

## THE QUESTION OF A PENNSYLVANIAN OVERLAP IN THE ROCK ISLAND REGION\*

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### SUMMARY OF PREVIOUS INVESTIGATIONS

In 1870 Worthen described the section of Coal Measures strata exposed in Fulton County, Illinois, in the valley of Spoon River as "the most complete and typical in the State,"<sup>1</sup> and designated the coal beds there exposed as Nos. 1 to 7. The typical exposure of No. 1 coal was stated to be in the west bank of Spoon River in the vicinity of Seville. Subsequently the coal of Rock Island and Mercer counties was correlated with this bed<sup>2</sup> and the term Rock Island (No. 1) coal has been used in numerous reports. In 1906-1908 Dr. David White made paleobotanical studies of the Illinois Coal Measures to determine the approximate correlatives in Illinois of the various divisions of the Pennsylvanian in the Appalachian province.<sup>3</sup> He stated that the beds below coal No. 2 of the Illinois strata were approximately equivalent to the Pottsville formation in the Appalachian province, and the fossil floras of the Rock Island region were identified as the equivalents of the floras from upper Pottsville strata in Ohio and Pennsylvania. The strata between and including coals Nos. 2 and 6 and possibly No. 7 in Illinois belong in the Allegheny formation. Because the exact upper boundary of the Allegheny in Illinois could not be determined, the local name of Carbondale was applied to the beds approximately equivalent to the Allegheny, and the name McLeansboro was given to the higher beds approximately equivalent to the Conemaugh. The boundary between the Carbondale and McLeansboro formations was placed at the top of the No. 6 coal.

In the course of detailed studies in the Rock Island region in connection with the geologic mapping of the Edgington and Milan

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<sup>1</sup> Worthen, A. H., *Geology of Fulton County*, Geol. Survey of Illinois, Vol. 4, *Geology and Paleontology*, pp. 92-94, 1870.

<sup>2</sup> Worthen, A. H., and Shaw, James, *Geology of Rock Island County*, Geol. Survey of Illinois, Vol. 5, *Geology and Paleontology*, pp. 221, 229-232, 1873.

<sup>3</sup> White, David, *Report of the field work in the coal districts of the state*, Illinois State Geol. Survey Bull. 4 (Yearbook for 1906), pp. 201-203, 1907.

White, David, *Report on field work done in 1907*, Illinois State Geol. Survey Bull. 8 (Yearbook for 1907) pp. 262-272, 1908.

White, David, *Paleobotanical work in Illinois in 1908*, Illinois State Geol. Survey Bull. 14, (Yearbook for 1908), pp. 293-295, 1910.

quadrangles and the collection of data on the coal resources of district III (Western Illinois), new evidence was discovered which threw doubt upon the correlation of Pennsylvanian strata in the Rock Island region. The fusulinid *Fusulina girtyi* (then known as *Girtyina ventricosa*) was discovered to be abundantly distributed in the limestone cap rock of coal No. 6, and it was thought to be a reliable guide to that horizon. It was also believed that no fusulinids were present below the McLeansboro or upper Carbondale beds. The discovery of fusulinids in abundance in a limestone exposed near Andalusia, Rock Island County and in the limestone cap rock of coal mined at Carbon Cliff and Coal Valley, Rock Island County, Matherville, Sherrard and Cable in northern Mercer County, and near Briar Bluff and Geneseo, Henry County, suggested that the strata in this region were much younger than had been thought.<sup>4</sup> Further field work in the western part of the State convinced Dr. Culver that an abundance of fusulinids was not a reliable guide to the limestone above coal No. 6, and that they occur much lower in the section than the upper Carbondale. However, he discovered that the sequence of beds—"slaty shale, argillaceous limestone, sandy shale, and sandstone"—associated with the "Rock Island" coal of Rock Island and northern Mercer counties was closely similar to the succession of beds associated with the coal at Sheffield, Bureau County, and Kewanee, Henry County, which was correlated with the No. 6 coal of Fulton County.<sup>5</sup>

Another criterion which was used in establishing this revised correlation was the presence of a clay band in the coal of the Rock Island region which was believed to be the same as the "blue band," a widely distributed clay parting in No. 6 coal.

As a result of the revised correlation of the coal in the Rock Island region, an overlap of strata of later Carbondale and early McLeansboro age toward the northwest margin of the Eastern Interior coal basin was postulated. No. 6 coal and associated strata were recognized very near the western boundary of the coal basin farther south in Adams County and in Randolph County. These observations led to the theory of the gradual extension of the Pennsylvanian basin of sedimentation during

<sup>4</sup> Culver, H. E., Note on the occurrence of *Fusulina* in the Pennsylvanian rocks of Illinois, Trans. Ill. State Acad. Sci. for 1922, Vol. 15, pp. 422-425, 1922.

Savage, T. E., and Udden, J. A., Geology and mineral resources of the Edgington and Milan quadrangles, Illinois State Geol. Survey Bull. 38C, pp. 3, 37, 38, 44-49, 1922.

Savage, T. E., Marine invertebrate fossils as horizon markers in the Pennsylvanian rocks of Illinois, Jour. Geol. Vol. 32, p. 581, 1924.

Savage, T. E., Significant breaks and overlaps in the Pennsylvanian rocks of Illinois, Amer. Jour. Sci., Vol. 14, p. 314, 1927.

<sup>5</sup> Culver, H. E., Pennsylvanian correlation in northwestern Illinois, Bull. Geol. Soc. Amer., Vol. 35, pp. 321-328, 1924.

Culver, H. E., Coal resources of District III (Western Illinois), Illinois State Geol. Survey Coop. Mining Ser. Bull. 29, pp. 16-17, 19-20, 99-104, 1925.

Culver, H. E., Present status of correlation of Illinois coals, Illinois State Geol. Survey Rept. Inv. No. 14, 1927.

the Pottsville and Carbondale to a maximum size attained during the latest Carbondale and early McLeansboro stages.<sup>6</sup> Recently this overlap has been interpreted as indicating the disappearance of the Pottsville strata near the northwest margin of the Eastern Interior coal basin in Illinois and southeastern Iowa.<sup>7</sup>

Field work in the Alexis quadrangle in 1925 and 1926 demonstrated that the "Rock Island" coal of southern Mercer County was actually equivalent to No. 1 coal of Fulton County and stratigraphically 80-125 feet below the top of the Pottsville formation.<sup>8</sup> The limestone cap rock of the coal in that area contains an abundance of small fusulinids which have been found to represent two unnamed species both of which are different from *Fusulina girtyi*.<sup>9</sup>

#### RECENT INVESTIGATIONS

During the field seasons of 1929 and 1930, the writer, assisted by Mr. Sidney E. Ekblaw, has traced the Pennsylvanian strata from Worthen's type section in Fulton County north through Knox, Warren, and Mercer counties to the Rock Island region, eastward along the northern border of the coal basin across Rock Island, Henry, and Bureau counties, and southward along the Illinois River valley through Bureau, Marshall, and Peoria counties to Fulton County. The general stratigraphic section worked out in this region extends from the base of the Pennsylvanian to the horizon of coal No. 8, about 150 feet above the base of the McLeansboro formation.<sup>10</sup> All of the exposures cited by Savage and Culver to establish the overlap in the Rock Island region were revisited.

This study has demonstrated that there is no overlap of No. 6 coal toward the northwest border of the Eastern Interior coal basin. The Pottsville strata were found to be actually thicker in Rock Island County than in Mercer, Knox, Warren, and Fulton counties to the south, and the basal strata along the northern border of the coal basin are as old as, if not older than, the basal strata 80 to 100 miles to the southeast in Fulton County. The entire Carbondale formation is also

<sup>6</sup> Culver, H. E., Present status of correlation of Illinois coals, Illinois State Geol. Survey, Rept. Inv. No. 14, pp. 10-11, 1927.

<sup>7</sup> Savage, T. E., Significant breaks and overlaps in the Pennsylvanian rocks of Illinois, Amer. Jour. Sci., Vol. 14, pp. 313-315, 1927.

<sup>8</sup> Savage, T. E., Sedimentary cycles in the Pennsylvanian strata, Amer. Jour. Sci., Vol. 20, p. 130, 1930.

<sup>9</sup> Levorsen, A. J., Pennsylvanian overlap in the United States, Bull. Amer. Assoc. Petroleum Geol., Vol. 15, p. 118, figs. 8, 17, 1931.

<sup>10</sup> Wanless, H. R., Geology and mineral resources of the Alexis quadrangle, Illinois State Geol. Survey, Bull. 57, pp. 63-64, 1929.

<sup>11</sup> The identification was made by Mr. L. G. Henbest.

<sup>12</sup> Wanless, H. R., Pennsylvanian cycles in western Illinois, Illinois State Geol. Survey, Bull. 60, pp. 179-193, 1931.

<sup>13</sup> Wanless, H. R., Pennsylvanian Section of western Illinois, Bull. Geol. Soc. Amer. Vol. 42, (In press).

well developed to the limit of its outcrops and shows no indication of appreciable thinning to the northwest.

#### STRATIGRAPHIC EVIDENCE

The principal stratigraphic evidence that there is no overlap of No. 6 coal in the Rock Island region is the recognition here of several "key beds" of the typical Fulton County strata which have been traced northward to the northern border of the Illinois coal basin. The following key beds have proved most useful:

1. Coal No. 6 and its limestone cap rock.
2. Coal No. 5 and its overlying carbonaceous shale.
3. Limestone and conglomerate over coal No. 4.
4. Coal No. 2 and its associated strata.
5. Seahorne limestone (20-40 feet below Coal No. 2).
6. Coal No. 1 and its overlying limestone and shale.

(1) *Coal No. 6.* Herrin (No. 6) coal and its limestone cap rock have been traced from Cuba (T. 6 N., R. 3 E.) to Middle Grove (T. 8 N., R. 3 E.), Fulton County; Wataga (T. 12 N., R. 2 E.), Knox County; Galva (T. 14 N., R. 4 E.) and Kewanee (T. 15 N., R. 5 E.), Henry County; and Sheffield (T. 16 N., R. 7 E.), Bureau County. The coal is 4 feet 6 inches thick at Cuba, 3 feet 6 inches to 4 feet thick at Middle Grove, 3 feet 2 inches to 4 feet thick at Wataga, 3 feet thick near Galva, 4 feet 2 inches thick near Kewanee and 3 feet 9 inches thick at Sheffield. In all of this area the limestone cap rock is less than 1½ feet thick and it is so discontinuous that it is absent from about half of the exposures studied along its outcrop line.

(2) *Coal No. 5.* The Springfield (No. 5) coal has been traced from Cuba (T. 6 N., R. 3 E.) north to Fairview (T. 8 N., R. 3 E.), Fulton County; Rapatee (T. 9 N., R. 3 E.), near Abingdon (T. 9 N., R. 1 E.), Galesburg (T. 11 N., R. 1 E.) and Soperville (T. 12 N., R. 1 E.), Knox County. Near Rio (T. 13 N., R. 1 E.) Knox County, the underclay of coal No. 5 is exposed without an overlying coal bed, and east of Cambridge (T. 15 N., R. 3 E.), Henry County, the seam is also absent, although its horizon is exposed. Throughout this distance the Springfield coal thins rather regularly and the limestone cap rock changes from a persistent bed of limestone 1 to 2 feet thick to discontinuous masses or nodules of limestone and at the northern edge of the basin it is entirely absent. The thinning of the coal is revealed by these measurements: 5 feet near Cuba, 4 feet near Fairview, 3½ feet at Rapatee, 3½-4 feet near Abingdon, 2½ feet south of Galesburg, 1½ feet at Soperville and absent at Cambridge.



(3) *Coal No. 4.*<sup>11</sup> No. 4 coal lies only 5-15 feet below No. 5 and it has been found at all of the places mentioned in connection with that coal. It is commonly a thin bed 1-4 inches thick throughout most of this region, but it thickens at various places to a bed 3-6 feet thick, as near Cuba and Fairview, Fulton County, and near Soperville, Knox County. The roof beds of this coal are a black shale with large subspherical black calcareous concretions overlain by the Hanover limestone. The black concretions are very easily recognized in the field and have been found from the vicinity of Alton north to Cambridge and east along the northern border of the field to Mazon Creek, near Morris, Illinois.<sup>12</sup> The Hanover limestone is best developed southward from Fulton County. It is discontinuous in Fulton County, but reappears northward and eastward in Knox, Peoria, Henry, and LaSalle counties with a very easily recognized lithologic character. In the southern part of western Illinois it is a thick, rather pure, light gray limestone, but in the northern area it is commonly a conglomeratic or glauconitic limestone.

(4) *Coal No. 2.* No. 2 coal has been traced northward from Seville (T. 6 N., R. 1 E.) to Babylon (T. 7 N., R. 1 E.), Fulton County; near Abingdon (T. 9 N., R. 1 E.), Knox County; Cedar Creek east of Monmouth (T. 11 N., R. 2 W.), Warren County; Viola (T. 14 N., R. 2 W.), Mercer County; west of Geneseo (T. 17 N., R. 2 E.) and Atkinson (T. 17 N., R. 4 E.), Henry County. An outlier of this seam has been discovered near Andalusia (T. 16 N., R. 3 W.), Rock Island County. No. 2 coal is very easily identified by the overlying sequence of gray shale, black shale, and several thin impure limestone beds interbedded with dark fossiliferous shale. The thickness of this coal varies from 1½ to 3 feet in northwestern Illinois.

(5) *Seahorne limestone.* The Seahorne limestone differs from most of the other persistent lower Pennsylvanian limestones in that it is not the cap rock of an important coal. A thin coal 1-3 inches thick occurs about 1 foot below it and it is commonly less than 2 feet below a somewhat thicker coal 1½ to 2 feet thick (Wiley coal). The upper surface of this limestone is commonly very uneven with knobs projecting into the overlying clay. Its thickness is variable and in many places it passes into a discontinuous band of limestone concretions. Its color is light gray and it is somewhat purer than the other Pennsylvanian limestones in northwestern Illinois. Fossils are very abundant in some places, but elsewhere they are rare or absent. A rather large

<sup>11</sup> This number is used for convenience only as this seam is not the one to which the number "4" was originally applied by Worthen.

<sup>12</sup> The exposures of these concretions from LaSalle eastward have been discovered and correlated by Mr. H. B. Willman.



fusulinid is abundant in some outcrops. The Seahorne limestone is quite persistent through Fulton County but dies out northward in the vicinity of London Mills. It has not been found in Knox or Warren counties, although its exact horizon, between the thin coal below and the thicker one above, has been recognized throughout these counties. Farther north the Seahorne limestone reappears and has been recognized near Millersburg (T. 15 N., R. 4 W.), Mercer County; near Briar Bluff (T. 17 N., R. 1 E.) and west of Geneseo (T. 17 N., R. 2 E.), Henry County; and west of Andalusia (T. 17 N., R. 3 W. and T. 17 N., R. 4 W.), Rock Island County. Its characteristics in this northern district are similar to those in Fulton County where it is typically developed, and in all the places mentioned its stratigraphic relations with No. 2 coal above or No. 1 below are revealed. This is the limestone from which fusulinids were first reported near Andalusia.

(6) *Rock Island (No. 1) coal.* No. 1 coal differs from most of the coals of western Illinois in its great variability in thickness and altitude and in the character of the associated rocks. It varies from a soot streak to 5 or 6 feet in thickness and often varies 2 to 4 feet in thickness and 20 to 30 feet in altitude within a few hundred yards. The areas of thick coal are long fairly straight belts averaging  $\frac{1}{2}$  to  $1\frac{1}{2}$  miles in width. Within these belts the character of the coal and associated strata is fairly constant, but outside them there may not be a single characteristic of the coal and associated beds which will make its identification as coal No. 1 certain. The limestone cap rock reaches a maximum thickness of 15-30 feet in the narrow belts of thick coal, but is commonly somewhat thinner. It is a dark blue-gray limestone which is quite impure. The whole thickness of the limestone has about the same characteristics in the Fulton County area. In Warren, Mercer, Rock Island, and Henry counties the lower part of the limestone is a massive bed 1-2 feet thick, locally known as "cap rock," and the upper part consists of rather slabby and unevenly bedded very impure limestone, blue gray to chalky buff in color, which is locally known as the "blue rock." The upper part of the limestone is more shaly than the lower part and it grades up into a calcareous or siliceous shale. In places a bed of chert occurs at the top of the limestone sequence. The coal and its overlying limestone can be traced northward from its type outcrop at Seville (T. 6 N., R. 1 E.) to Babylon (T. 7 N., R. 1 E.), Fulton County; the vicinity of St. Augustine (T. 8 N., R. 1 W.), Monmouth (T. 11 N., R. 2 W.), and Alexis (T. 12 N., R. 2 W.), Warren County; Viola (T. 14 N., R. 2 W.), and Sherrard (T. 15 N., R. 1 W.), Mercer County; Coal Valley (T. 17 N., R. 1 W.), Rock Island County; and Briar Bluff (T. 17 N., R. 1 E.) and Cleveland (T. 18 N., R. 2 E.),

Henry County. Within this area the only important regional change in the character of the succession is the increasing amount of chert and siliceous shale near the northern border of the basin. The lower part of the limestone above the No. 1 coal contains a small fusulinid at a number of localities, especially near Seville, Fulton County, Viola,

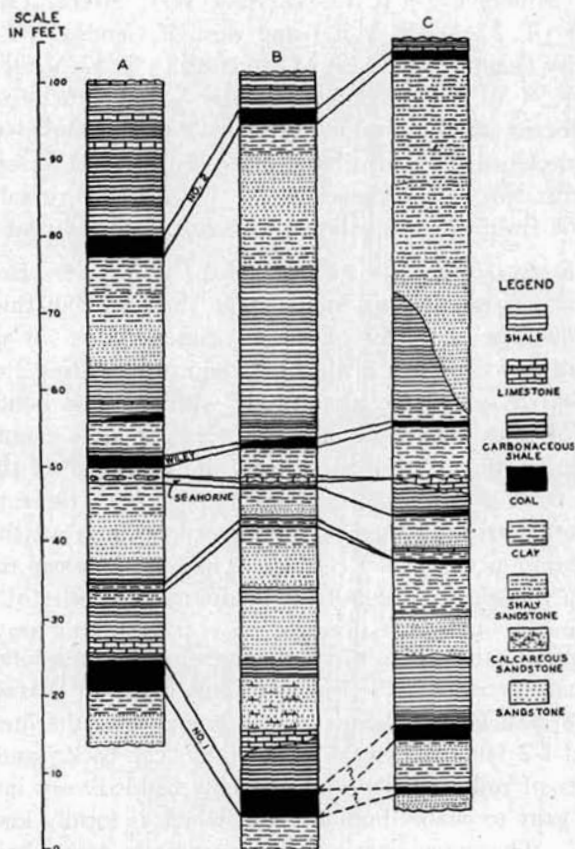


FIG. 2. Stratigraphic sections of Pottsville strata between coal No. 1 and coal No. 2 at (a) southern Knox County, east of Abingdon, (b) Mineral Creek, southwest of Geneseo, Henry County, and (c) 2 to 4 miles west of Andalusia, Rock Island County.

Millersburg and Mathersville, Mercer County, Coal Valley and Carbon Cliff, Rock Island County, and Briar Bluff, Cleveland and Geneseo, Henry County. These fusulinids in Mercer, Rock Island and Henry County outcrops were formerly believed to identify this limestone as the cap rock of coal No. 6.



Figure 1 shows the outcrop lines of the base of the Pennsylvanian and coals 1, 2, 5, 6, 7, and 8 in the northwestern part of the Illinois coal field. The data used in the preparation of this map include, in addition to the writer's own field notes, published reports, drill records and the notes of other members of the State Geological Survey.

In two localities near the northern border of the coal field the entire geologic section between the Rock Island (No. 1) coal and the No. 2 coal is exposed. These localities are (1) along Mineral Creek, southwest of Geneseo, Henry County and (2), 2 to 4 miles west of Andalusia, Rock Island County. The sections measured at these places, together with a section of the same interval near Abingdon in southern Knox County are shown in figure 2.

#### SUMMARY OF STRATIGRAPHIC EVIDENCE

The strata exposed across Rock Island, Henry, and Bureau counties can all be placed in a standard stratigraphic section as it appears in the valley of Spoon River in Fulton County. The beds dip gently to the southeast and all strata outcropping between Rock Island and Sheffield occur in their normal position relative to the adjoining strata. Many details of this standard section were not known in 1921 when Culver and Savage interpreted the coal of the Rock Island region as the No. 6 bed. The geologic mapping of the Alexis, Monmouth, and Galesburg quadrangles south of the Rock Island region since 1925 and reconnaissance studies in unmapped areas have yielded much additional data on the stratigraphy of this area.

#### LITHOLOGIC EVIDENCE

One of the reasons urged by Culver for the correlation of the Rock Island coal with No. 6 was that the sequence of beds associated with the "Rock Island" coal of Rock Island and northern Mercer counties was closely similar to the succession of beds associated with the coal at Sheffield and Kewanee. Many recent studies have shown that a coal bed is normally overlain by carbonaceous shale, limestone, and clay shale and underlain by underclay, shale, and sandstone.<sup>13</sup> The succession of beds from the sandstone below to the clay shale above, including the coal, record a cycle of sedimentation. The sort of sequence mentioned by Culver has been found in western Illinois

<sup>13</sup> Udden, J. A., *Geology and mineral resources of the Peoria quadrangle, Illinois*, U. S. Geol. Survey Bull. 506, pp. 47-50, 1912.

Stout, W., *Coal formation clays of Ohio*, Ohio Geol. Survey, Ser. 4, Bull. 26, pp. 533-568, 1923.

Weller, J. M., *Cyclical sedimentation of the Pennsylvanian period and its significance*, Jour. Geol. Vol. 38, pp. 97-135, 1930.

in association with coals 1, 2, 4, 5, 6, 7, 8, and 9, as well as several other seams which are not designated by number.

Another of the reasons urged for the correlation of the Rock Island and No. 6 coals is the presence of a clay parting in each coal. The clay parting known as the "blue band" in Coal No. 6 is persistent through the greater part of the Illinois coal field, but clay partings are also present in several other coal beds of western Illinois. The best examples are Coal No. 8 near Scottville, Macoupin County, Coal No. 7 at Sparland, Marshall County, Coal No. 4 near Bryant, Fulton County and Coal No. 1 at Viola, Mercer County and in many outcrops in Schuyler and southern Fulton counties. The clay band in coal No. 1 is quite variable in the northern part of Mercer County, ranging from zero to one foot within three miles. The presence of a clay band, therefore, cannot be used in the correlation of a coal bed unless it is in harmony with other stratigraphic evidence.

#### PALEONTOLOGIC EVIDENCE

The roof limestone of the Rock Island coal contains several fossils which are believed to be limited to horizons below the Herrin (No. 6) coal. These include *Productus nanus* Meek and Worthen and *Spirifer rocky-montana* (Marcou). The species *Chonetes mesolobus* Norwood and Pratten is represented by somewhat different varieties in the limestones over coals 1, 2, 5, and 6. The variety which occurs in the cap rock of the Rock Island coal is the same as that in the cap rock of the No. 1 coal in Fulton County, but it is quite distinct from the form which occurs in the cap limestone of the No. 6 coal.

The presence of fusulinids in the limestones of the Rock Island region has been considered important evidence that these limestones belonged above Coal No. 6. The limestone over coal No. 6 in Fulton County and in many other parts of Illinois contains *Fusulina girtyi* (Dunbar and Condra) in great abundance, but fusulinids have been found in practically every Pennsylvanian limestone in western Illinois. A careful study of the Fusulinidae of Nebraska has revealed the fact that many species of the family are valuable index fossils.<sup>14</sup> However, the discrimination of the species is based on twelve characters, of which only two are visible externally, the other ten being seen only in thin sections. The fusulinids in the cap rock of the Rock Island coal, as noted above, have been sectioned, and found to belong to two unnamed species, both of which are now known to be distinct from *Fusulina girtyi*.

<sup>14</sup> Dunbar, C. O., and Condra, G. E., *The Fusulinidae of the Pennsylvanian system in Nebraska*, Nebraska Geol. Survey Bull. 2, 2nd Ser., pp. 9-13, 49-50, 124-130, 1927.