V. THE CORRELATION OF COALS IN OKLAHOMA AND KANSAS

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Foreword

It has been known for a number of years that coal occurs in the McAlester and Boggy shales in the east-central part of Oklahoma and for perhaps an equal number of years coals in the Cherokee formation have been stripped by farmers in the northeastern part of the state. These coals are all of Pennsylvanian age, but little has been done on the correlation of the coal within the state, or the correlation of these coals with the coals of Kansas or Arkanas. Mr. Shannon, while director of the Oklahoma Geological Survey prepared a very comprehensive manuscript and drew a number of maps giving the geology of the coals of the state, particularly in the east-central part. This report which Mr. Shannon finished about 1914 has been revised and is now available as bulletin No. 4 of the Survey. The writer did the field work on the coals in northeastern Oklahoma during March, 1926. The stratigraphy of the Pennsylvanian formations in Oklahoma has been taken from an unpublished manuscript by Ohern[1] and Bulletin 35 of the Oklahoma Geological Survey[2], 1925, the Kansas formations are described according to Moore and Haynes[3].

No attempt is made in this paper to describe the formations in detail. The important facts brought out and emphasized in the descriptions are the character of the formations, their thickness and direction of thinning.

Stratigraphy of the Pennsylvania Formations Oklahoma, South of Arkansas River

McAlester Shale

This formation consists of a great series of shales and sandstones with an estimated thickness of 2,000 feet. Taff[4] has divided the formation into three parts for convenience of discussion.

The lowest division is composed almost entirely of shale, with a few thin sandstones and coal, all having a thickness of

[1]Ohern, D. W., Geology of the Vinita and Nowata Quadrangles, Oklahoma unpublished manuscript.

[2]Gould, C. N. Index to the Stratigraphy of Oklahoma, Bulletin 35, Oklahoma Geological Survey.

[3]Moore, Raymond C., and Haynes, Winthrop P., Oil and Gas Resources of Kansas, State Geol. Survey of Kansas, Bulletin 3, 1917.

[4]Taff, J. A., U. S., Geol Survey Coalgate folio, (No. 74), 1901.

800 feet. The Hartshorne coal occurs at the base of this division and just above the Hartshorn sandstone, which is the formation immediately below the McAlester. The middle division consists of three or four beds of sandstone separated by 100 to 200 feet of shale, and having a total thickness of about 500 feet. The upper division is almost entirely shale about 700 feet thick with the McAlester coal about 50 feet above the base. To the east in Arkanas the formation has a thickness of 1600 feet.

Savanna Sandstone

This formation consists of five or more beds of sandstone, 50 to 200 feet in thickness, which with the intervening shale beds has an aggregate thickness averaging 1,150 feet. The sandstones are brown, grayish-brown, fine grained, and compact, and may be distinguished only by their position in the section, and their thickness of bedding. The Cavanal Coal, 24 to 42 inches in thickness, is found in this formation in northern LeFlore County on the east and south sides of Cavanal Mountain. It is generally free from impurities, and is overlain by a hard, slaty shale, and underlain by compact clay. The formation thins rapidly to the north and disappears near Warner.

Boggy Shale.

A thick series of shales, varying from 1,200 to 2,600 feet in thickness, containing, near the top a sandstone member and a few limesone beds. The greatest development of the sandstones is found along the Canadian River Valley. Extending northeast and southwest there is a gradual thinning of the sandstone beds as well as of the entire formation and, as the sands thin out limestones are introduced. The formation cannot be traced north of the Arkansas River. Taff mentions a bed of coal about 30 inches thick about 400 feet above the base of the Boggy, which has been prospected southwest of McAlester. Evidently, this coal is the same as the Witteville coal found northeast of McAlester and west of Poteau. In the above two localities there are two beds of coal, one at the base of the Boggy, resting on top of the Savanna sandstone, and the other 200 feet above the Savanna. The lower bed is 58 inches thick, separated into three parts by two variable bands of bone and carbonaceous shale.

Thurman Sandstone

Composed of over 200 feet of sediments in the vicinity of McAlester, consisting of 50 feet of conglomerate at the base after which occurs more than 150 feet of finer sands.

Stuart Shale

Consists of blue clay shales and beds of sandstone, reaching a thickness of 280 feet, which may be divided into three members,

an upper and lower member of shale separated by a variable sandstone 10-15 feet thcik.

Senora Formation

This formation reaches a maximum thickness of 480 feet consisting of 320 feet of sandstone at the base, grading upward through sandy beds into shale which are approximately 160 feet in thickness.

The above three formations are not differentiated north of the Canadian River, and in general thin to the north.

Calvin Sandstone.

This formation is made up of thick bedded, hard sandstone, with a few thin layers of shales which are more resistant that the over and underlaying formations, and consequently weather out as low roundtd ridges. The formation reaches a maximum of 240 feet in thickness, which is made up of 140 feet of massive sandstone at the base, while the upper part is composed of two or more beds of shale 10-20 feet in thickness.

Wetumka Shale.

This formation consists of approximately 120 feet of clay and sandy shales, and thin sandstones, with a thin limestone which appears to be the same as the Ft. Scott limestone of Kansas and northern Oklahoma.

Oklahoma, North of Arkansas River
Cherokee Shale.

The Cherokee shale is a variable series of shales and beds of sandstone with a few lenses of limestone. Here and there occur thin beds of coal, some of which are of sufficient thickness to be of economic importance. In Oklahoma the formation outcrops in a belt 20-30 miles wide from the Kansas line south to the 36° parallel, where the formation name is changed. The name is taken from Cherokee County, Kansas., where it was first used by Haworth and Kirk[1] to designate the shales between the base of the Pennsylvania series and the base of the Ft. Scott limestone.

The thickness of the Cherokee at the Kansas-Oklahoma line is 450-500 feet, and thickens southward to approximately 650 feet just north of Vinita, and 675-700 feet near Chelsea, while at the 36° parallel it approximates 1,000 feet in thicknes. Although the stratigraphy of the Cherokee is complex owing to the lenticular character of a large number of its inter-stratified sandstones, three distinct sandstones[2] are recognized in Oklahoma. The

[1]Haworth, Erasmus, and Kirk, M. Z., Kansas Univ. Quart. 2: 105, 1894.

[2]Ohern, D. W., unpublished manuscript on the Geology of Vinita and Nowata Quadrangles, Oklahoma.

Little Cabin sandstone occurs 60 feet above the base of the formation. It is composed of a series of distinct beds laying close together, a heavy member about 10 feet thick is easily distinguished from its thinner associates. It forms a prominent scarp just south of Miami and extends southward west from Afton and along the west bank of Little Cabin Creek, as far south as Vinita. It is not traceable farther south. The Bluejacket sandstone lies about 150 feet above the Little Cabin member and is traceable from the southwestern bank of the Neosho River to the Arkansas River. It forms a prominent ridge throughout its course, except locally where it has been cut by streams. Its total thickness reaches 50-60 feet, and in places it is a solid mass of sandstone, but is usually found as a series of thin beds of sandstone with intervening shales. A typical development of this member is to be found west of the town of Bluejacket, from which it gets its name. The Chelsea sandstone lies about 200 feet above the Bluejacket. It forms a prominent escarpment from the upper branches of Whiteoak Creek, thence south and west of Chelsea.

In addition to the sandstone just mentioned there are several beds of limestone found in the Cherokee, which with one exception are similar to the sandstones in their lenticular character. One of these beds lies from 10 to 25 feet below the Little Cabin sandstone, and is brownish, crystalline, highly fossiliferous and about five inches thick. The most conspicuous limestone in the formation lies 35-50 feet below the Ft. Scott limestone. It is remarkably persistent, although only about six feet thick, and extends from the Kansas line south to the Arkansas River and beyond.

Coals in the Cherokee formation. The most persistent coal bed in the formation occurs 35-50 feet below the conspicuous limestone ledge just described, and has been traced from a point just south of the Kansas line to a point a few miles north of the Arkansas River, south of the town of Oneta. It ranges from a few inches to about four feet in thickness, with an average of 24-30 inches. It is extensively stripped, both by team and steam shovel every few miles throughout the extent of its outcrop. In a few places near West Cabin School in secs. 13 and 14, T. 26 R. 19 E, and the coal is obtained by shaft mining east of Estella in sec. 4, T. 25 N., R. 19 E. Minera calls this bed the Cherokee coal, and it is so called on the map, which is to appear with the bulletin on Oklahoma coals.

Another extensive seam of coal is found just beneath the basal member of the Ft. Scott limestone, and to which is given

the name of Ft. Scott coal, although it does not occur in the Ft Scott formation. It roughly parallels the Cherokee seam just described, and is about as extensive as that coal. It ranges in thickness from 17 o 21 inches in the northern part of the area, thinning southward to a little over a foot in thickness. It is extensively mined in strip pits for local consumption.

There are about three other small beds of coal of limited extent, found in the Cherokee. Coal is found just above, interstratified with, and below the Bluejacket sandstone, east of Welch, in the Timbered Hills west of Bluejacket, east of Chelsea, north of Wagoner, and northwest and south of Okmulgee. In all probability these coals are only small lenticular beds, and therefore cannot be traced continuously.

Fort Scott Limestone.

Cosists of two limestones separated by a black, fissile carbonaceous shale, with an average thickness of 50 feet. It thins rapidly and disappears a short distance south of the Arkantas River.

Labette Shale.

Consists chiefly of blue shale, with a massive brownish sandstone 10 feet thick near the middle of the formation. In the vicinity of Claremore a total thickness of 140 feet has been measured in Oklahoma, as compared with 20-80 feet in Kansas.

Pawnee Limestone.

The Pawnee is made up of three members; a lower hard, gray, partly crystalline limestone generally 6 feet thick; a middle member of black fissile shale about 12 feet thick; and an upper massive limestone which is about 35 feet thick at the Kansas line, increasing to 40 feet in central Nowata County.

Bandera Shale.

This shale consists of about 100 feet of blue to black shales, with many arenaceous beds, and one bed of thick massive sandstone. The shales thin both north and south practically disappearing a few miles south of Nowata County, where the Altamont limestone rests on the Pawnee.

Altamont Limestone.

Massively bedded, white or bluish partly crystalline limestone, in general rather siliceous and yields abundant chert on weathering. The limestone has a thickness of 30 feet at the state line, which gradually increases southward.

The Nowata Shale.

Ohern[1] uses the term Nowata to include the rocks in the interval from the top of the Altamont limestone to the top of the

Lenapah limestone member in the northern part of the area near the Kansas line and the Dawson coal at the southern boundary. The formation then consists of a lower shale member and an upper limestone or coal member. The shale is 20 feet thick at the state line and thickens rapidly to120 feet at Talala. The limestone thins from a thickness of 20 feet at the Kansas line to nothing three miles southwest of Nowata, where it is probably represented by flaggy beds asociated with the Dawson coal. The shales are olive green to buff in color, but locally certain beds are black. Near the upper part of the formation there occur small layers of sandstone. The limestone is massive, white to gray, semi-crytalline and contains an abundance of fossils.

The Dawson coal occurs at the top of the formation and extends from a point near Nowata to the Aransas River. It varies from 15-30 inches in thicknes, with an average of 20-24 inches. The coal is extensively stripped at points along its outcrop from Dawson to Oologah, mostly by team shovels.

Coffeyville Formation.

This formation consists of a series of shales, sandstone, lenses of limestone and thin beds of coal. The thickness adjoining the state is about 225 feet and gradually increases southward, where it is found to be about 435 feet thick.

Drum Group

This group consists of the Hogshooter (Lost City) limestone, Nelly Bly formation and the Dewey limestone. The Hogshooter limestone is about 15 ft. thick, at the Kansas line, thins southward, and is composed of granular, semi crystalline limestone, thin beds of shale, and a bed of flaggy limestone. The Nelly Bly formation consists of alternating shales and hard, gray to brown sandstones, the individual beds varying in thickness from a few inches to several feet. The thickness of the formation at the state line is about 15 feet and thickens southward, and west of Ramona it attains a maximum thickness of approximately 200 feet. The Dewey limestone is about 12 feet thick at the Kansas line. It also thickens southward, and is composed largely of clay and limestone members and arenaceous beds.

Ochelata formation.

The Ochelata is made up of a thick series of shales and sandstone lentils. It has a thickness of about 480 feet at the Kansas line, which slightly decreases to the south.

Nelagoney Formation.

This formation is composed of shales, sandstones and limestone lentils, and average 500 to 600 feet in thickness. Near the

center of the formation there is a massive limestone about 20 feet in thickness, and at the base there occurs a bed known as the Bigheart sandstone member.

Elgin Sandstone.

The Elgin is a massive sandstone, usually consisting of a single massive member from 50 to 210 feet in thickness. The formation thins and becomes shaly to the north.

Pawhuska Formation.

The Pawhuska consists of three beds of limestone with intervening shales which change into shales and sandstones to the south. The thickness varies up to 180 feet.

Buck Creek Formation.

Made up of 175 feet of limestones, shales, and sandstones.

Sand Creek Formation.

The Sand Creek contains two prominent limestone members, the Grayhorse, four feet thick at the base, and the Foraker, 60-110 feet thick at the top. These limestones with intervening shales and sandstones make up a total thickness of 200 feet for the formation.

Elmdale Formation.

About 100 feet of variagated shales with thin limetones.

Neva Limestone.

Interbedded limestones and shales, with many chert concretions in the lower part. The formation thickens to the north grades into limestone with a shale parting. The thickness averages 15-20 feet.

Eskridge Shale.

Brown, green and yellow shale and thin beds of limestone, aggregating 40-60 feet in thickness.

Kansas.

The Pennsylvanian of Kansas has been divided into 42 members grouped under seven formations, and which in turn are the subdivisions of the Des Moines and Missouri series. These members will not be described separately, but the formations will be briefly discussed.

Cherokee Shale.

The Cherokee shale, the basal Pennsylvanian formation, is undifferentiated in Kansas. It consists of a series of shales and lenticular sandstones, with a number of beds of coal, and therefore exhibits the same characteristics as it does in Oklahoma. In Kansas, the Columbus sandstone has been described as occurring near the middle of the formation, and it is probable that

this is the same horizon described as the Bluejacket sandstone in Oklahoma. Limestones are almost entirely absent.

Marmaton Formation.

The Marmaton formation, in contrast to the Cherokee, contains a number of well-defined limestone members which have been traced across the state. Between the limestones are persistent shale members. The average thickness of the Marmaton is about 300 to 400 feet, and it is sub-divided into eight members of alternating shale and limestone.

Kansas City Formation.

The Kansas City formation, as observed at its type locality, consist of more than half limestone, and the shale members are argillaceou or calcareous, but are black and slaty in some places. The total thickness of the formation varies from 200 feet to more than 300 feet. The only coal shown in this formation occurs in the upper part of the Lawrence shale member.

Lansing Formation.

The Lansing has a thickness of approximately 140 feet in the north, but thins somewhat to the south, where the shales are less important. Four subdivisions are made, two limestones and two shales.

Douglas Formation.

The Douglas formation is essentially a body of shale and sandstone with a capping of limestone, and thin, persistent limetone in the middle portion, which is in contrast to two preceeding formations which are made up of shales and limestones. The shale members are variable in texture and composition, marked changes occurring from point to point. In the north there is a predominance of clay shale which is sufficiently pure for brick manufacture, but toward the south the proportion of shale increases very much, and in places is replaced by thick, massive sandstones. Coals occur locally at one or two horizons. The thickness of the formation ranges from 350 to 550 feet.

Shawnee Formation.

The Shawnee consists of alternating shales and limestones, most of which are traceable across the state. Quantitatively the shales are much the most important, and make up about three-fourths of the formation. The thin shale members are predominantly argillaceous or calcareous, while the thick members are arenaceous and micaceous. Black slaty shale and thin seams of coal are found at a number of horizions. The maximum thickness of the Shawnee is over 500 feet, but at certain localities is not more than 375-400 feet.

Wabaunsee Formation

This formation, comprising the upper portion of the Pennsylvanian system in Kansas, is made up of eight members, consisting of thin limestones and thick shales, with a total thickness of about 500 feet. A few thin beds of coal are found.

Correlations

The entire series of strata from the Atoka formation up through the Hartshorne, McAlester, Savanna, Boggy, Thurman, Stuart, Senora and Calvin formations, are to be correlated with the Cherokee formation to the north. The Ft. Scott limestone once thought to be the northern equivalent of the Calvin sandstone, has been shown by Blooesch and Miser to be equivalent of the Wetumka shales. This throws the Calvin in the southern extension of the Cherokee as the equivalent of the top member of that formation. The Bluejacket sandstone member of the Cherokee is to be correlated with the Savanna sandstone of east-central Oklahoma. Although it has been stated[1] that the Savanna disappears near the town of Warner, the continuing of the Savanna horizion, or the McAlester-Winslow-Boggy contact to the Arkansas River shows the plausibility of this correlation. This horizon forms a god marker o which to refer the coals of the Cherokee and its equivalents.

South of the Arkansas River there are two distinct coals of mineable thickness found above this horizon, namely, the Wittesville or Jones Creek, and the Henryetta coals. From the map (Bull. 4, Okla. Geol. Survey) it is evident that the Henryetta coal is the equivalent of the Cherokee coal to the north, and in all probability is continuous throughout. This coal is also probably the same as the Wier-Pittsburg bed of Haworth. But in the case of the Witteville coal, we do not have an extensive coal exposed in the Cherokee so this cannot be said to be the same bed as the coals mentioned near Bluejacket and east of Chelsea, but they are perhaps to be correlated because they occur at the same horizion, namely, just above the Bluejacket-Savanna horizion.

With the exception of the lower members of the Pennsylvanian system, the formation names used in Oklahoma are not carried across into Kansas. The counterpart of the members of the Marmaton formation in Kansas with the exception of the Dudley shale are found in Oklahoma. The Kansas City is represented by the Coffeyville, Hoghooter, Nelly Bly, Dewey and

[1]Gould, Chas. N., Index to the Stratigraphy of Oklahoma, Okla. Geol. Survey, Bull. 35: 41, 1925

lower Ochelata; the Lansing by the remainder of the Ochelata; the Douglas by the Nelagony; the Shawnee by the Elgin and Pawhuska; and the Wabaunsee by the Buck Creek, Sand Creek, Elmdale, Neva and Eskridge.

Conclusion.

The following observations are made from the foregoing brief discussion of the stratigraphy of Oklahoma and Kansas. Almost without exception the Pennsylvanian formations of Oklahoma rapidly thin out, and in some cases disappear to the north, while the Pennsylvanian formations of Kansas distinctly thin to the south. The formations in Oklahoma south of the Arkansas River are a thick series of sandstone and shales, with an almost total absence of limestone, and in contrast to this north of the river and into Kansas the Pennsylvanian syctem is made up of alternating shales and limestones, with a few sandstones and sandy shales. An exception to this is the Cherokee shale which is predominately shale and sandstone with some limestone throughout. The formations of Kansas thin out to the south, and the coals follow the same trend as do the formations with which they are associated. The greater part of the commercial coals of east-central Oklahoma are found to lie below the Savanna-Blue-Jacket horizon, thinning out and disappearing to the north of the Arkansas River, while the important coals of northern Oklahoma and Kansas are found above this horizon.

In order to find the reasons for the above obervations it is necessary to go into the source of sediments and the conditions under which the sediments were deposited. It is thought by a great many geologists that source of these rocks lay in the old landmass Llanoria, the northern border of which lay just to the south of Oklahoma in northeastern Texas and western Louisiana. This is substantiated by the extreme thickening of the Cherokee equivalents in east-central Oklahoma. The rivers carrying the sediments deposited their load of material along the rim of this continent upon a broad, flat coastal plain. Conditions at times were favorable for the accumulation and preservation of the vegetal material which grew there, and the coals of east-central Oklahoma were formed. As the sea retreated northward from its original position the conditions necessary for the formation of coal deposits also retreated to the north. It is probable that the old land mass of the Ozark uplift was still present to a certain extent, not as distinct positive element or as a source of sediment, but as a shallow area in the Pennsylvanian sea, and so caused the thinning of the sediments in that area. That the retreat of the sea was not gradual or continuous, but oscillatory in

nature, is shown by introduction of coarse ripp'ed-marked clastics and coal beds among marine shales and limestones in the geologic section.