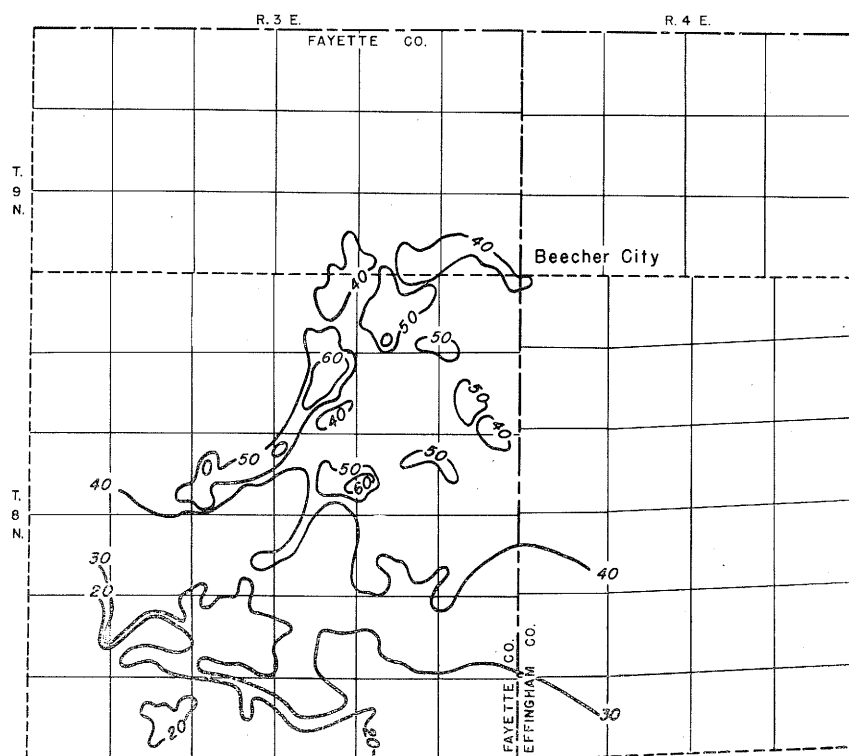
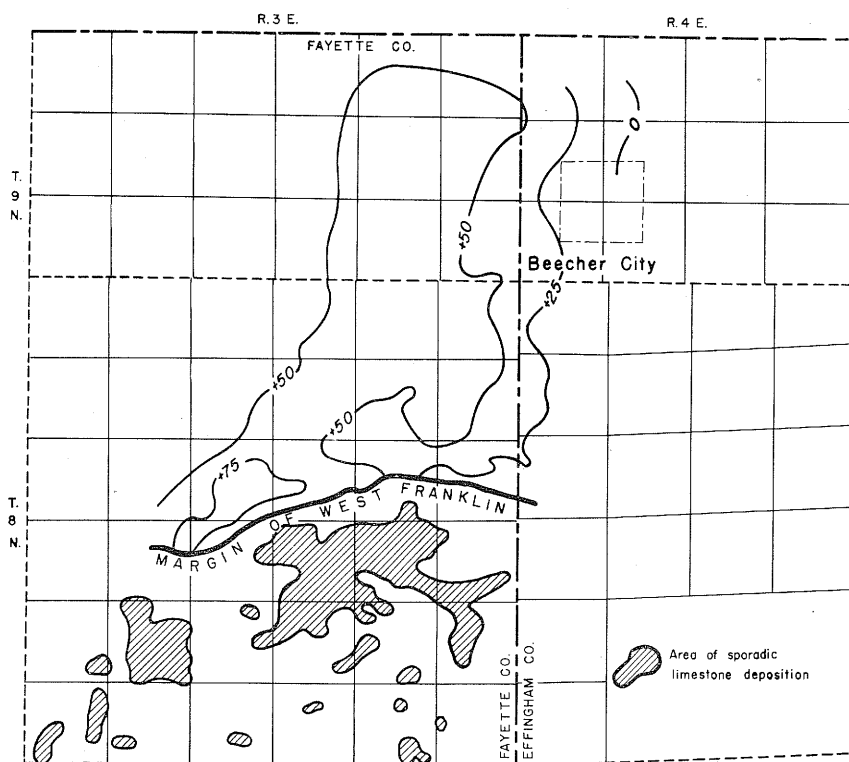


FIG. 7.—Above: Elevation of base of West Franklin limestone. Datum, sea level.  
Below: Thickness of Millersville limestone. Contour intervals: for West Franklin, 25 feet; for Millersville, 10 feet.

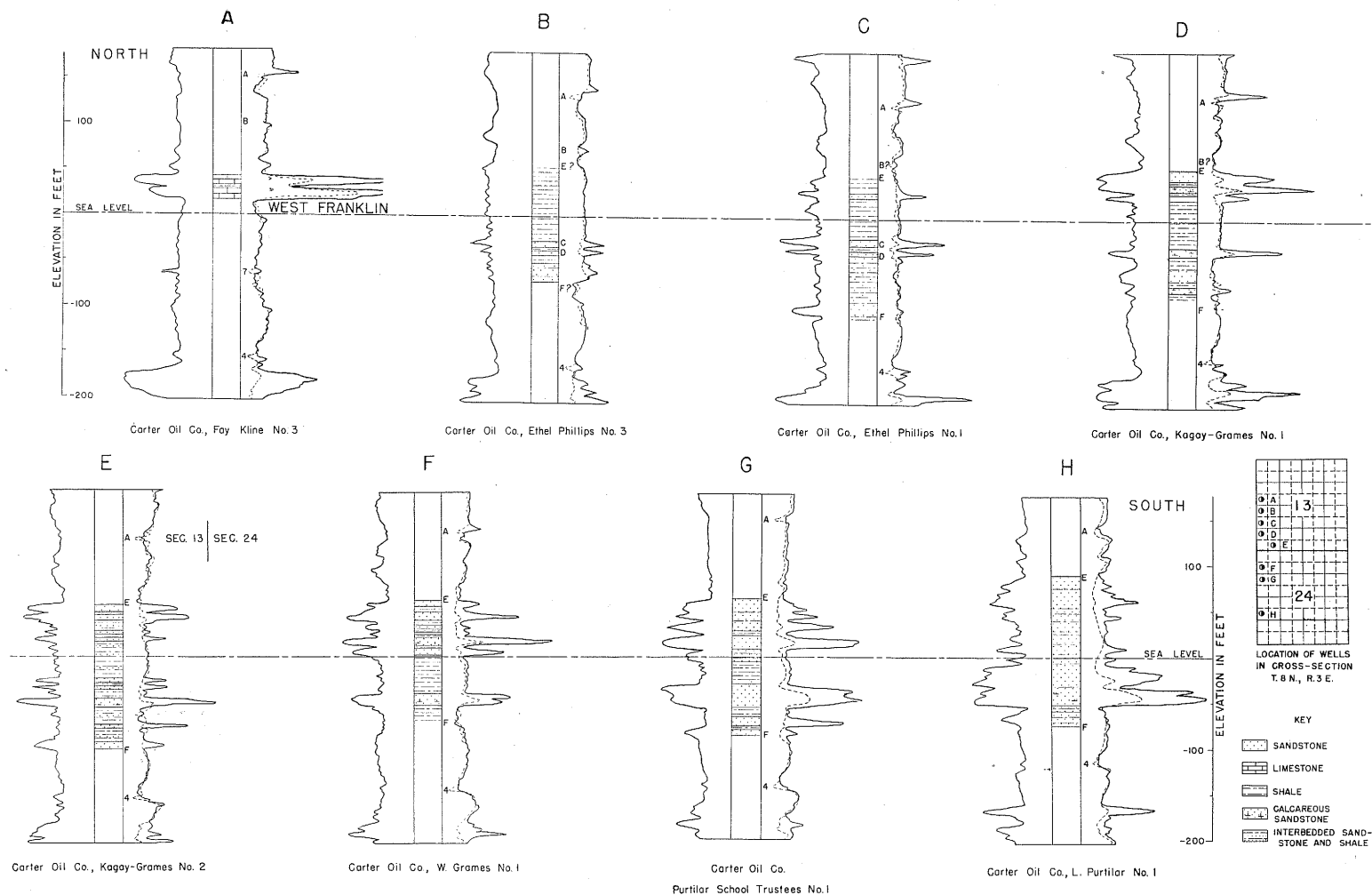


FIG. 8.—Electric log cross section and lithologic interpretation illustrating abrupt transition from West Franklin limestone to interbedded sandstone and shale.

8) and of Coal No. 4. The figure "7" is placed at the horizon of Coal No. 7 in well A (which is the only well in the cross section in which the horizon can be identified), and "E" and "F" mark the upper and lower limits of the intercalated body of sandstone and shale at the place of the West Franklin limestone and the associated beds above and below. The cross section shows that the sandstone (and shale) sequence descends to within 75 feet of the horizon of Coal No. 4, and that in so doing it extends below the probable position of Coal No. 7, and probably Coal No. 6 as well. No evidence is at hand for dating the sandstone with relation to the West Franklin limestone. It is possible that the limestones and calcareous sands which in some places occur at the base of the sandstone may be continuous or contemporaneous with the West Franklin limestone. It is known that the sandstone post-dates Coal No. 7, and it appears probable that it predates Coal No. 8.

The interval between Coal No. 4 and the base of the West Franklin limestone shows little variation in thickness. In about half the wells in which the limestone is present the interval is between 160 and 170 feet, in most wells the interval is between 150 and 180 feet and only rarely is it greater or smaller. Within the area of "Trivoli" sandstone, however, the interval between the base of the sandstone and the top of Coal No. 4 is significantly smaller and locally very erratic. Although the average interval between the sandstone and Coal No. 4 is about 100 feet, over the crest of the structure it may be as little as 60 feet. It is noteworthy that the more massive deposits of sandstone are in general restricted to the higher parts of the structure and therefore may in some way be related to its development. Although similar deposits of sandstone in the position of the "Trivoli" sandstone have only rarely been noted elsewhere in the area of this report, they are known to be common to the south and southeast.

Any explanation of the relations of the West Franklin limestone to the "Trivoli" sandstone must take into account the following statements:

- 1) In T. 8 N., R. 3 E., the West Franklin limestone varies in thickness from 18 to 30 feet, being generally thicker to the south.
- 2) In general the limestone appears to terminate abruptly, and beyond its border drill holes encounter shale or sandstone at approximately the same position; sandstone is more common in the southern part of the township.
- 3) In western Shelby County the strata above Coal No. 7 include (in ascending order) a thin sequence of shale, two beds of argillaceous limestone or calcareous shale, and a thick sequence of shale; within a short distance laterally this group of beds may be replaced by a thick sequence of shale above Coal No. 7 followed above by the West Franklin limestone and another relatively thick shale sequence.
- 4) Massive sandstone (of the "Trivoli" type) rarely overlies the West Franklin limestone in the vicinity of Loudon anticline; such a sandstone also rarely underlies the limestone.
- 5) The massive sandstones may contain very calcareous zones, which locally may be sufficiently pure to be called limestones. Such calcareous zones occur most commonly near the base, in which instance they may represent conglomerates, and less frequently within the body of the sandstone.
- 6) The massive sandstones are more common in the southern part of T. 8 N., R. 3 E., and similar sandstones are of frequent occurrence in Fayette, Clay, and Wayne counties.
- 7) The lower surface of the massive "Trivoli" sandstone is unconformable, as indicated by its irregular distance above Coal No. 4 and by its erosion of Coals Nos. 7 and 6 in certain areas, whereas the lower surface of the West Franklin limestone appears to be conformable with the underlying strata.

Because the exact stratigraphic relations of the West Franklin limestone and the

"Trivoli" sandstone are not understood, it is difficult to construct a well integrated history of West Franklin time. It is possible that, during the time the West Franklin limestone was being deposited upon the northern flanks of the anticline, the structure as a whole possessed considerable submarine topographic relief. This relief may have been sufficient to alter conditions of sedimentation and to effect the deposition of sandstone instead of limestone. This concept more or less presupposes the approximate contemporaneity of the "Trivoli" sandstone and the West Franklin limestone. If, on the other hand, the sandstone is younger than the limestone, it is possible that the West Franklin limestone may have been laid down over the entire area and that subsequently the topographic relief of the anticline was sufficient to influence the deposition of sand on those parts of the structure where it is now encountered. If this is the case, the sandstone has cut down through the West Franklin limestone and underlying shales as well as through Coals Nos. 7 and 6.

The agency of deposition is undetermined. Although subaerial streams may have operated as an agent, the generally good sorting of the sand and the absence of any well-defined channel pattern indicates that this is improbable. From the widespread geographic extent of the association of West Franklin limestone with sandstone similar to, or continuous with, the "Trivoli" sandstone, it is possible that the sandstone may represent a near-shore, or shoal-ward, equivalent of the West Franklin limestone. In the case of Loudon anticline, the topographic relief may have been sufficient to create the shoal conditions necessary for deposition of the sandstone phase.

Coal beds Nos. 4, 5, 6, and 7 are considered together. Unfortunately, records of only four control wells are available from the north end of Loudon pool and, because of their variability, they provide no basis for generalization. The following observations are therefore mostly derived from interpretation of the electric logs. The normal fully developed section, including the several coals separated by intervening strata similar

in thickness and character to that encountered in most parts of the report area, is nowhere present in Loudon pool proper. Immediately off-structure (on the flanks and in the vicinity of the anticline), however, the normal complete sequence of beds from Coal No. 4 through Coal No. 7 is present. Over the crest of the structure the interval between No. 4 and No. 7 coal beds (fig. 5) and between No. 6 and No. 7 coal beds decreases markedly, and No. 5 coal is only rarely recognized. Coals Nos. 6 and 7 (with the single questionable exception of the four feet of Coal No. 7 recorded in the Carter Oil Co., Stubblefield No. 3) appear to be thinner than usual, suggesting that conditions of deposition and/or preservation were not favorable on the crest of the structure. Coal No. 5 is believed to be generally absent. In the southern part of T. 8 N., R. 3 E., in the area of deposition of the "Trivoli" sandstone, erosion has in some instances cut through the horizons of Coals Nos. 7 and 6 and within 50 feet of Coal No. 4 (figs. 8, 9, pls. 2, 3).

To summarize the relations between the Loudon anticline and the deposition of the several key beds, the Millersville limestone appears to have been little affected by the influence of the developing Loudon anticline, although it is possible that the somewhat thicker deposits of limestone along a part of its crest are in some way related to the presence of a structural high. The Shoal Creek limestone is less often present over the structure than elsewhere, whereas the Carlinville limestone is developed, though erratically, only in that area. The problem of the West Franklin limestone-"Trivoli" sandstone is still unsolved, and the exact relation of the anticline to these two units is not known. The several coals, from available evidence, appear to be thinner and more irregular in development over the crest of Loudon anticline than elsewhere.

### COAL PRODUCTION

Coal was mined in Shelby County as early as 1840, but the industry has never been large. Total production of coal be-

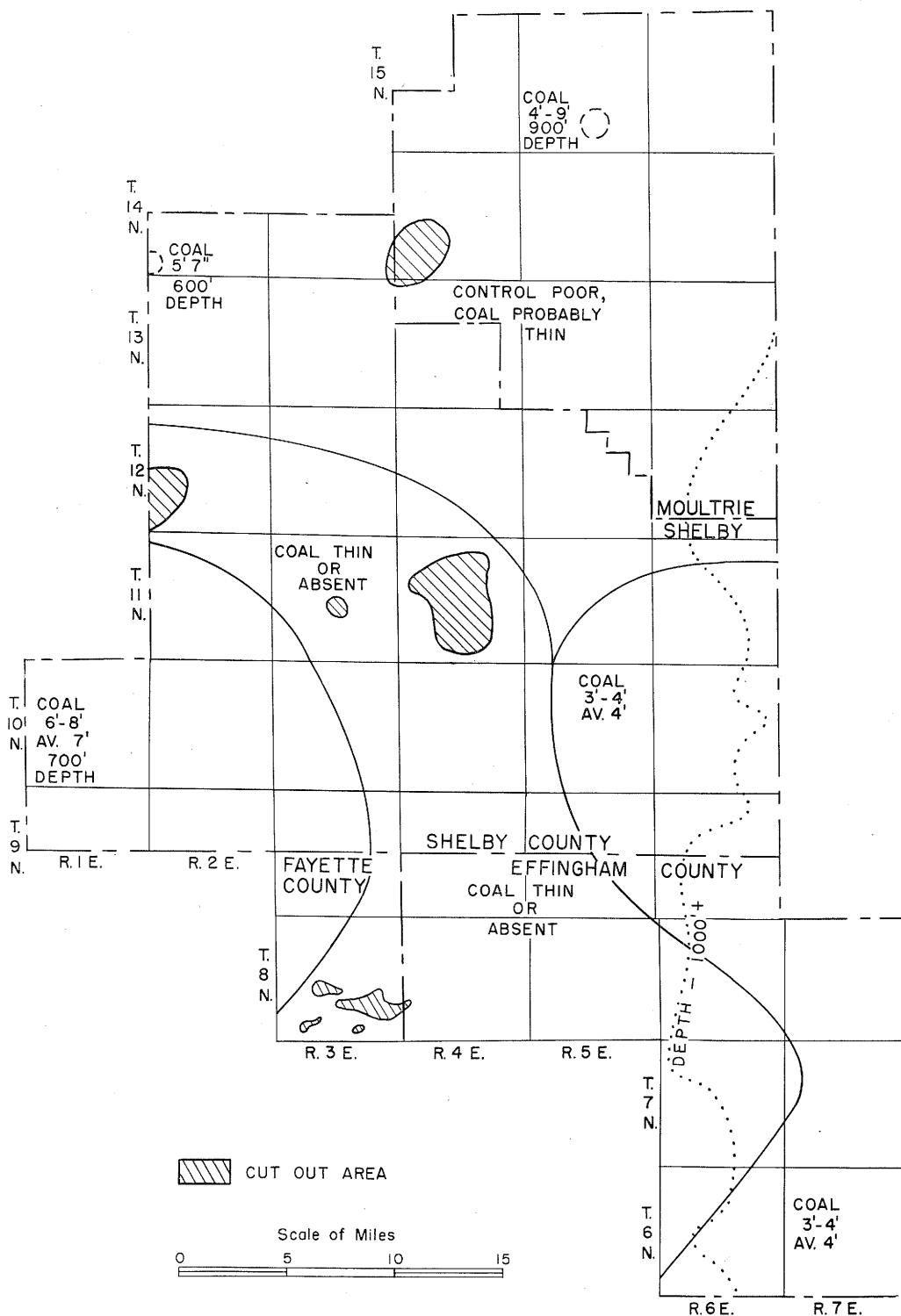


FIG. 9.—Distribution of No. 6 coal bed in various degrees of thickness and depth in Shelby, Moultrie, and part of Effingham and Fayette counties.

## GEOLOGY AND COAL RESOURCES

TOWER HILL COAL CO. (COAL NO. 6)<sup>37</sup>  
(One sample)

Condition	PROXIMATE				ULTIMATE					HEAT VALUES			
	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Calories	British thermal units	Rank index	Unit coal index
1	10.54	37.05	39.44	12.97	4.18	.....	.....	.....	.....	.....	10777	.....	.....
2	.....	41.41	44.10	14.49	4.67	.....	.....	.....	.....	.....	12047	.....	.....

<sup>37</sup> Analysis by Illinois Geol. Survey, in files.MOWEAQUA COAL MINING AND MFG. CO. (COAL NO. 5)<sup>38</sup>  
(Composite of three samples)

Condition	PROXIMATE				ULTIMATE					HEAT VALUES			
	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Calories	British thermal units	Rank index	Unit coal index
1	11.2	35.3	42.8	10.7	3.6	5.7	61.2	1.2	17.6	6150	11070	.....	.....
2	.....	39.7	48.2	12.1	4.0	5.0	69.0	1.4	8.5	6927	12470	.....	.....
3	.....	45.1	54.9	.....	4.6	5.7	78.4	1.6	9.7	7880	14190	.....	.....
4	13.0	38.1	48.9	.....	.....	.....	.....	.....	.....	7001	12600	126	.....
5	.....	43.8	56.2	.....	.....	.....	.....	.....	.....	8045	14480	.....	145

County Average Rank Index 126

County Average Unit Coal Index 145

<sup>38</sup> Cady, G. H., "Classification and selection of Illinois Coals," Illinois Geol. Survey Bull. 62, p. 247, 1935.LOVINGTON COAL CO. (COAL NO. 6)<sup>39</sup>  
(Composite of three samples)

Condition	PROXIMATE				ULTIMATE					HEAT VALUES			
	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Calories	British thermal units	Rank index	Unit coal index
1	6.8	39.2	42.3	11.7	4.0	.....	.....	.....	.....	6599	11880	.....	.....
2	.....	42.0	45.4	12.6	4.3	.....	.....	.....	.....	7083	12750	.....	.....
3	.....	48.1	51.9	.....	4.9	.....	.....	.....	.....	8101	14580	.....	.....
4	8.0	43.0	49.0	.....	.....	.....	.....	.....	.....	7619	13720	137	.....
5	.....	46.7	53.3	.....	.....	.....	.....	.....	.....	8284	14910	.....	149

County Average Rank Index 137

County Average Unit Coal Index 149

<sup>39</sup> Cady, G. H., *Ibid.*, p. 270.

tween the years 1882 and 1948 was as follows:<sup>40</sup>

	<i>In tons</i>
Shelby County.....	4,119,550
Moultrie County.....	2,032,236
Effingham County.....	796
Fayette County.....	0

Maximum production was attained in the early part of the present century, but has since ceased entirely except for occasional operations of local mines.

Of the total production of Shelby County, well over half (2,584,558 tons) was taken out in the twenty-year period between 1903 and 1922. Of this amount, most was taken from the mines of the Tower Hill Coal Company and the Moweaqua Coal Mining and Manufacturing Company. In 1938 there were still 13 local mines in the vicinity of Shelbyville and Mode, but by 1949 this number had dwindled to one mine with a total output in that year of 197 tons.

Nearly all the total production of Moultrie County (1,707,337 tons) was extracted in the ten-year period 1913-1922 from the mine of the Lovington Coal Company. No coal has been mined commercially in that county since 1924.

Most of the coal production of the two counties is the result of three mine workings:

- 1) The Tower Hill Coal Co., sec. 23, T. 11 N., R. 2 E., in Shelby County, operating Coal No. 6: period of operation, 1904-1919; average thickness, over 7'; roof, usually shale, 0 to 6', with overlying limestone, rarely limestone alone; floor, underclay.
- 2) Moweaqua Coal Mining and Mfg. Co., sec. 31, T. 14 N., R. 2 E., Shelby County, mining Springfield Coal No. 5, as well as a 2-foot bed lying from 50 to 160 feet below the surface. Coal No. 6 is present but there is no record of its having been mined; a lower coal, probably the same as that mined at Assumption, was also mined for a short time. Period of operation, 1890-1932; average thickness of Coal No. 5, 63";

depth, 620'; roof composed of black shale, shaly limestone, and gray shale in ascending order; floor composed of "floor clay" with underlying limestone.

- 3) Lovington Coal Company, sec. 27, T. 15 N., R. 5 E., Moultrie County, mining Coal No. 6; operated from 1909-1924; thickness variable, 48 to 114 inches—average, about 96 inches; depth to coal, 904'; roof, 2½ feet black shale, 9 feet limestone; floor, dark fire clay.

Coal analyses in the area concerned are few and limited to the mines noted above. Those available are given on page 30. The form of analysis is denoted by number, as follows: 1. sample as received at laboratory; 2. moisture-free; 3. moisture- and ash-free; 4. moist mineral-matter-free; and 5. dry mineral-matter-free (unit coal).

Further information on the methods and significance of these analyses may be obtained by consulting Illinois Geol. Survey Bulletin 62.

## COAL RESERVES

The most important minable reserves of Coal No. 6 are located in southwestern Shelby County. Approximately 188 square miles, in T. 10 N., Rs. 1, 2, and 3 E., and parts of adjacent townships (fig. 9) are believed to be underlain by Coal No. 6, ranging from 6 to 8 feet in thickness, and lying at depths of 600 to 800 feet. The total estimated reserves for this area of 188 square miles, calculated on a basis of 1,132,800 tons per square mile foot, are 1,490,764,800 tons. Reliable information, however, is restricted to Ts. 9 and 10 N., R. 1 E., and T. 11 N., R. 2 E. If this area alone is considered, there are only 75 square miles which may be considered as reserve, and this, calculated on the same basis, comes to 594,720,000 tons. Coal No. 6 is also present in the vicinity of Moweaqua, with a thickness of about 5 feet 7 inches, and at Lovington, where it is erratic and ranges from 4 to 9 feet in thickness. These two areas constitute a reserve of unknown extent. Coal No. 6 is also present in the eastern part of the area,

<sup>40</sup> In Sixty-Seventh Coal Report of Illinois, 1948, Dept. of Mines and Minerals, p. 84.



north and south of Effingham, with an average of 4 feet of thickness, and lies at depths of 1,000 to 1,100 feet, which is considered too deep for commercial development at present. Likewise, the situation for the exploitation of No. 6 coal is unfavorable in other parts of Shelby, Moultrie, Effingham, and Fayette counties. These are areas in which the coal is thin, erratic in development, or below the depth of profitable recovery. Such coal supplies constitute reserves which may be extracted when other more readily available sources are exhausted.

Coal No. 5 has been mined successfully at Moweaqua, sec. 31, T. 14 N., R. 2 E., and constitutes a considerable undetermined reserve in this area.

Coal No. 4 is less than two feet thick over most of the area and in some places it is absent. It is not considered a reserve.

The coal formerly mined at Assumption, in nearby Christian County, sec. 2, T. 12 N., R. 1 E., occurs approximately 275 feet below the horizon of Coal No. 6, and 125 feet below Coal No. 2. It is tentatively correlated with the Davis or DeKoven coals of southeastern Illinois. A coal believed to represent the same bed was mined at Moweaqua for a short time and is thought to be present in adjacent parts of Shelby County. It is considered to lie at depths too great for commercial mining.

#### SUGGESTIONS CONCERNING PROTECTION OF COAL BEDS

The "General Rules and Regulations Relating to Oil and Gas" of the Illinois Department of Mines and Minerals suggests that in order to prevent waste, workable coal beds shall be protected in the drilling, casing, and plugging of wells drilled for oil and gas. Workable coal beds are defined as all seams 30 inches or more in thickness less than 1,000 feet below the surface. When wells penetrating such seams are abandoned, the coal shall be protected by a cement plug extending 100 feet above and 50 feet below the bed in question.

Within the area of this report, in general, the only beds which need such protection are Coal No. 6 and Coal No. 5. Reference to figure 7 indicates that protection is not considered essential in extreme eastern Shelby County and in Effingham County where Coal No. 6 lies at depths of more than 1,000 feet. Protection should be considered necessary in eastern Shelby County where Coal No. 6 is indicated as 3 to 4 feet in thickness at less than 1,000 feet in depth. Similarly, protection is needed in southwestern Shelby County, in the area indicated on figure 7, where Coal No. 6 averages 7 feet in thickness and lies at about 700 feet below the surface. Elsewhere in the report area the coal should be assumed to be present in workable thicknesses, except in the "cut-out" areas, unless there is definite evidence to the contrary.

Definite information on Coal No. 5 cannot be given. In much of eastern Effingham and Shelby counties this coal is at depths greater than 1,000 feet. In south central Shelby County and probably in parts of western Effingham County the coal is of workable thickness and at depths less than 1,000 feet. In these areas the coal needs protection. So far as is known, Coal No. 5 is not present in southwestern Shelby County. Coal No. 5 was formerly mined in the vicinity of Moweaqua, T. 14 N., R. 2 E., and must be considered as present in that general area unless it can be otherwise shown.

Where both Coal No. 6 and Coal No. 5 are present in workable thicknesses at depths less than 1,000 feet, a single plug reaching from 50 feet below Coal No. 5 to 100 feet above Coal No. 6 should adequately cover the two seams. If the position of Coal No. 5 is not known, a single plug reaching from 100 feet below to 100 feet above Coal No. 6 will insure proper protection. The accompanying structure map of Coal No. 6 (pl. 3) should be of assistance in determining the depth at which such plugs should be placed.