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SIGNIFICANT UNCERTAINTIES IN PENNSYLVANIAN
CORRELATION IN ILLINOIS COAL BASIN

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SIGNIFICANT UNCERTAINTIES IN PENNSYLVANIAN CORRELATION IN ILLINOIS COAL BASIN¹

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ABSTRACT

In connection with the preparation of coal-bed structure maps stratigraphic studies have been made based on the matching of drilling logs of a series of wells extending from the vicinity of Carlinville on the west to western Cumberland County on the east. Such studies reveal a lack of agreement with correlations based on the study of outcrops. The pattern of succession on the western margin of the basin produced by the spacing of important limestone and coal beds appears to be traceable into the central part of the basin, indicating that the surface beds in the central area are much younger than those on the margin. Such a conclusion is at variance with conclusions that have been recently reached by the study of outcrops independent of coal-bed structures. Such studies have resulted in correlations which require a conspicuous spreading between the prominent limestone beds as they approach the inner part of the basin, resulting in a marked departure from parallelism with coal bed No. 6 on the part of the higher limestones. The paper points out the need of further studies and elaborates the evidence on which surface correlations are based.

For the better part of three decades the writer has given the major part of his attention to the geology of the coal beds of Illinois. His interest has been centered on the economic aspects of the coal beds as mineral resources to be explored, mined, and utilized. A large amount of time has been devoted to the delineation of the position of outcrop of the workable coal beds, in a study of their variations in thickness and their chemical and physical characteristics, and in mapping their structural features. Necessarily in such mapping projects, since the coal beds are usually at considerable depths, in some places 1,000 feet or more, much dependence has been placed on drilling records in determining their extent and position.

Within the main coal-mining districts the identification of the workable coal beds in Illinois is based on familiar peculiarities of the individual beds, the spacing of the beds in the Coal Measures, and the relationship of the coal beds to other widespread and recognizable units, such, for example, as the cap-rock limestone of Herrin (No. 6) coal bed. Away from the regions where the coal beds have been mined or closely explored, the correct identification of a coal bed is not everywhere apparent, and reliance for identification is placed on the usual procedure of stratigraphic correlation. The economic geologist is therefore not uncommonly dependent on the stratigraphic geolo-

¹ Presented at Geology Section, Milwaukee Meeting, A.A.A.S., June 21, 1939, by permission of the chief of the Illinois State Geological Survey. Manuscript received, July 8, 1939. Published with the permission of the chief of the Survey but representing the author's individual opinion.

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gist, or on such facts in regard to the stratigraphic succession as he can himself decipher from the drill logs for identification of coal beds outside the mining districts.

Had the knowledge of Pennsylvanian stratigraphy kept abreast, or better, a little ahead of the growing need for that knowledge in preparing fuel-resource inventories, the economic geologist would probably now be able to interpret drilling data on the basis of sound stratigraphic information; at least this would apply to such records as are reasonably accurate. Unfortunately, the details of our Pennsylvanian succession are so inadequately understood that a great deal of dependence in interpretation is still placed on nimbleness, ingenuity, and shrewdness in log matching for the purpose of discovering regular patterns and spacing in the succession. Such regularity when discovered has been taken to indicate continuity of beds, even though the identity of such beds may be uncertain.

The great superiority of systematic stratigraphy over log matching is readily admitted, since it requires very little geological knowledge to make such comparisons, but it should likewise be realized that danger of error in correlation and identification of beds also exists when stratigraphic studies based on outcropping beds give no consideration to the facts in regard to the structure as revealed by drilling.

One of the principal activities of the Coal Division of the Survey has been the mapping of the structure of the workable coal beds of the state. During the last 10 years or more attention has been directed particularly to the delineation of the structure of Herrin (No. 6) coal for a large part of the southern half of the Illinois coal basin. In large areas in southwestern and southern Illinois drilling has been fairly closely spaced and much of it has been done by coring devices. In general, in this area the tracing of the coal bed from drill hole to drill hole is mainly based on the altitude and thickness of the coal bed. Away from the mines, however, and the more closely spaced drill holes, more care in identifying the coal bed is necessary, and the details of the drilling records become important.

In preparing structure maps the economic geologist finds it necessary to familiarize himself with the stratigraphic succession revealed by the drilling logs. He may be working in an area where the coal bed is many hundred feet below the surface so that most of the beds penetrated in drilling are exposed only at places remote from the area being studied. Unless the stratigraphy is thoroughly understood, which is rarely the fact in Illinois, the geologist will find it impossible

to interpret his drilling data in terms of standard stratigraphic units. Instead he will seek to discover beds of apparent continuity in the area by matching log with log and thereby work out a sort of stratigraphic pattern that seems to prevail. Such a stratigraphic pattern can then be used as a standard for identifying a coal bed or the position of a coal-bed horizon on the fringes of a coal-mining district.

It is almost inevitable, however, following such a practice, that there will be some effort made to give the individual units comprising the stratigraphic pattern the names of outcropping beds if relationships seem to be similar, although the exposure of such beds may be at considerable distance. These correlations will vary greatly in correctness, depending on the care exercised in making identifications. Experience has shown that many of them have been erroneous, particularly those made in the early years of the present Survey.

In general, in Illinois, surface and underground stratigraphy of the Pennsylvanian rocks has been carried on largely independently by different groups of workers, so that miscorrelations resulted in a number of instances. In general, Pennsylvanian strata encountered in drilling have not been systematically identified in the logs largely because the need for such identification has not been particularly pressing since the coal beds could generally be identified and followed by the log-matching procedure. With the recent discovery of oil fields in the coal basin, the stratigraphic identification of beds becomes of much greater importance in the interpretation of structure.

In the light of these remarks, the development of the present confusion in the correlation of a number of important members of the McLeansboro formation in the Illinois coal basin can probably be better understood. The nature of this confusion will now be considered.

Because of the emphasis that has been placed on the economic aspects of geological investigations by the Survey during its first ten years of existence, structural studies have proceeded much more rapidly than stratigraphic studies, in spite of the fundamental value of the latter. In the preparation of structure maps of coal bed No. 6 in southwestern and southern Illinois many hundreds of drilling logs were used to locate the position of the coal. These were generally studied in graphic form on a scale of 1 inch to 100 feet of vertical distance. Using such graphic logs the prevailing arrangement of beds of the McLeansboro formation for the southwestern part of the basin was worked out with little attempt to tie in known outcrops with strata penetrated in drilling except in two or three instances. The

outstanding distinctive units of the stratigraphic pattern based on log matching were described by Kay³ in 1915 as follows (Fig. 1).

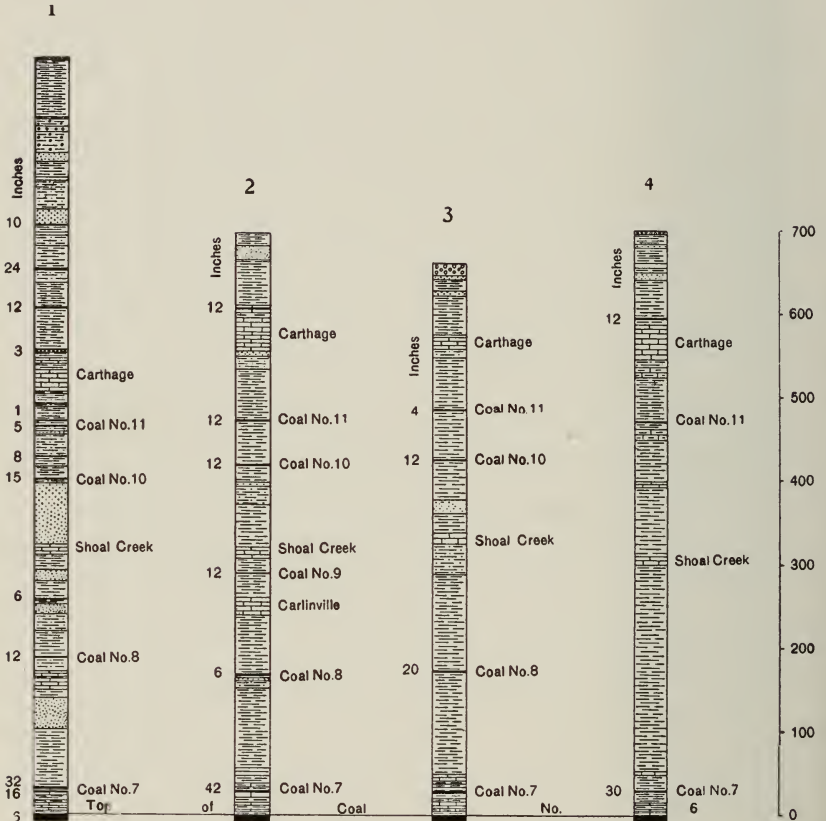


FIG. 1.—Sections showing persistent nature of limestones in McLeansboro formation (after Kay).

1. Lovington, Moultrie County.
2. Sec. 8, T. 10 N., R. 1 E., Shelby County.
3. NW. $\frac{1}{4}$, NW. $\frac{1}{4}$, Sec. 8, T. 9 N., R. 1 W., Montgomery County.
4. Sec. 29, T. 9 N., R. 1 E., Fayette County.

7. New Haven limestone, 200 to 250 feet above Carlinville limestone
6. Shoal Creek limestone, about 100 feet above Carlinville limestone
5. Carlinville limestone, so-called because of typical outcrops near town of this name in Macoupin County. Its position is from 200 feet to a little more than 300 feet above coal No. 6
4. Coal No. 8, ranging in thickness from 8 inches where present to 2 feet and lying 150 to 180 feet above coal No. 6

³ F. H. Kay, "Coal Resources of District VII," *Illinois State Geol. Survey Coöperative Mining Investigations Bull. 11* (1915), p. 23.

3. A bed of pink, red, or variegated shale, variable in thickness, seldom exceeding 15 feet, averaging from 35 to 50 feet above coal No. 6

Wallace Lee⁴ states that the Shoal Creek limestone lies 75 feet above the Carlinville. Kay calls a coal, lying a short distance below the Shoal Creek limestone, coal No. 9. He states that "the New Haven limestone is encountered in nearly every drill hole that reaches coal No. 6 at a depth of 700 feet or more," and in "most logs is given a thickness of at least 25 feet." Kay calls the limestone New Haven, but the basis of correlation is mainly the interval between the limestone cropping out at New Haven, White County, and coal bed No. 6, which is about 500 feet. At any rate, whether or not the limestone 500 feet above coal bed No. 6 in District VII is correctly identified as the New Haven, its existence must be conceded. Kay finds two fairly persistent thin coal beds which he calls No. 10 and No. 11 about 50-60 feet apart midway between the limestone he designates the Shoal Creek and the one he calls the New Haven.

This general pattern of the McLeansboro succession has been the basis for identifying the position of coal bed No. 6 in the central part of the basin for more than 20 years. The general sequence undoubtedly exists irrespective of the identification of the different beds. The identification used by Kay is largely adopted from Lee⁵ and Shaw and Udden⁶ following the systematic geological mapping of four quadrangles lying in Macoupin, Montgomery, Madison, St. Clair, and Clinton counties. This quadrangle mapping between 1907 and 1914 gave considerable weight to the identifications made by Kay, which, however, were based largely on the evidence supplied by drilling.

Since 1925, under the stimulation of a new theory of Pennsylvanian sedimentation and stratigraphy announced by J. M. Weller and H. R. Wanless about 10 years ago, the outcrops of Pennsylvanian beds in Illinois have been examined and mapped with renewed interest. As a result correlations have been proposed that are of particular interest because of their departure from long accepted ideas. These later investigators recognized in the McLeansboro formation of southwestern Illinois the following distinctive beds other than coal beds.⁷

⁴ Wallace Lee, "Gillespie and Mt. Olive, Illinois," *U. S. Geol. Survey Geol. Atlas Folio 220* (1926), p. 6.

⁵ Wallace Lee, *op. cit.*

⁶ E. W. Shaw and J. A. Udden, "Belleville-Breese, Illinois," *U. S. Geol. Survey Geol. Atlas Folio 195* (1915).

⁷ Harold R. Wanless, "Pennsylvanian Correlations in the Eastern Interior and Appalachian Coal Fields," *Geol. Soc. America Spec. Paper 17* (March 30, 1939), pp. 15-19.

5. La Salle limestone
4. Shoal Creek limestone which is correlated with the New Haven limestone at New Haven, White County
3. Lonsdale limestone, also identified as the Cutler limestone in southwestern Illinois
2. Piasa limestone, also identified as the Bankston Fork limestone in southern and southwestern Illinois
1. Herrin limestone, the cap-rock of coal No. 6.

It may be well to note especially that the Shoal Creek limestone of Kay and Lee is renamed the LaSalle limestone and that the Carlinville limestone of Kay and Lee is given the name Shoal Creek. The Shoal Creek limestone as revised is correlated with the New Haven limestone. Two additional limestones are listed, the Lonsdale and the Piasa which are correlated with two widespread limestones encountered in many logs and exposed at many places in southern Illinois. The upper or Cutler limestone is about 40 feet above the Herrin (No. 6) coal bed and is underlain by the Cutler coal bed, probably coal No. 7 of Kay. The lower or Bankston Fork limestone lies about 20-25 feet above the Herrin (No. 6) coal bed (Fig. 2). It is in places overlain by a thin bed of coal. This coal bed and the Cutler coal bed (No. 7?) which has a black sheety shale roof are commonly encountered by the drill in passing through the strata intervening between the Cutler and Bankston Fork limestones.

These two limestone beds were found by field parties of the Coal Division working in Saline, Randolph, and Perry counties between 1920 and 1930.

The two schemes of stratigraphic arrangement that have been noted, one dependent largely on the organization and comparison of drilling data and the other mainly on surface outcrops, are not in agreement in a number of particulars. Decision in regard to the accuracy of either, so far as the economic geologist is concerned, is for the present in abeyance. The bases for the uncertainty in regard to the identity and correlation of the more distinctive of these McLeansboro beds may well be explained in greater detail.

NEW HAVEN LIMESTONE OF KAY

What is the limestone designated by Kay as the New Haven (or Carthage) which the study of well records indicates overlies the Shoal Creek and Carlinville limestones as he identified them in the succession, if the limestone exposed at New Haven, White County, is correctly correlated with the Carlinville limestone of Kay and Lee?

Studies by Taylor and Prescott⁸ indicate that such an upper lime-

⁸ Unpublished paper read at Illinois Academy of Sciences, May, 1939.

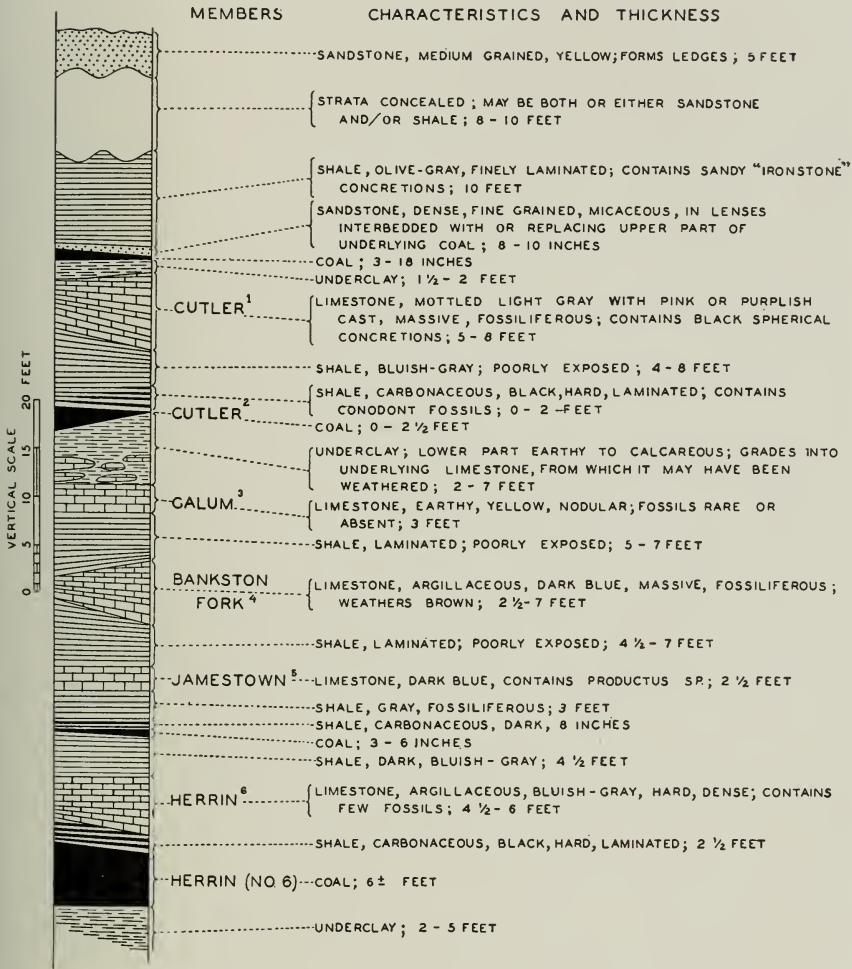


FIG. 2.—Generalized stratigraphic column of Pennsylvanian strata above and including Herrin (No. 6) coal in vicinity of Pinckneyville and Jamestown, as compiled from outcrops and records (after Ball and McCabe).

1. The name *Cutler* is applied to this limestone member because it is typically exposed in the vicinity of Cutler, Perry County, Illinois.
2. The name *Cutler* is applied to this coal bed because it is generally associated with the Cutler limestone.
3. The name *Galum* is applied to this limestone because it is well exposed along Galum Creek near Pinckneyville, Illinois.
4. See G. H. Cady, "Areal geology of Saline County," *Trans. Illinois Acad. Sci.*, Vol. 19 (1927), p. 261.
5. The name *Jamestown* is applied to this limestone because it is typically well exposed in the vicinity of Jamestown, Perry County, Illinois.
6. See Cady, *op. cit.*

stone is present in central Illinois 150-200 feet above the upper of a pair of limestones having a relationship similar to that of the Shoal Creek and Carlinville limestones of Kay and Lee (Fig. 3). This upper

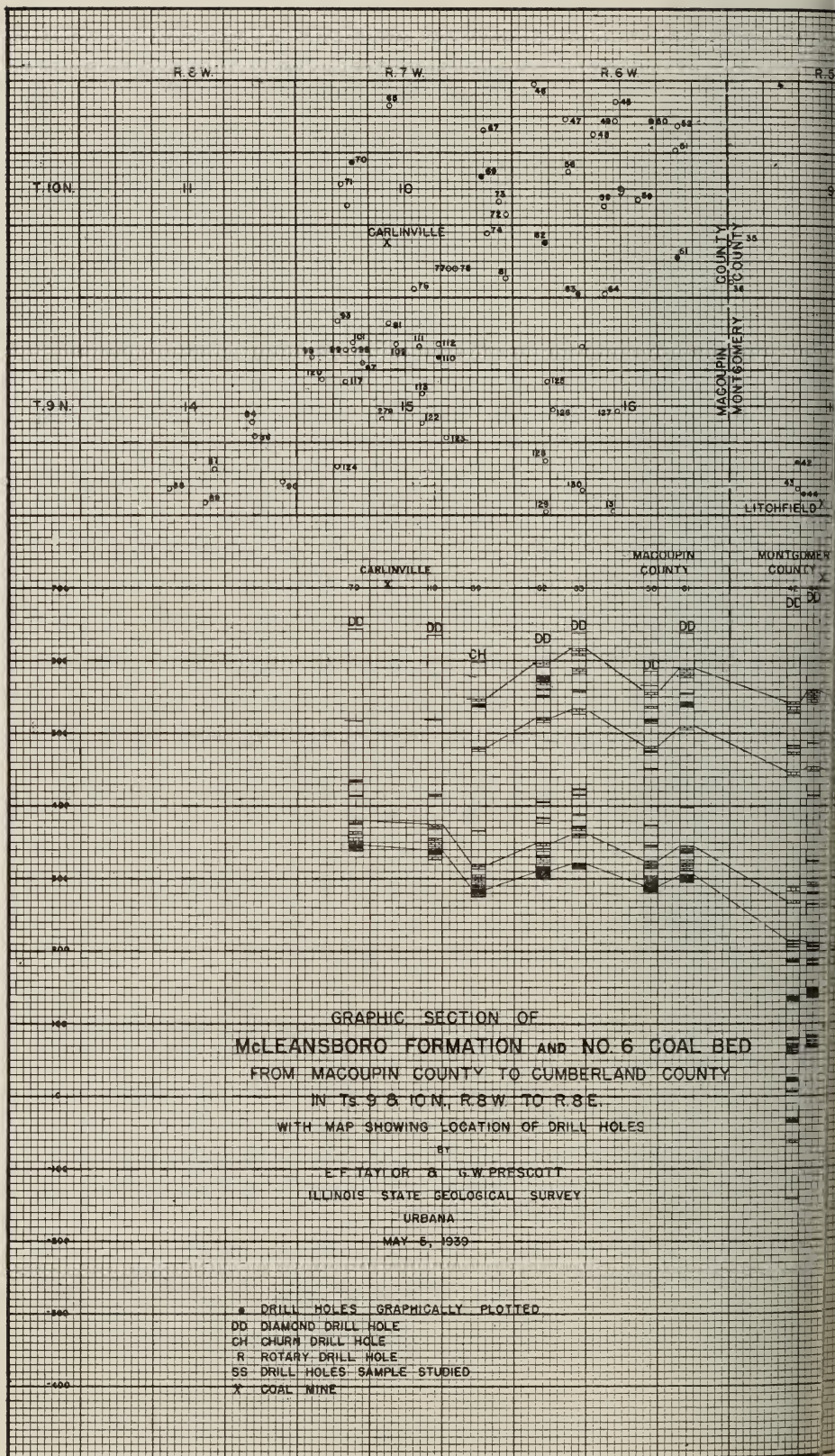
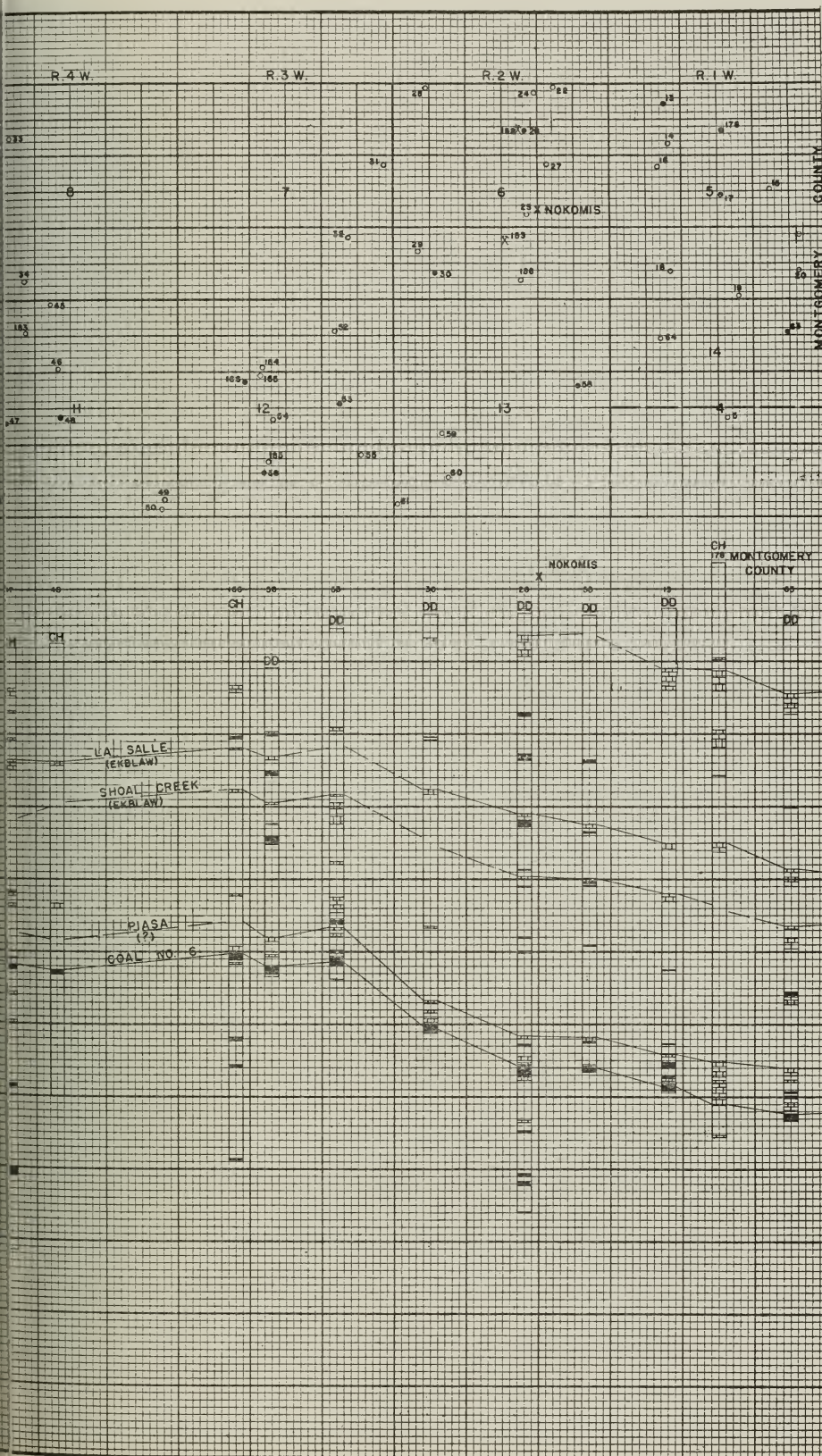


FIG. 3.—Graphic section of McLeansboro formation and No. 6 coal bed.



oupin County to Cumberland County.

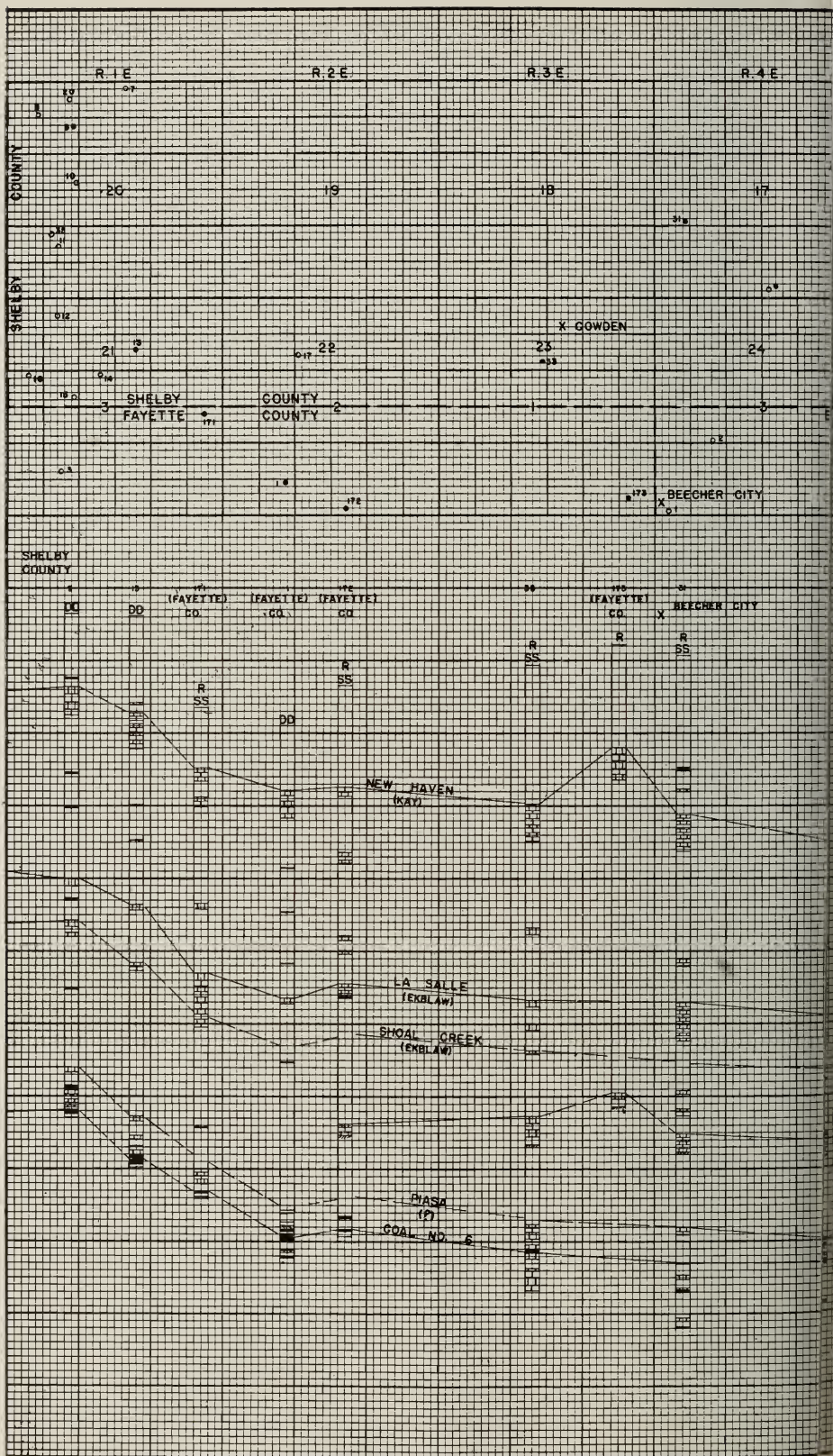
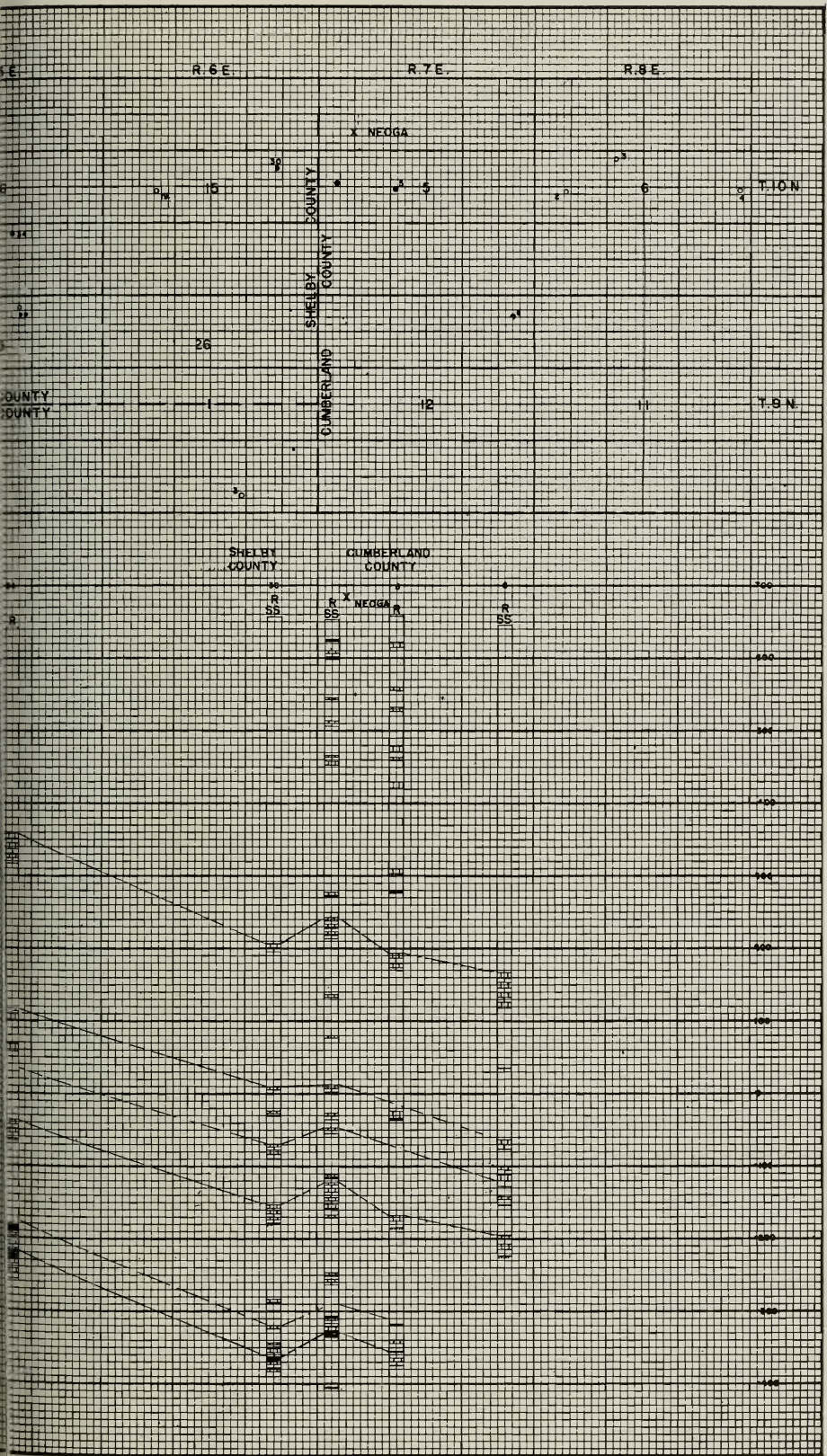


Fig. 3. (continued).—Graphic section of McLainsboro formation and No. 6 coal.



Map of Shelby County to Cumberland County.

limestone passes entirely beneath a section of the Pennsylvanian system in Cumberland and adjacent counties in which Newton and Weller⁹ have identified certain beds as the LaSalle limestone, that is, equivalent to the Shoal Creek of Kay and Lee.

This upper New Haven limestone of Kay has a common thickness of 25-40 feet and is encountered in most drilling in the central counties of the state, as noted by Kay, and lies 500-600 feet above Herrin (No. 6) coal bed. This interval is about the same as that separating the limestone cropping out at New Haven from the Herrin coal but the continuity of this upper limestone in Cumberland and adjacent counties in the central part of the basin with the limestone at New Haven seems very doubtful. If the New Haven of Kay is younger than the limestone at New Haven, there is obviously an area in the central part of the state underlain by this upper limestone and a marginal line of outcrop which has not been traced. The graphic section prepared by Taylor and Prescott indicates that one position of such outcrop is in eastern Montgomery County, and it seems probable that an exposure of the limestone has recently been located near Millersville, Christian County, Illinois. No name has been proposed for this upper limestone other than New Haven, except that the geologists employed by some of the oil companies that have drilled in the central part of the basin commonly refer to it as the LaSalle, which adds further confusion to the nomenclature.

SHOAL CREEK-CARLINVILLE LIMESTONES CONTROVERSY

Probably no group of beds in the Pennsylvanian system in Illinois has received more severe treatment by stratigraphers than that group extending from the base of the Carlinville limestone of Lee and Kay to the top of their Shoal Creek limestone. There is no question about the presence of these two limestones since they may be observed in outcrop in what is essentially a continuous exposure in the vicinity of Carlinville, and limestones at the same position and having the same relationships have been penetrated in many drill holes and mine shafts. The confusion in nomenclature has come from the misinterpretation of exposures, isolated exposures apparently being difficult to identify. These difficulties seem to be in part due to the failure to make suitable allowance for regional dip such as is manifested by the structure of the underlying Herrin (No. 6) coal bed.

The attempt to trace these beds south and southeastward in drill records encounters difficulty first because of an apparently increasing

⁹ William A. Newton, and J. Marvin Weller, "Stratigraphic Studies of the Pennsylvanian Outcrops in Part of Southeastern Illinois," *Illinois State Geol. Survey Rept. Investig.* 45 (1937), Pl. 1.

interval to Herrin coal bed, and secondly because the lower limestone, the Carlinville of Lee and Kay, becomes less persistent in that direction.

Additional difficulty in correlation has arisen apparently because of the indiscriminating use of the name Shoal Creek for what are apparently different limestones exposed in eastern Madison, western Clinton, southwest Bond and in Washington counties. The identification is made irrespective of the evident persistence of interval between the two limestones and Herrin (No. 6) coal bed, and a regional eastward dip of 6-8 feet per mile. Thus, a limestone outcrops along Shoal Creek which runs south in western Clinton County. A somewhat similar limestone also crops out along Sugar Creek which also flows south but about 7-8 miles west of Shoal Creek. According to Shaw and Udden¹⁰ the altitude of Herrin coal bed declines about 75 feet from Sugar Creek to Shoal Creek. The exposures of the limestone being at about the same altitude, it seems probable that the limestone exposed along Shoal Creek is actually stratigraphically higher than that exposed along Sugar Creek and that the identification of the limestones on both creeks as Shoal Creek limestone is probably a mistake. Descriptions of the limestones such as are given by Jon A. Udden¹¹ indicate that the exposures are sufficiently different so that two limestones may well be represented.

In 1932 Sidney Ekblaw¹² reviewed the Shoal Creek-Carlinville problem under the supervision of H. E. Wanless and came to the conclusion that the limestone exposed along Shoal Creek, that is the easternmost limestone, is the same as the lower or Carlinville limestone at Carlinville as defined by Lee. Lee earlier correlated the Shoal Creek limestone with the upper limestone at Carlinville and called it the Shoal Creek. Both Lee and Ekblaw apparently regarded the basis for their correlations as more or less self-evident and produced little or no definite support for their conclusions. It may be pointed out that Lee states that the interval to the Herrin (No. 6) coal bed from his Shoal Creek limestone is 275-325 feet in the Gillespie-Mt. Olive quadrangles and 350 feet at Breese along Shoal Creek in Clinton County. If the limestone exposed at the Timmerman quarry 4 miles northeast of Breese, and here possibly 375 feet above the Herrin (No. 6) coal bed, is actually the lower limestone as believed by Ekblaw,

¹⁰ E. W. Shaw and J. A. Udden, *op. cit.*

¹¹ Jon A. Udden, "Notes on the Shoal Creek limestone," *Illinois State Geol. Survey Bull.* 8 (1907), pp. 117-26.

¹² Sidney E. Ekblaw, "The Question of the Shoal Creek and Carlinville Limestones," *Trans. Illinois Acad. Sci.*, Vol. 25, No. 4 (May, 1932), pp. 143-45.

then the upper limestone, that is Lee's Shoal Creek, would be more than 400 feet above coal No. 6. This is as much as 100 feet in excess of the maximum interval reported by Lee, and the evidence of drilling does not bear out the probability of such a divergence of beds in the distance involved. Indeed comparison of logs of wells drilled in eastern Clinton County indicates the persistence of two limestones having the stratigraphic position of the Carlinville and Shoal Creek limestones as they occur in Macoupin County at least as far east as Centralia. Here the lower limestone is about 300 feet and the upper limestone about 400 feet above the Herrin (No. 6) coal bed. The stratigraphic pattern seems to be essentially the same as that seen in the graphic section from Macoupin to Cumberland counties prepared by Taylor and Prescott.

The upper or Shoal Creek limestone of Lee is not uncommonly underlain by a black fissile shale or "slate" beneath which there is commonly a thin bed of coal, nowhere more than a foot thick. No such coal horizon is reported by Lee to underlie the Carlinville limestone at the type locality or on the Gillespie or the Mt. Olive quadrangle. Ekblaw, on the other hand, describes a black sheety shale and coal bed a short distance below his Shoal Creek limestone (Carlinville of Lee) in his generalized section and reports no coal below his LaSalle limestone (Shoal Creek of Lee). These differences in interpretation and geological succession as reported by competent geologists are difficult for the economic geologist to comprehend and indicate that the solution of the controversy will require careful and discriminating observations with due consideration of the correlations made by both Lee and Ekblaw and of the structural conditions that exist.

The correlation of the upper or Shoal Creek limestone with the LaSalle limestone, that is the cement rock limestone at LaSalle, is based entirely on similarity in the stratigraphic pattern at LaSalle and at Carlinville so far as the writer is aware. In this case the stratigraphers have used the system of matching the grouping and spacing of beds to establish correlations, since there is no possibility of tracing the beds in exposures from one region to another. No particular objection exists to such a correlation so far as the present writer is concerned, so long as its basis is understood and the possibility of error realized. The very local distribution of the typical cement-rock limestone at LaSalle makes comparison on the basis of lithological similarity of little significance. A mile west of LaSalle the LaSalle limestone has little if any resemblance to the beds composing what would probably be called the typical LaSalle limestone.

The correlation of the Carlinville (Shoal Creek of Ekblaw) with

the New Haven is again largely based on the procedure of log matching. A limestone which may be either the Carlinville or the Shoal Creek of Lee is present in the shaft of the mine at Nashville, Washington County, about 400 feet above Herrin (No. 6) coal. There is only one such limestone reported and it is underlain by a thin coal bed. The interval is such as to suggest to the writer that this limestone is probably the upper or Shoal Creek limestone. The writer believes that Wanless, on the other hand, regards it as the Carlinville of Lee. So likewise the limestone cropping out at Radom, that near Galatia, and that at New Haven, except that in these latter two places the interval to the Herrin (No. 6) coal bed has increased to about 500 feet. Occasionally in drill holes in intervening positions in Jefferson, Franklin, and Saline counties two limestones having the general position of the Carlinville and Shoal Creek are reported. The uppermost of these limestones is between 400 and 500 feet above coal bed No. 6. There seems to be about as good evidence that the New Haven limestone represents the Shoal Creek of Lee as the Carlinville of Lee.

If the New Haven limestone represents Lee's upper limestone, called the Shoal Creek, it must be assumed that in many places between New Haven and western Clinton County the lower limestone is absent or poorly represented in the succession so that it commonly is not recorded in the logs. On the other hand correlating the New Haven with the Carlinville of Lee involves postulating a considerable thickening of the interval to the Herrin (No. 6) coal bed between the two localities. The basis for such belief rests very largely in the tenets of the cyclical theory of deposition which in general call for a widespread distribution of the individual members of each cycle.

These statements indicate some of the uncertainties that exist with respect to the correlation and identification of the Shoal Creek, LaSalle, Carlinville, and New Haven limestones in Illinois. The uncertainties become increasingly complex if Indiana limestones at the same general horizons are considered.

IDENTITY AND CORRELATION OF LONSDALE, PIASA, CUTLER, AND BANKSTON FORK LIMESTONES

This group of limestones lies between the Carlinville of Lee and the Herrin (No. 6) coal bed. Concerning their identity, continuity, and correlation there is much uncertainty in spite of the local distinction of each as a horizon marker. Limestones at this general horizon were not included in Kay's list of distinctive horizons. The graphic sections of Taylor and Prescott show a limestone at an intermediate position between the Carlinville of Lee and Herrin (No. 6) coal bed

which is usually associated with a variegated, usually a red, shale in logs of wells located in the central part of the basin. This limestone appears to give way toward the west in western Montgomery County and in Macoupin County, although the Piasa limestone is known to crop out in western Macoupin County.

Wanless¹³ regards the Piasa as distinctly different and somewhat older than the Lonsdale limestone. The latter is a persistent bed of limestone in northern and western Illinois occurring in the interval separating coal bed No. 7 and a bed of limestone possibly the equivalent of the Carlinville or a closely adjacent limestone in the Longwall district of northern Illinois. Inasmuch as the Lonsdale and Piasa limestones never occur with their typical lithologic appearance in the same outcrop, although the exposure may cross the position of both horizons as defined by Wanless, and inasmuch as both limestones are undoubtedly nearly at the same stratigraphic position, although said to be in different cyclical formations, better evidence should be advanced than is now available before the existence of two limestones can be accepted as definitely established.

Both the Piasa and the Lonsdale limestones are characterized by the presence of a long slender form of fusulinoid fossil not found in lower limestones. In certain places these are found in great abundance, but this is not commonly the case.

The Cutler-Bankston Fork succession was first described by Bell, Ball, and McCabe in 1931.¹⁴ It is a succession that can be observed in outcrop at numerous places between Belleville and Pinckneyville, but is less commonly fully exposed east of the DuQuoin anticline. Exposures of the Bankston Fork limestone are fairly common in Saline County, but the section above this limestone is rarely seen, and where seen the Cutler limestone if correctly identified does not have the distinctive lithological characteristics that it possesses west of DuQuoin, but rather closely resembles the Bankston Fork limestone. West of DuQuoin the two limestones are readily differentiated in exposures, but this is not so easily done in Williamson, Saline, and Gallatin counties. Their relation to associated coals is the best means of differentiation east of the DuQuoin anticline. What appear in graphic logs to be both limestones and the two thin coal beds that lie between them are commonly reported so that the continuity of these beds in southeastern Illinois seems probable.

¹³ Harold R. Wanless, *op. cit.*

¹⁴ A. H. Bell, C. G. Ball, and L. C. McCabe, "Geology of the Pinckneyville and Jamestown Areas, Perry County, Illinois," *Illinois State Geol. Survey, Illinois Petroleum* 19 (April 11, 1931), p. 3.

The Anvil Rock sandstone intervenes between the Bankston Fork limestone and the cap rock of coal No. 6 in some places in southern Illinois, considerably increasing the interval between these two beds where such intervention occurs.

The correctness of the correlation of these two limestones of southern Illinois with the Piasa (Bankston Fork) and Lonsdale (Cutler) of central Illinois appears to the present writer to be very uncertain. Neither the Piasa nor the Lonsdale can be definitely traced from outcrop to outcrop at closely spaced intervals to definite agreement with the southern Illinois limestones. The corresponding limestones are different lithologically and associated sediments and stratigraphic relationships are different. According to Henbest¹⁵ neither of the southern limestones contains the elongate form of fusulinoid fossil characteristic of the Piasa and Lonsdale limestones.

Instead they are characterized by the presence of fat or ventricosely fusiform fusulinids formerly misnamed *Girtyina ventricosa*, now properly known as *Fusulina girtyi*, and an unpublished new species *Fusulina illinoisensis* Dunbar and Henbest (ms.).

If the Bankston Fork and Cutler limestones are not the equivalent of the Piasa and Lonsdale limestones it is probable that they underlie the latter limestones, although this assumption is as poorly founded as the assumption that they are the same, except for the fact that fossil contents are different and more nearly resemble the fossils of the Herrin limestone than those of the Piasa and Lonsdale limestones.

The present writer is inclined to place any limestone intervening between the Cutler limestone and the Carlinville limestone of Lee (Shoal Creek of Wanless), particularly a limestone associated with variegated shale, at the position of the Lonsdale (or Piasa) limestone. The occurrence of such a limestone in the graphic section prepared by Taylor and Prescott has been noted. It is noteworthy that Shaw and Udden suggested a possible correlation with the Lonsdale of a limestone 2-6 feet thick called the "top limestone" exposed in several places in the Belleville quadrangle. This limestone according to Shaw and Udden contains a long slender form of fusulinoid fossil "quite different from the form of *Fusulina* found in the roof limestone over the Herrin coal."¹⁶

In general, limestone at this position is not a distinctive part of the succession in southern Illinois, and its outcrops have scarcely ever been described. It is possible that its position is not far from that

¹⁵ Lloyd G. Henbest, personal communication (June 14, 1939).

¹⁶ E. W. Shaw and J. E. Udden, "Belleville-Breese, Illinois," *U. S. Geol. Survey Geol. Atlas Folio 195* (1915), p. 6.

of coal No. 8, a fairly persistent coal about midway between coal beds of the Carlinville-Shoal Creek group and those of the Cutler-Bankston Fork group.

The Lonsdale-Piasa, Cutler-Bankston Fork correlation is one of the most important uncertainties of the McLeansboro succession. Its solution undoubtedly involves important aspects of the cyclical theory of sedimentation. The settlement of the controversy will involve, first, a careful scrutiny of the field relationships of both the Piasa and Lonsdale limestones and the determination of their relative positions. It will then be necessary to work out the relative position of the Piasa-Lonsdale succession and the Cutler-Bankston Fork succession across Madison and St. Clair counties. It is not improbable that the outcrops may be adequate to establish the facts of the relationship in this area.

CONCLUSION

Some of the significant uncertainties in stratigraphic identity and correlation in the McLeansboro formation of the Pennsylvanian system in the Illinois basin have been discussed. These uncertainties exist in spite of the considerable amount of surface mapping and delineation of the subsurface structure of the Herrin (No. 6) coal bed that has been undertaken. The current generalizations in regard to the succession do not agree in important particulars, due in part to the paucity of exposures, making it difficult to compile a complete columnar succession from the outcrops, and in part to apparent mis-correlation of such exposed limestones as are occasionally seen which are difficult to differentiate lithologically, and in further part to an apparent failure to determine the extent of parallelism of the outcropping beds and the coal beds of which the structure has been delineated. The uncertainties involve the correlation and identification of the more important of the McLeansboro limestones and the interpretation of the sedimentary history of the basin, particularly the matter of the wedge thickening of the clastic beds toward the trough of the Illinois basin.

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