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Carl C. Branson, *Director*

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Geology of the Featherston Area
Pittsburg County, Oklahoma

By

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GEOLOGY OF THE FEATHERSTON AREA, PITTSBURG COUNTY, OKLAHOMA

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ABSTRACT

Rocks of the upper part of the McAlester formation, the Savanna formation, and the lower part of the Boggy formation crop out in the area. Three anticlines and two synclines are the major structural features. Coal has been produced and is now of little importance. Small gas fields are yielding natural gas from the Hartshorne sandstone.

INTRODUCTION

Location and Description

The Featherston area is in east-central Oklahoma in the northeastern part of Pittsburg County (Figure 1). It includes all of T. 7 N., Rs. 17 and 18 E. plus the south half of T. 8 N., R. 18 E. and the northwestern six sections of T. 6 N., R. 17 E. The total surface area is 132 square miles. The area is bounded on the northeast by Haskell County and on the southeast by Latimer County.

The name "Featherston Area" is derived from the small, centrally located community of Featherston. The community of Russellville, consisting of no more than a country store, is in the north-central part of the area. The only town in the Featherston area is Quinton (population: 1,100) near the eastern boundary. It is the business center for local ranchers and farmers. At one time the town had a zinc smelter and was a coal-mining center.

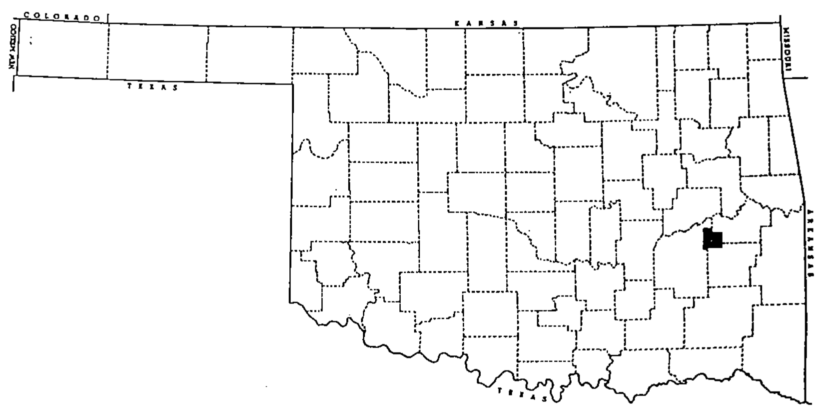

Fig. 1. Index map showing location of Featherston area.

State Highway 31 is a hard-surfaced road traversing the area in an east-west direction, connecting Quinton and Featherston. State Highway 71 is a hard-surfaced road running north from Quinton into Haskell County. State Highway 2 is a newly surfaced road which enters the area along the eastern county line. This highway curves into and back out of the area as it crosses Sans Bois Creek south of Quinton.

A few improved roads are maintained in the area. In the hills north and south of Highway 31 there are a few poor trails, none of which can be used by vehicles. Large parts of the area are accessible only on foot.

The area was formerly served by the Fort Smith and Western Railroad, abandoned about twenty years ago.

Physical Features

According to the Oklahoma Geological Survey (1957), the Featherston area lies in two physiographic belts. The northern part of the area is in the Eastern Sandstone Cuesta Plains and the southern part of the area is in the McAlester Marginal Hills Belt. Topographically, the area consists of shale valleys between sandstone hills and broad stream floodplains covered with alluvium. The hills of sandstone form well-defined cuestas, especially where the sandstone is thick and is underlain by a thick shale sequence.

The maximum relief is about 800 feet. The minimum elevation of 550 feet is in sec. 1, T. 7 N., R. 18 E. where Sans Bois Creek leaves the area. The maximum elevation is only three miles away where Panther Mountain rises to a height of 1,470 feet.

Two major streams drain the area. Longtown Creek flows westward and northward through T. 8 N., Rs. 17 and 18 E. A high ridge of sandstone north of and parallel to Highway 31 forms a divide between Longtown Creek to the north and Sans Bois Creek to the south. Sans Bois Creek flows generally eastward and drains most of the southern portion of the area with the exception of a portion of the extreme southwestern part which is drained by the west flowing Elm Creek. The drainage pattern of streams is a combination of trellis and dendritic.

A heavy cover of vegetation masks much of the area. The high ridges and many of the shale valleys support elms, oaks, hickories and various types of vines. Native grasses provide pasture land where other vegetation is lacking. Agriculture is limited, since fertile soil is restricted to alluvial plains and stream terraces.

The climate is moderate. Temperatures range from about 100 degrees during hot summer days to just below freezing during cold winter nights. Rainfall averages 41 to 42 inches a year (U. S. Dept. Agr., 1941), with the maximum during the Spring and Fall months.

Previous Investigations

Prior to 1937, several investigations of the reconnaissance type were carried out in the general vicinity of the Featherston area. Jules Marcou (1856) reported a study of the region made while searching for a possible railroad route from east to west. Drake (1897) in an early publication on the geology of the coal fields in Indian Territory included the rocks of the area in the Poteau group.

Taff (1899) reported on the McAlester-Lehigh coal field, introducing formal names for the mappable units he studied. Taff (1905) later reported on the progress of coal work in Indian Territory. In a description of coal fields in Oklahoma, Shannon (1926) included part of the area in his report.

The first detailed mapping in the region was carried on by the United States Geological Survey during the years 1935-1939. Dane and others (1938) made a comprehensive study of the Quinton-Scipio district in northern Pittsburg County. The eastern third of their work area is approximately the present area. The report does, however, exclude twelve sections in T. 7 N., R. 18 E. and no attempt was made to subdivide the Savanna formation.

Other reports were made at this time in nearby areas. Hendricks (1937) mapped the McAlester district to the south of Dane's area and (1939) also mapped the Howe-Wilburton district, east of the McAlester district.

In recent years three adjacent areas have been studied and mapped. Oakes and Knechtel (1948) published a report on Haskell County. Webb (1957) completed a map of the southeastern part of McIntosh County and part of Pittsburg County north of the Featherston area. Russell (1958) mapped northern Latimer County, southeast of the area.

Acknowledgments

Dr. Carl C. Branson directed the study and supervised the field work. The Oklahoma Geological Survey furnished aerial photographs of the area. Dr. George G. Huffman and Dr. Hugh E. Hunter, both of the School of Geology, University of Oklahoma, made suggestions and criticized the manuscript.

STRATIGRAPHY

General Statement

Rocks exposed at the surface in the Featherston area are Middle Pennsylvanian in age, with the exception of thin, unconsolidated material of Quaternary age along the floodplains of present streams.

Pennsylvanian rocks are included in the Krebs group of the Desmoinesian series. Three formations are represented, the McAlester, Savanna and Boggy. These formations consist of shales, sandstones, and coal beds. Total thickness of Pennsylvanian rocks in the area is about 2,700 feet.

The Desmoinesian series is divided into three groups in eastern Oklahoma, the Krebs, Cabaniss and Marmaton. The older Krebs group was defined by Oakes (1953) to include the Hartshorne, McAlester, Savanna and Boggy formations. Thus, all Pennsylvanian rocks in the Featherston area are in the Krebs group.

Pennsylvanian System

McAlester Formation

Definition. The first reference to the McAlester formation was by Taff (1899) who defined the formation to include a 2,000-foot sequence of shale with sandstones and several coal seams. He originally called it the McAlester shale because of the relative proportion of shale to sandstone. Taff included the strata between the top of the first persistent sandstone below the Upper Hartshorne coal and the base of the Savanna formation in the McAlester formation, placing it at the top of the Upper Hartshorne coal. Oakes and Knechtel established a definite contact between the Savanna and McAlester formations, placing it at the top of the first shale unit above the Keota sandstone member.

Distribution. In the Featherston area, exposure of the formation is restricted to the eastern edge of the area on the crest of the Kinta anticline and in the core of the Burning Springs anticline in T. 6 N, R. 17 E.

Thickness and Character. The McAlester formation is composed of dark gray, blue to black shale with lenses of brown or gray sandstone. Owing to relatively poor exposures in the Feather-

ston area, it was not possible to determine the exact thickness of the formation. It is estimated that approximately 300 feet of McAlester is present on the crest of the Kinta anticline within the area. Oakes and Knechtel (1948) reported a thickness of 2,000 feet in southern Haskell County. The only known section of McAlester units in the Featherston area is shown in measured section 9 (Appendix) where 155 feet of dark shale and the Keota sandstone member occur. A similar dark shale occurs below the Keota sandstone and both shales are designated simply by IPm to agree with the mapping of Oakes and Knechtel in Haskell County (1948). The same unnamed shale unit at the top of the McAlester formation is found in the center of the Burning Springs anticline; however, no sandstone was found at this location and no part of the formation was measured.

The Keota sandstone member is an erratic sequence of sandy lenses and varies considerably throughout its extent, both in thickness and in character. It was named from the type locality near the town of Keota in Haskell County. The Keota was not found in the Burning Springs locality, either because of the shallowness of erosion or because the member is absent there.

Stratigraphic Relations. The base of the McAlester formation is not exposed in the Featherston area. The formation is reported to be conformable with the underlying Hartshorne formation by Oakes and Knechtel (1948) and by Russell (1958). The McAlester-Savanna contact appears to be conformable in this area. Hendricks (1937) believed that an unconformity exists at this contact because of channeling he discovered in the McAlester district. He also reported partial truncation of the upper shale of the McAlester formation by a Savanna sandstone in the Howe-Wilburton district (1939). Oakes and Knechtel (1948) suggested minor unconformity at the base of the Savanna formation, having found some channeling at the contact. No evidence of even a minor unconformity at the Savanna-McAlester contact was found.

Savanna Formation

Definition. The Savanna formation was described and defined by Taff (1899) from exposures near the town of Savanna in Pittsburg County. He originally used the term sandstone with the for-

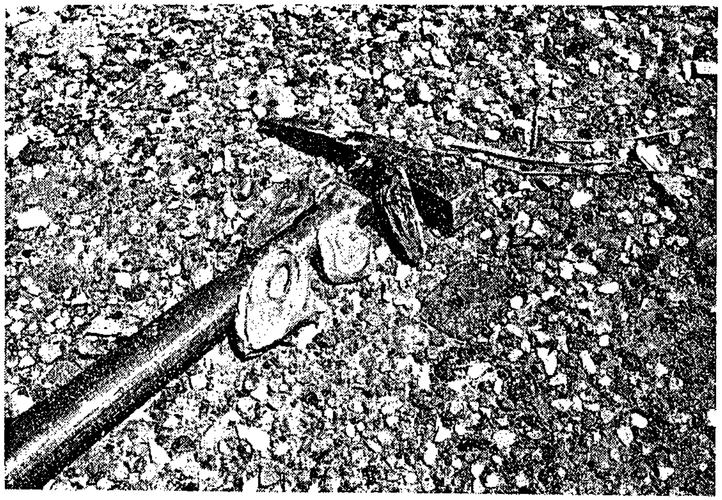

Fig. 2. Ironstone concretions removed from two shale units of the Savanna formation in sec. 15, T. 7 N., R. 18 E.

Fig. 3. Flow casts on the bottom of sandy siltstone taken from a Savanna shale unit in the southeast corner of sec. 5, T. 6 N., R. 17 E.

mational name because of the prominence of the sandstone ridges at the type locality. He did explain the predominance of shale, but indicated five principal sandstone zones.

The upper limit of the Savanna formation was originally placed at the top of the Bluejacket sandstone. Dane and Hendricks (1936) considered the Bluejacket to be the lowermost sandstone of the Boggy formation, thus lowering the contact of the two formations. The shale unit below the Bluejacket was included in the Boggy formation for several years. Miser (1954), on the second geologic map of Oklahoma, raised the contact from the base of the shale unit below the Bluejacket to the top of that unit, the base of the Bluejacket. Oakes and Knechtel (1948) mapped Haskell County prior to the change in formational boundary, and they show the contact at a level lower than the presently accepted one.

The base of the Savanna formation is at the top of the shale unit above the Keota sandstone.

Distribution. The Savanna formation crops out in eastern Oklahoma from the Arbuckle Mountain area eastward through the McAlester basin and into Arkansas. It is exposed at far north as Ottawa County.

In the Featherston area the Savanna formation crops out on the flanks of the Kinta anticline in the east-central and south-central parts of the area; it is exposed on the Burning Springs anticline along the whole southern border of the area.

Thickness and Character. Hendricks (1937) reported a maximum thickness of 2,500 feet for the Savanna formation in the McAlester basin. Northward from the basin, the Savanna thins markedly. Oakes and Knechtel (1948) noted a progressive thinning of the formation from 1,400 feet in southern Haskell County to 200 feet in the extreme northern part of that county.

In the Featherston area the Savanna formation thickens to the south and west. There is an increase of about 40 percent for the whole formation from the area just south of Quinton to the exposures in T. 6 N., R. 17 E. Measured sections show little difference in the thickness of the formation from north flank to south flank of the Kinta anticline. The minimum thickness of the formation within the area is 810 feet; the maximum thickness is 1,130 feet.

The sandstones of the Savanna formation are brown and fine grained with various amounts of silt. In most cases they are lenticular. A section of Savanna units showing both gray and brown sandstones was observed north of Shoe Mountain along the Latimer County line.

The shales of the Savanna formation are varied in character within the area. Gray and black shale is common with local green, yellow and red shale. The shale units are normally covered with debris from the high sandstone bluffs above them. Siltstone or sandstone beds are numerous within the shale units. Ironstone is commonly found both as concretions and as individual beds in many of the shales.

Several sandstone units of the Savanna show cross-bedding, and minor channeling occurs at a few sandstone-shale contacts. Flow casts are found at the base of siltstone and sandstone beds with the molds below them in shale.

Individual units of the Savanna formation are not given formal names. The system used by the writer to designate the character of each mappable unit is in agreement with Russell (1958) and Oakes and Knechtel (1948) in the areas adjacent to the Featherston area. The mapped sandstone units are numbered from the base upward. A few of the units of the Savanna formation require explanation of their nature (see Plate I).

The basal sandstone bed is continuous throughout the Featherston area except at a locality in secs. 1 and 2, T. 7 N., R. 18 E., where it pinches out and disappears eastward. Probably the thinning of the section is only local and is due to unlift of the Kinta anticline during early Savanna time. Oakes and Knechtel (1948) show the absence of these two units along the same anticline in Haskell County.

The shale between IPsv-3 and IPsv-5 is a thick unit throughout the eastern, central, and southern parts of the area (south of Highway 31). It contains two interbedded sandstone lenses, mapped as IPsv-4a and IPsv-4b, in the extreme southwestern sections (T. 6 N., R. 17 E.). Between secs. 15 and 16, T. 7 N., R. 18 E. a thin seam of coal is exposed (Figure 4) in this shale.

The uppermost and thickest Savanna unit in the Featherston area is the shale that lies at the top of the formation. Because of its thickness, this shale forms a low, wide valley. The larger streams in the southern part of the area flow through this valley and the surface is mostly covered with alluvium. The unit averages 230 to

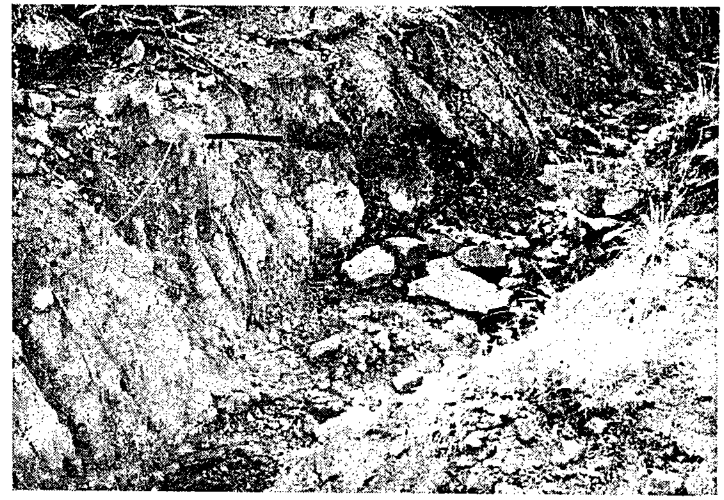

Fig. 4. A seam of coal about one inch thick underlain by six inches of underclay, as exposed in the SW ¼ sec. 15, T. 7 N., R. 17 E.

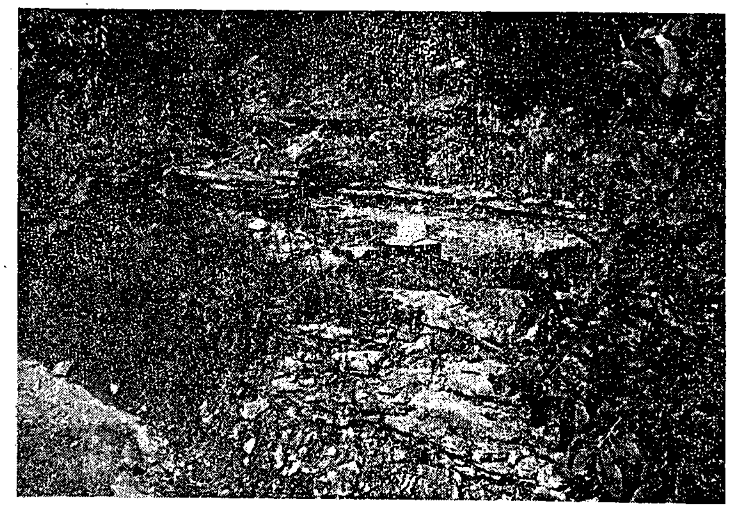

Fig. 5. Savanna sandstone with shale stringers exposed in the SW ¼ sec. 13, T. 7 N., R. 17 E.

250 feet in thickness along Highway 31. In the vicinity of Elm Creek the average thickness is 400 feet. Along the south flank of the Kinta anticline the shale unit thins remarkably, measuring only 97 feet. In secs. 5 and 8, T. 7 N., R. 18 E. a lens of sandstone approximately 25 feet thick occurs in the middle part of the shale (Plate I).

Stratigraphic Relations. The base of the Savanna formation may or may not be conformable with the underlying McAlester formation. The Savanna-Boggy contact is conformable.

Boggy Formation

Definition. Taff (1899) named the Boggy formation at the same time and in the same general locality as he did the other formations of the Krebs group. Apparently, Taff considered exposures of the formation to be most typical in the vicinity of Boggy Creek in Coal, Pontotoc and Pittsburg Counties. At present, the base of the formation is considered to be the base of the Bluejacket sandstone. The upper limit of the formation is the base of the Thurman sandstone. Taff described the Boggy-Thurman contact as indicated by an abrupt change from fine sandstone in the Boggy to sandstone containing chert fragments in the Thurman.

Distribution. The Boggy formation crops out continuously from the east flank of the Arbuckle Mountains eastward into Arkansas and northward into Kansas.

In the Featherston area outcrops of the Boggy are quite extensive, covering more than half the total area. North of Highway 31, lower units of the formation make up the rocks of the large Russellville syncline. Higher units of the formation crop out farther to the north and east. To the south, the Boggy formation is restricted to the eastern and western parts of the Panther Mountain syncline.

Thickness and Character. The Boggy formation has a maximum thickness of about 4,000 feet in the Canaval syncline of LeFlore County and eastern Latimer County as measured by Hendricks (1939).

The entire thickness of the Boggy formation is not exposed in the Featherston area. The total thickness of the exposed portion of the formation can be estimated accurately from measured sections. No one section can be taken for all the units of the Boggy, but a composite of several measured sections shows a maximum thickness of 1,150 feet. This is the average for sections taken in the northern and eastern parts of the area (see Appendix, measured sections 1 through 4). Oakes and Knechtel (1948) noted a gradual thinning of the Boggy formation from south to north in Haskell County. The thinning northward, which must exist, is difficult to prove in the Featherston area because much of the formation has been removed by erosion in the southern half of the area. At Panther Mountain, the lower five units of the Boggy formation are approximately 740 feet thick. This same five-unit interval is only 585 feet thick in sec. 33, T. 8 N., R. 18 E. This represents a thinning of 21 percent from south to north over a map distance of 4.5 miles.

The sandstone units of the Boggy formation are fine grained, brown to reddish, and silty.

The shales of the Boggy are similar to those of the Savanna. Black or gray color dominates, with minor red, green, blue, yellow or tan. Ironstone concretions are common, especially in shale above the Bluejacket. Thin siltstones and sandstones are interbedded within the shale units of the Boggy.

Several thin coal seams are present in the shales of the Boggy formation; however, only one is more than a few inches thick. The Secor coal occurs in shale and is about 100 feet stratigraphically above the Bluejacket sandstone. Plate I shows a dashed line for the outcrop pattern of the Secor coal, because it is normally covered by debris. Only in small ravines on the steep slopes of cuestas can it be seen. The Secor coal averages about 24 inches in thickness. Where observable, the Secor coal consists of a thin lower bed, 4 to 6 inches thick, and an upper bed, 10 to 14 inches thick, the two being separated by 3 to 5 inches of black shale. Black shale occurs above and below the Secor coal in most of its exposures.

Two other coal seams were identified in the Boggy formation, but each in only one locality. One coal bed 20 inches thick crops out in sec. 6, T. 6 N., R. 17 E. It is stratigraphically 70 feet below the Secor coal. This coal is of local occurrence only. In sec. 27, T. 8 N., R. 17 E. another seam of coal crops out in the bed of Lick Creek. It is reported to be 22 inches thick by Dane (1938) and by local farmers. The exposure was under water during the period of field mapping.

The sandstones of the Boggy formation show cross-bedding and many are ripple-marked. Locally, the effects of channeling can be

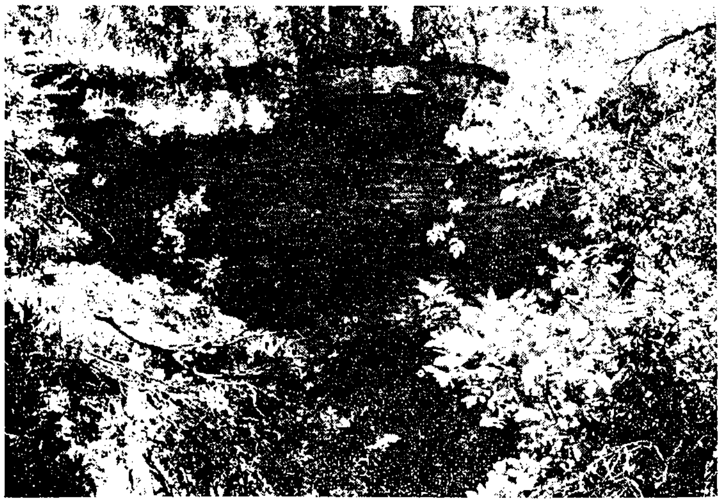

Fig. 6. Exposure of Secor coal in abandoned slope mine, sec. 25, T. 8 N., R. 17 E. Coal is overlain by sandy shale.

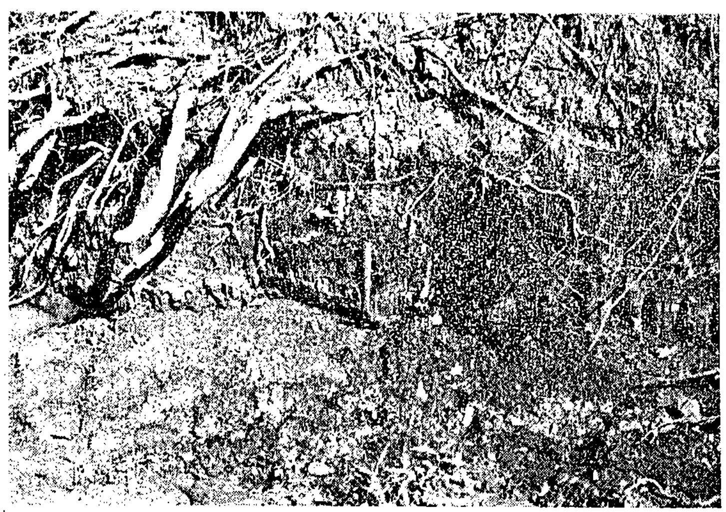

Fig. 7. Secor coal in strip pit along the bed of a creek in sec. 30, T. 7 N., R. 17 E.

seen at sandstone-shale contacts. As in the Savanna, flow casts occur on the underside of sandy or silty beds with corresponding molds in the shale below. An unusual feature in the shale units of the Boggy formation is the presence of "rolled" structures. An excellent example of this structure may be seen in sec. 7, T. 7 N., R. 18 E. The structure is an ellipsoidal mass of sandstone, resembling a concretion, and is incorporated in claystone.

The subdivision of the Boggy formation into numbered units is consistent with the division of the Savanna formation in the area.

The basal sandstone of the Boggy formation is the Bluejacket sandstone member. It can be traced continuously from the McAlester basin into Kansas. The Bluejacket was named in an unpublished manuscript by D. W. Ohern (Oakes and Knechtel, 1948). The Bluejacket may be divided into three parts in Haskell County, an upper sandy zone, a middle shaly zone and a lower sandy zone. Locally, the lowermost massive sandy zone grades into shale and at many places the middle zone is missing. Because of this variation, the Bluejacket sandstone is mapped as one complete unit in the Featherston area. Russell (1958) mapped the Bluejacket as a single unit in Latimer County. In the Featherston area the Bluejacket member forms topographic ridges along most of its outcrop pattern. A notable exception is in the north-central part of the area where the sandstone forms the core of the Enterprise anticline. Here, the eroded top of the Bluejacket is smooth. A steep cuesta face along the north side of Highway 31 is formed by the Bluejacket member. The outcrop pattern swings out of the area on the western boundary as it crosses Highway 31, only to reappear to the south. Here it forms another distinct bluff completely around the western edge of the Panther Mountain syncline. The eastern part of the same syncline is largely covered with Bluejacket sandstone, most of which forms a long dip slope to the south.

Twelve samples were collected, spaced at regular intervals, from the lower two feet of the Bluejacket sandstone. A size analysis and petrographic study of the member was made from these samples. Fifty grams of each sample was boiled in dilute hydrochloric acid and then screened for the weight percentage in each size class. A representative size class was chosen for the mineral study. Five grams of this representative class, for each sample, was mixed with tetrabromoethane and centrifuged to allow separation of light and

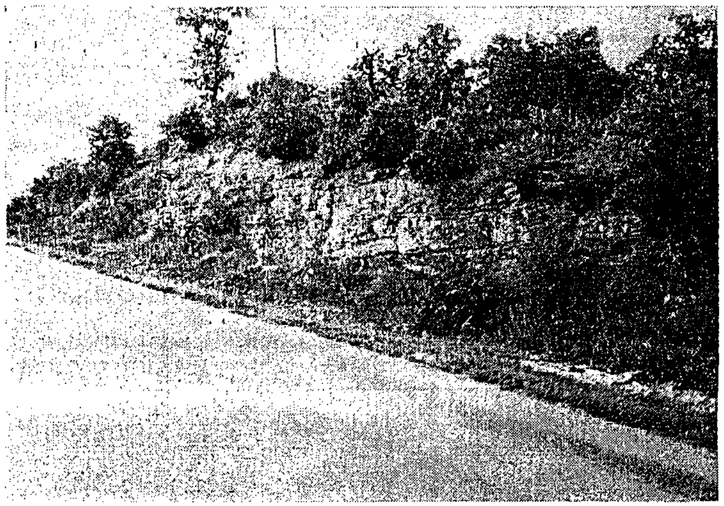

Fig. 8. Upper sandy zone of the Bluejacket sandstone along Highway 71 in sec. 26, T. 8 N., R. 18 E.

Fig. 9. Lower massive zone of the Bluejacket sandstone in contact with uppermost Savanna shale. The exposure is in the NE ¼ sec. 19, T. 8 N., R. 18 E.

heavy minerals. For each sample, a slide of light minerals and a slide of heavy minerals were prepared; mineral counts were run on each slide. The results of the study are as follows:

SIZE: By the Wentworth scale, about 75 percent of the grains are classed as fine or very fine sand (0.25 mm to 0.062 mm). The mode averages about 0.1 mm for all samples. No grain larger than 0.125 mm in diameter was present in any sample, but every sample had grains smaller than sand size. The weight percentage of grains finer than sand size averaged about 14, most of which is silt.

SOLUBLE PERCENTAGE: The percentage of weight lost by boiling in acid averaged 10. Most of this was calcium carbonate with a minor amount of iron oxide.

HEAVY MINERALS: Every slide showed an abundance of leucoxene, which masks the other minerals. A few grains of biotite and zircon were identified and two generations of allogenic tourmaline were found. The older tourmaline consists of dark green, blue and yellow grains that are well rounded. The younger tourmaline consists of angular green grains, some of which show good parting.

LIGHT MINERALS: No feldspar was identified in any of the light mineral slides. The quartz grains are angular.

CONCLUSIONS: The Bluejacket member is a fine-grained silty sandstone with little carbonate content. The angularity of quartz grains suggests a nearby igneous or metamorphic source, although the few rounded grains suggest an older sandstone for the source. The high percentage of leucoxene indicates an igneous source, since leucoxene is a replacement mineral of ilmenite. According to Pettijohn (1957) ilmenite is associated with basic igneous rocks.

The analysis of the Bluejacket sandstone, as shown above, is probably representative for most of the sandstones of both the Savanna and Boggy formations, within the mapped area.

The shale unit above the Bluejacket and below IPb-1 contains the Secor coal and one or two other thin coal seams. It has a fairly uniform thickness throughout the area. It thickens locally in secs. 27, 28, 33 and 34, T. 7 N., R. 17 E. and contains a single massive sandstone lens below the Secor coal. This sandstone lens forms a distinct ridge between the Bluejacket member and the IPb-1 sand-

Fig. 10. View of the double ridge north of the town of Quinton in sec. 26, T. 8 N., R. 18 E. The camera is facing southwest toward sec. 35 of the same township. The valley below is formed by shale and is crossed by Highway 71. Bluejacket is seen just below the camera and midway up the opposite hill. Sandstone tops the hill.

stone and is mapped separately. The IPb-2 sandstone unit pinches out in sec. 5, T. 8 N., R.17 E., and the underlying and overlying shales thin considerably. The interval represented by these shales is only 102 feet at the edge of the area to the west in sec. 18. In the northern part of T. 8 N., R. 17 E. this interval is more than 400 feet.

The shale above IPb-3 contains a conspicuous lens of sandstone in secs. 16, 17, 20 and 21, T. 8 N., R. 17 E. It is indurated and resistant, and is mapped as IPb-3a. The base of the lens does not seem to be high enough above IPb-3 sandstone to warrant mapping it as an outlier of IPb-4 sandstone.

Stratigraphic Relations. The base of the Boggy formation is conformable with the underlying Savanna formation, at least within the Featherston area. The upper contact of the Boggy formation is absent in the area, but it is believed to be disconformable by Hendricks (1937) and by Dane (1938).

Quaternary System

Terrace Deposits

Deposits of unconsolidated sand and silt occur as terrace deposits along the floodplains of large streams within the Featherston area. These terrace deposits are thought to be of Pleistocene age. The deposits generally border the floodplains of streams, rising twenty or thirty feet above them. A few of the terraces contain streaks of gravel and coarse sand. These probably represent former deposits of braided streams. The color of the deposits is tan to buff or red.

Pimple mounds are present on the flat terrace tops. These mounds vary from ten to thirty feet in diameter with heights up to four feet. The surface of the terraces has a hummocky appearance as a result of these mounds. Knechtel (1952) believes that the pimple mounds of eastern Oklahoma are due to jointing beneath the terraces. According to this theory, dessication of a consolidated rock beneath the surface leaves a system of fissure polygons. Around the polygons, the ground subsides along the fissures leaving mounds over the centers of the polygons. Melton (1954) reviewed the hypotheses of origin of these pimple or "natural" mounds and offered another hypothesis. His conclusions and hypothesis were were based on previous literature and upon field observations. The theory supposes that rapid gullying in weak sandy soil removes a few feet of the soil in near parallel rivulets, followed by rain wash and slumping.

Mapping of the terraces is accomplished by noting the slightly elevated surfaces and by the presence of the pimple mounds. A particularly large terrace is found on the east side of T. 8 N., R. 17 E., where Bluejacket sandstone completely surrounds terrace material. This terrace is obviously higher in elevation than the terraces farther west and north. In the northern part of the area, the best soil is on the large terrace deposits, and it is the only soil suitable for farming.

Alluvial Deposits

Along the valleys of the larger streams within the area are deposits of recent alluvium composed of fine sand, silt and clay.

Sans Bois Creek and its tributaries have deposited alluvium in much of the southern part of the area. Extensive local deposits of this type are along the crest of the Kinta anticline, along Highway 31 from east to west and around the western part of the Panther Mountain syncline, joining with the deposits of Elm Creek to the southwest. Longtown Creek and its tributaries have left several alluvium-floored valleys in the northeastern part of the area. The best soil in the Featherston area occurs along Highway 31 in secs. 19, 20, 21 and 28, T. 7 N., R. 17 E.

STRUCTURAL GEOLOGY

Structure of the Region

The area lies on the northern flank of the McAlester basin. To the north and northeast is the gently dipping Prairie Plains homocline. The Ozark Dome is situated to the northeast and to the south of the area is the Arbuckle-Ouachita complex. Local structures within the basin were directly affected by movements of these large regional features surrounding the basin.

The Choctaw fault trends east-west through Le Flore, Latimer and Pittsburg Counties and then southwestward into Atoka County. It is the structural boundary between the intensely faulted and folded rocks of the Ouachita complex and the gently folded rocks to the north. These gently folded strata are characterized by narrow anticlines and broad shallow synclines. The axes of these folds are en echelon and are parallel to the Choctaw fault.

Local Structural Features

Parts of three anticlines and two synclines are defined in the surface rocks of the Featherston area. The axes of these folds are roughly en echelon and are from two to four miles apart, being nearly equally spaced. The axes of the five features trend east-northeast.

Burning Springs anticline. The Burning Springs anticlinal fold is perhaps the least prominent of the five structural features in the area. It crosses the Featherston area in the extreme southeastern

and southwestern parts. The name of the structure was applied by Hendricks (1937). The western part of the fold is west-southwest of the area in the McAlester district. It plunges gently westward there and disappears within a short distance. The core of the anticline is approximately in secs. 8 and 9, T. 6 N., R. 17 E. In the center the McAlester formation is exposed. Eastward, the fold axis passes into Latimer County. Russell (1958) mapped the fold across the northwestern corner of Latimer County in secs. 1, 2, 11 and 12, T. 6 N., R. 17 E. and sec. 6, T. 6 N., R. 18 E. Russell believed this part of the structure to be the eastern extent, but it is now known to continue farther to the east. The anticline re-enters Pittsburg County in the SE¼ sec. 31, T. 7 N., R. 18 E. and continues eastward to the Latimer County line on the east side of the area. The anticline is broad as it crosses this part of the area. The Burning Springs anticline is characterized by outcrops of the Savanna formation on both of its flanks. Nearly a full section of the Savanna is exposed on the north flank of the structure in secs. 4 and 9, T. 6 N., R. 17 E. Here in the southwestern part of the area, dips along the structure are nine to thirteen degrees. The eastern part of the anticline has dips of less than six degrees.

Panther Mountain syncline. The well-defined Panther Mountain syncline dominates much of the southern portion of the Featherston area. Dane (1938) apparently named the structure, choosing the name of a high peak in secs. 23 and 24, T. 8 N., R. 18 E. for a geographic designation. The synclinal axis is parallel to and less than two miles north of the Burning Springs anticline. Topographically, the Panther Mountain syncline is rugged, with high elevations, both in its eastern and western parts. The two highest elevations in the area are atop Shoe and Panther Mountains, on the axis of the syncline. West of the area, the syncline continues for a short distance. To the east, Oakes and Knechtel (1948) mapped the syncline in Haskell County for a few miles. In both the eastern and western thirds of the syncline, within the area, outcrops of the Bluejacket sandstone member set the fold apart from its surroundings. Higher units of the Boggy formation make up both mountains to the east. The western portion is capped by the IPb-1 sandstone. The central third of the syncline is a structural saddle (see Plate I). The width of outcrop increases considerably for IPsv-5 and overlying shale along the axis of the syncline. Because of the structural saddle, there are two synclinal plunges, one to the east and one to the west. Along the entire extent of the structure, dips are quite low, ranging from two to eight degrees.

Kinta anticline. To the north and parallel to the Panther Mountain syncline is the narrow, symmetrical Kinta anticline. The major portion of this anticline is in Haskell County. The axis passes through the town of Kinta, for which it is named. The western plunge of the anticline is almost entirely contained within the Featherston area. Erosion of the fold has formed a topographic low along its axis. It has outcrops of Savanna units along both flanks for most of its extent in the area. The Bluejacket does, however, crop out at the west end of the fold in a symmetrical band, and the McAlester formation is exposed in the eastern portion of the fold. This eastern part, where the McAlester formation is uncovered, is the lowest topographic level in the area. The western plunge is well displayed in secs. 19 through 23, T. 7 N., R. 17 E. with dips of two to four degrees. The anticline has a narrow appearance with dips as high as fourteen and fifteen degrees on both flanks.

Russellville syncline. The broad shallow Russellville syncline dominates most of the northern half of the Featherston area. It was named by Dane (1938) for the former post office at Russellville in sec. 20, T. 8 N., R. 18 E. The synclinal axis is three to four miles north of the axis of the Kinta anticline. The syncline does not continue to the west of the area but disappears before reaching the western boundary. To the east, Oakes and Knechtel (1948) traced the structure half way across Haskell County. The axis bends slightly northward in T. 8 N., R 18 E. as it passes out of the area. In northwestern Haskell County it bends back eastward again and continues across the county. The Bluejacket sandstone crops out along the southern flank of the fold, from east to west across the entire area. On the northern flank, part of the extent of the syncline is shown by the Bluejacket member, but the western end of the structure is nearly hidden. The syncline becomes quite broad in the western part of the area. The topography on the fold characteristically is high and rugged, especially along the southern flank. A double row of cliffs is formed by the Bluejacket and IPb-1 sandstones along Highway 31. Nearer the axis, higher units of the Boggy formation appear. Several flat low hills are formed by the IPb-2 sandstone. At the western edge of the area, IPb-3, -3a, and

-4, make their appearance, just as the syncline is losing its identity. Dips on the flanks of the structure are low, averaging less than seven degrees.

Enterprise anticline. North of and parallel to the Russellville syncline is a broad anticlinal structure. It was named for the community of Enterprise in Haskell County. Only the southwestern plunge of the fold can be seen in the Featherston area; the structure terminates near the eastern boundary of the area. Longtown Creek and its tributaries cut through much of the eastern part of the structure, and a considerable portion of the Boggy rocks there is covered by Quaternary deposits. The Bluejacket sandstone is uncovered along part of the axis, but the center of this outcrop is covered by terrace material. The uppermost Boggy units dip gently away from the anticline in all directions. Two broad dip slopes of sandstone are especially noticeable. IPb-3 sandstone dips away to the west in secs. 21, 22 29 and 30, T. 8 N., R. 17 E. IPb-4 sandstone forms a large dip slope at the northern boundary of the area. The anticline is broad enough to appear dome-shaped. The north and south dipping flanks and the western plunge all have similar dips, ranging from three to nine degrees. A long high ridge is formed by the lens of sandstone IPb-3a in secs. 16, 17 and 21, T. 8 N., R. 17 E.

North and west of the Enterprise anticline is an unnamed synclinal structure. Only part of the southeastern flank of the structure is seen in the Featherston area. The flank of this structure is delineated on the geologic map (see Plate I) by the ridge of IPb-4 sandstone in secs. 3, 4, 5 and 6, T. 8 N., R. 17 E. Webb (1957) mentioned this syncline and indicated its presence on his geologic map.

GEOLOGIC HISTORY

The McAlester basin, or Arkoma basin (Branson, 1956), began subsidence in Pennsylvanian time following uplift of the Ouachita Mountains to the south. Earliest movement of the Ouachita area probably occurred in Late Mississippian time. The Arkoma basin began to sink in early Atokan time and geosynclinal conditions continued throughout Desmoinesian time. The subsidence was partly in response to the adjacent uplift to the south. The Desmoinesian sea transgressed to the northwest as deposition of the McAlester, Savanna and Boggy formations took place. Minor pulsations in the thrust zone to the south accompanied the transgression.

Fluctuations of the sea during deposition were responsible for the present lenticular sandstones found with the thick shale zones. The Bluejacket sandstone may be regarded as a basal transgressive deposit of the Boggy formation, because of its persistence throughout the Arkoma basin and northward. Some evidence of local deltaic conditions such as cross-bedding and the "rolled" structures in a few exposures of the Boggy formation may have some relation to deltaic conditions.

The age of the Ouachita orogeny is interpreted differently by various authors. Melton (1930) believed the age to be Early Permian. Van der Gracht (1931) suggested a pulsation as early as Late Mississippian time on the basis of the unconformity between the Caney shale and the Arkansas novaculite. One or more of these pulsations caused folding of strata in the immediate area. In all probability, the most important movement occurred in post-Boggy, pre-Thurman time, as indicated by the fact that the strata of the Krebs group are uniformly folded whereas Thurman and younger strata are more gently folded.

ECONOMIC GEOLOGY

In the past, coal mining was of some importance in the Featherston area. Only the Secor coal is of commercial thickness and quality within the area, although several other coals exist. Strip mining on a small scale is possible. One large strip pit is located in sec. 30, T. 7 N., R. 17 E. Several small slope mines were in operation prior to 1930. These mines have long since been abandoned; few of them can even be found. The exposures of the Secor coal are located north of Highway 31 in T. 8 N., Rs. 17 and 18 E. and a few in the western end of the Panther Mountain syncline. The Secor coal is of good quality except for a high percentage of sulphur. Within the area, the Secor coal is everywhere less than three feet thick. It is highly doubtful if the coal will ever be profitably mined again in this part of the basin.

No oil has been discovered within the area. The fixed carbon ratio is too high for the existence of commercial quantities of petroleum, according to most authors.

Natural gas is being produced from three fields on the Kinta anticline. The Quinton gas field is centered along the axis of the Kinta anticline south of the town of Quinton and overlapping into Haskell County. The Pittsburg County portion of the field is in secs. 1, 2, 11 and 12, T. 7 N., R. 18 E. Production is from the Hartshorne sandstone. The Carney gas field is immediately west of the Quinton field, in parts of secs. 3, 4, 5, 7, 8, 9, 10, 15, 16, 17 and 18, T. 7 N., R. 17 E. Production is from a lens of McAlester sandstone and from the Hartshorne sandstone. The Blocker-Featherston gas field is at the western edge of the area along the Kinta anticline. Producing wells of this field are in secs. 19 through 22, T. 7 N., R. 17 E. Production is from the Hartshorne sandstone. Most of the gas in the area is bought by the Oklahoma Natural Gas Company. Shows of gas have been encountered in both the Enterprise anticline and the Burning Springs anticline, but both structures are unproductive at this time.

Locally, sandstone is used for building purposes. A number of buildings in Quinton and Featherston are constructed of sandstone blocks. The thickness of bedding and nature of jointing in sandstones of both the Savanna and Boggy formations make them desirable for building purposes. The lower massive zone of the Bluejacket sandstone probably provides the best all-purpose building stone available in the area.

SUMMARY

Rocks of Middle Pennsylvanian (Desmoinesian) age crop out in the area. Three formations in the Krebs group include all the Pennsylvanian rocks exposed. The upper 300 feet of the McAlester formation is exposed in the cores of two anticlines. A maximum of 1,130 feet of the Savanna formation crops out in the area. The lower part of the Boggy formation crops out in the area, mostly in the northern half; it reaches a maximum thickness of 1,150 feet. The entire thickness of strata may be considered a shale sequence with fine-grained brown lenticular sandstone lenses throughout. Both the Boggy and Savanna formations thin progressively northward. Thin deposits of alluvium and terrace material, of Quaternary age, are distributed along the valleys of present streams.

Local structural features include the Burning Springs, Kinta and Enterprise anticlines and the Russellville and Panther Mountain synclines. These structures were formed by lateral compressive forces from the south in the Ouachita Mountain complex. The movements probably occurred in post-Boggy time.

The Arkoma basin was an active geosyncline during Atokan and Desmoinesian time. The sediments are shallow-water and terrestrial deposits. The source of sediments was to the south and southwest.

The Secor coal was once mined in the area but is now of no commercial importance. Three gas fields are along the crest of the Kinta anticline, all of which produce from the Hartshorne sandstone.

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APPENDIX

MEASURED SECTIONS OF THE FEATHERSTON AREA

1. Boggy formation in secs. 6, 7 and 18, T. 7 N., R. 17 E. measured along the center of secs. on county road from south to north. Section is a composite of two Brunton traverses.

Description of Unit	Thickness in Feet
Boggy Formation:	
Sandstone, brown, resistant, top eroded	63.5
Shale, reddish-brown and gray	41.0
Sandstone, brown, fine-grained, silty	52.0
Covered, shale and siltstone	34.0
Sandstone, buff, fine-grained	3.0
Covered, mostly shale with a few thin siltstones	64.5
Sandstone (IPb-1), brown, thick-bedded	67.0
Covered, shale and siltstones, Secor coal not exposed	178.5
Sandstone (IPbb), buff, fine-grained	91.0

2. Boggy formation in secs. 4 and 9, T. 8 N., R. 17 E. measured from southeast to northwest beginning at base of sandstone unit IPb-4.

Description of Unit	Thickness in Feet
Boggy Formation:	
Sandstone, brown, fine-grained, top eroded	65.0
Shale, dark, silty	164.5
Sandstone (IPb-3), brown, fine-grained, massive to thin-bedded	37.0
Covered, shale and siltstone, dark	194.0
Sandstone, brown, fine-grained, silty	62.0

3. Boggy formation in sec. 1, T. 8 N., R. 17 E. near county line. Section begins at the base of the Secor coal and ends to the north atop a high ridge.

Description of Unit	Thickness in Feet
Boggy Formation:	
Sandstone (IPb-2), brown, fine-grained, top eroded	39.0
Shale, dark, silty, iron staining and many ironstone concretions	206.5
Sandstone (IPb-1), brown, fine-grained	62.0
Covered, shale and siltstones	96.0
Coal- Secor, contains two seams, black shale above, below and between	2.5

4. Boggy formation in sec. 33, T. 8 N., R. 18 E. measured north along the middle of the section from just north of Highway 31.

Description of Unit	Thickness in Feet
Boggy Formation:	
Sandstone (IPb-2), brown, fine-grained	27.5
Covered, shale and siltstone	183.0
Sandstone (IPb-1), brown, thin-bedded, fine-grained	53.0
Shale, gray to black, silty	213.0
Sandstone (IPbb), brown, fine-grained, forms a high ridge	108.0

5. Boggy formation in sec. 6, T. 6 N., R. 17 E. along the west line (west edge of area) measured from south to north.

Description of Unit	Thickness in Feet
Boggy Formation:	
Sandstone, brown, fine-grained, caps ridge	48.0
Covered, shale and siltstone	312.0
Sandstone (IPbb), brown, fine-grained, massive	143.0

6. Savanna formation on county road between sec. 13, T. 7 N., R. 18 E. and sec. 18, T. 7 N., R. 17 E. measured from south to north.

Description of Unit	Thickness in Feet
Savanna Formation:	
Covered, alluvium over uppermost shale unit of the formation, not measured.	
Sandstone (IPsv-5), brown, shale stringers interbedded, fine-grained	51.0
Shale, silty, siltstones and claystone interbedded	152.0
Sandstone (IPsv-3), brown, fine-grained, massive	62.5

7. Savanna and McAlester formations in sec. 8, T. 6 N., R. 17 E. measured northeastward from the crest of the Burning Springs anticline.

Description of Unit	Thickness in Feet
Savanna Formation:	
Sandstone (IPsv-3), not measured	
Shale, silty, dark, ironstone streaks and concretions	116.5
Sandstone (IPsv-2), brown, fine-grained	171.0
Shale, gray, silty, blocky	135.0
Sandstone, brown, fine-grained, abundant flow casts, cross-bedded	14.0
McAlester Formation:	
Shale, dark, silty, not measured but probably more than 100 feet thick	

8. Savanna formation measured from the center of sec. 2, T. 6 N., R. 17 E. (Latimer County) to the middle of N½ sec. 35, T. 7 N., R. 17 E. Base of section is 600 feet north of a cattle corral.

Description of Unit	Thickness in Feet
Savanna Formation:	
Sandstone (IPsv-5), reddish-brown, fine-grained, massive	51.5
Shale, dark, silty	26.0
Sandstone (IPsv-4b), brown, fine-grained	33.5
Covered, shale	25.0
Sandstone (IPsv-4a), brown, fine-grained, cross-bedded, flow casts	56.0
Covered, shale	26.0
Sandstone, brown, fine-grained, irregular bedding, shale stringers	80.0

9. Savanna and McAlester formations measured along section line between secs. 1 and 2, T. 7. N., R. 18 E. and north to Quinton.

Description of Unit	Thickness in Feet
Savanna Formation:	
Sandstone (IPsv-5), brown, fine-grained, forms first ridge south of Quinton	53.0
Covered, red and green shale, ironstone streaks, silty	143.5
Sandstone (IPsv-3), brown, fine-grained, massive	39.0
Covered, mostly silty shale, gray to black and green	177.0
Sandstone (IPsv-2), brown, fine-grained, cross-bedded	54.0
McAlester Formation:	
Shale, gray to black, silty. Upper part is equivalent to the Savanna fm. through disappearance of IPsv-1	136.0
Sandstone (IPmk), brown, fine-grained, cross-bedded, flow casts common, silty	19.0

10. Savanna formation measured up the south flank of the Kinta anticline against the dip. Measured along the county line on the east side of secs. 12 and 13, T. 7 N., R. 18 E.

Description of Unit	Thickness in Feet
Savanna Formation:	
Sandstone (IPsv-5), fine-grained, interbedded with shale stringers, mostly brown but some gray, partly covered	79.0
Shale, dark, silty	53.5
Sandstone (IPsv-3), gray, massive, fine-grained cross-bedded, silty	32.0
Covered, clay and shale, dark, a few sandy beds visible, silty	157.0
Sandstone (IPsv-2), brown and gray, fine-grained, shale stringers, massive	67.0
Covered, shale with interbedded siltstones, brown and green	38.0
Sandstone (IPsv-1), brown and green, fine-grained, massive in part, cross-bedded	49.0

11. Savanna formation measured along county road from north to south on the west side of secs. 10 and 15, T. 7 N., R. 18 E.

Description of Unit	Thickness in Feet
Savanna Formation:	
Shale, green and gray, silty	97.0
Sandstone (IPsv-5), brown, fine-grained, cross-bedded, and with flow casts	49.5
Covered, mostly shale, silty, a few siltstones, ironstone as concretions and in beds, gray and blue, one thin coal seam and six-inch underclay	221.0
Sandstone (IPsv-3), brown, fine-grained, silty	50.5
Covered, mostly shale, dark	203.0
Sandstone (IPsv-2), brown, fine-grained	61.0
Covered, shale	111.0

12. Boggy formation in secs. 23 and 26, T. 7 N., R. 18 E Measurement begins at base of Bluejacket sandstone in sec. 26, and ends atop Panther Mountain in sec. 23.

Description of Unit	Thickness in Feet
Boggy Formation:	
Sandstone (IPb-2), brown, fine-grained	41.0
Shale, dark, with ironstone streaks, silty, yellow in part	212.0
Sandstone (IPb-1), brown and red, fine-grained, resistant, massive	69.0
Covered, shale, masked by debris, Secor coal not exposed	310.0
Sandstone (IPbb), brown, fine-grained, shale stringers, cross-bedded, silty	105.0

INDEX

(Main references are in boldface)

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