OKLAHOMA GEOLOGICAL SURVEY

GUIDE BOOK 1

FIELD CONFERENCE

On Pre-Atoka Rocks

in

WESTERN PART OF THE OZARK UPLIFT
NORTHEASTERN OKLAHOMA

by

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Sponsored by

Oklahoma City Geological Society
Robert M. Becker, President
and
Oklahoma Geological Survey
William E. Ham, Acting Director

APRIL 24-25, 1953

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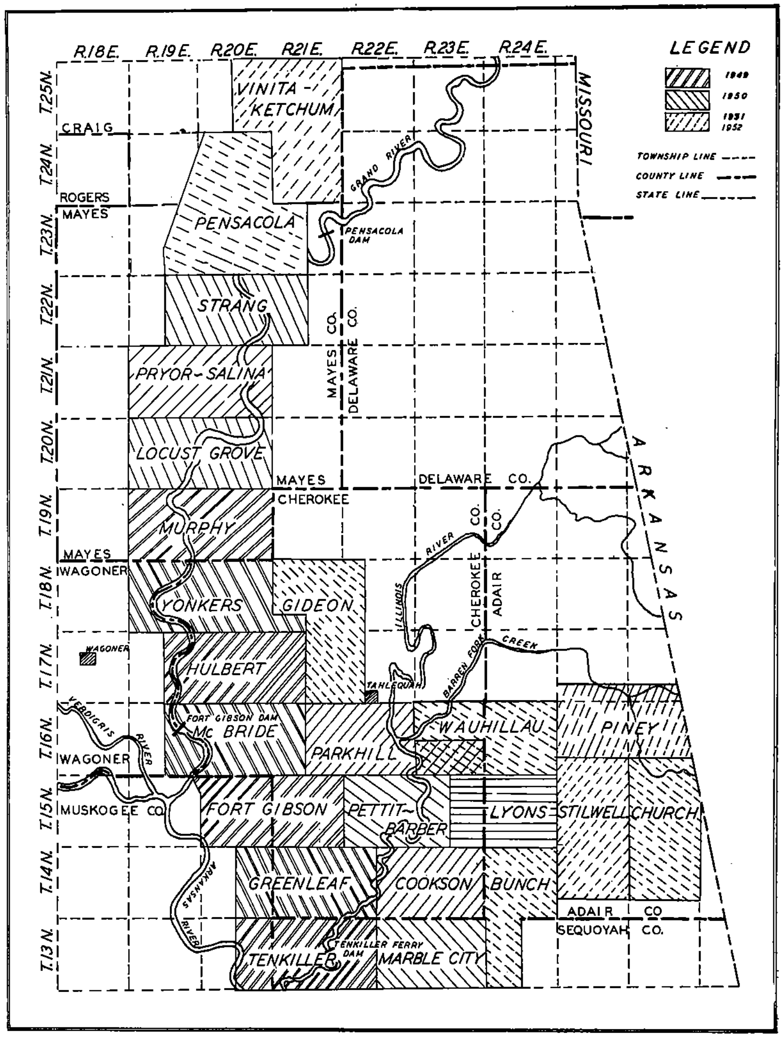
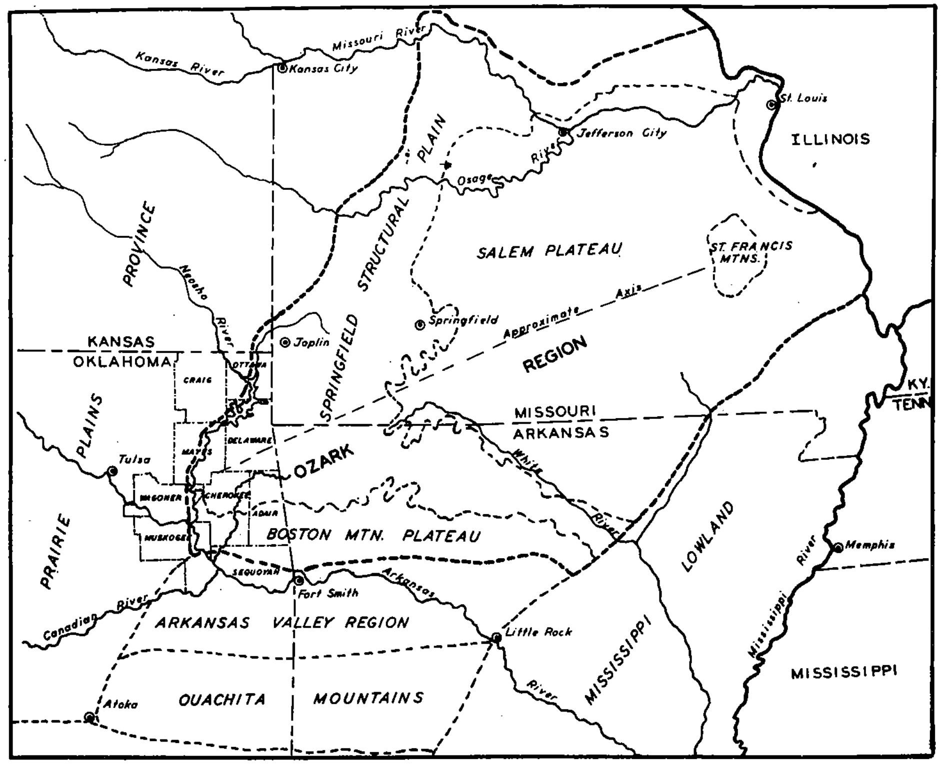


FIGURE I. MAP SHOWING AREAS UNDER INVESTIGATION

Reprinted with revisions from Tulsa Geological Society Digest, Vol. XIX, 1951.



SKETCH MAP OF OZARK UPLIFT AND ADJOINING PHYSIOGRAPHIC PROVINCES (After Taff, Fenneman, others)
FIGURE 2.

Reprinted from Shale Shaker, Vol. 2, November, 1951.

A RESUME' OF THE GEOLOGY OF THE OZARK UPLIFT, NORTHEASTERN OKLAHOMA*

by George G. Huffman

INTRODUCTION

Nature and Scope of Present Investigation

Since June 1, 1949, graduate students from the University of Oklahoma have mapped approximately 1,600 square miles on the south and west flanks of the Ozark uplift in northeastern Oklahoma. This work was sponsored by the Oklahoma Geological Survey to aid in obtaining information for the new geologic map of Oklahoma which is being compiled by Hugh D. Miser of the United States Geological Survey.

This area, in which rocks mostly of pre-Atoka age crop out, forms an arcuate belt from the Arkansas boundary westward to the vicinity of Gore, Oklahoma, thence northward to Vinita; extending from the north line of T. 12 N. to the north line of T. 25 N. and covering parts of Rs. 19 E. through 26 E.; (figure 1). Parts of Cherokee, Sequoyah, Muskogee, Wagoner, Mayes, Delaware, Craig, and Ottawa Counties are included. Additional studies of a closely related nature have been completed by Speer (41) in Ottawa County, by Montgomery (30) along the Illinois River northeast of Tahlequah, and by Gore (17) in the Spavinaw Area.

At the conclusion of the field work, the assembled information will be combined in a comprehensive report to be published as a Bulletin of the Oklahoma Geological Survey. The work includes detailed mapping of lithic units, collection and identification of faunas from each unit, and measurement and description of detailed stratigraphic sections.

Summary of Previous Investigations

The first notable geological work in northeastern Oklahoma was completed by Drake (15) in 1897. He discussed the stratigraphy and structure of the area and made a sketch map of the Mississippian-Pennsylvanian contact.

Subsequent work (see Bibliography) includes that of Taff; Siebenthal; Snider; Mather; Aurin, Clark, and Trager; Buchanan; Gould; Ireland; Cram; Weidman; Fowler and Lyden; Cline; Laudon; Wilson and Newell; Brant; and Moore.

Theses completed recently in this area include those by Bollman; Chandler; Beckwith; Siemens; Mondy; Douglass; Kozak; Mills; Simpson; Hurt; Speer; Montgomery; Gore; De Graffenreid; Smith; Brauer; Stafford; Snodgrass; Branson; Lauderback; Dobervich; McBryde; and Christian.

PHYSIOGRAPHY

General Regional Setting

The Ozark uplift is a broad, asymmetrical dome covering approximately 40,000 square miles in Missouri, Arkansas, and Oklahoma. It is bounded on the southeast by the Mississippi Lowlands, on the south by the Arkansas Valley, and on the west and northwest by the Prairie Plains homocline. (See figure 2.) The axis trends northeast-southwest, passing through the St. Francis Mountains of eastern Missouri and Wright County, south central Missouri, 40 miles east of Springfield. It plunges southwestward into Oklahoma.

The Ozark region can be subdivided into three physiographic provinces; the Salem Platform carved on Ordovician and older rocks; the Springfield Structural Plain underlain largely by rocks of Mississippian age, especially the Boone cherts and limestones; and the Boston Mountains, a dissected plateau capped by sandstones of early and middle Pennsylvanian age.

*Adapted from *Tulsa Geological Society Digest* 1951 (19) and *The Shale Shaker* 1951 (20).

SYSTEM	SERIES	FORMATION	ROCK	FEET	CHARACTERISTICS AND FAUNA
PENNSYLVANIAN	DES MOINESIAN	"CHEROKEE"		0~300	Yellow brown shales and sandstone with Warner or Little Cabin sandstone at base.
	"ATOKAN"	ATOKA		0~600	Sequence of marine and non-marine shales and sandstones with occasional limestone. Best developed in Muskogee Porum District where it includes the Coody, Pope Chapel, Georges Fork, Dirty Creek, Webbers Falls, and Blackjack School members.
	MORROWAN	BLOYD		0~150	Blue-gray, fossiliferous limestone interbedded with gray, fissile shale. Abundant Pentremites. Thins northward to extinction in Yonkers area.
		HALE		0~140	Massive, blue-gray, sandy limestone and cross-bedded sandstone; weathers pitted and fluted. Conglomerate at base. Abundant Pleurodictyum eugenae.
MISSISSIPPIAN	CHESTERIAN	PITKIN		0~80	Gray-blue, rubbly-weathering limestone with Archimedes, Diaphragmus, Eumetria, Torynifera. Thins northward to extinction near Yonkers.
		FAYETTEVILLE		15~185	Black, fissile shale and thin interbedded blue-black limestone. Fossiliferous with Eumetria, Diaphragmus, Spirifer increbescens, Linoproductus.
		HINDSVILLE		0~65	Gray, oolitic limestone with Spirifer leidyi, Agassizocrinus, Diaphragmus cestriensis.
	MERAMECIAN	MOOREFIELD		0~35	Blue-yellow, calcareous siltstone and shale.
				0~8	Gray, granular limestone with chert fragments.
				0~65	Blue black to brown, argillaceous limestone; Leiorhynchus carboniferum, Moorefieldella eurekensis; grades eastward into glauconitic, gray limestone.
	OSAGIAN	BOONE: KEOKUK		0~70	Massive, white to tan flecked, tripolitic chert and blue gray, crinoidal limestone.
		BOONE: REEDS SPRING		0~150	Blue-white to tan, thin-bedded chert and limestone.
		BOONE: ST. JOE		0~25	Gray, nodular weathering limestone and underlying green shale.
?	KINDERHOOKIAN	CHATTANOOGA		0~60	Black, fissile shale with basal Sylamore sandstone.
DEV.	ULSTERIAN	SALLISAW		0~25	Brown, calcareous sandstone and chert.
		FRISCO		0~8	Gray, coarsely crystalline limestone.
SIL.	NIAGARAN	ST. CLAIR		0~100	Pinkish-white, coarsely crystalline limestone; absent north of Qualls.
ORDOVICIAN	CINCINNATIAN	SYLVAN		0~25	Yellow-brown to green, unfossiliferous shale.
		FERNVALE		0~25	Gray, coarsely crystalline limestone with abundant Rhynchotrema capax.
	MOHAWKIAN	FITE		0~8	Gray, lithographic, calcite-flecked limestone.
		TYNER		0~90	Bright green shales and thin, sandy, yellow dolomite.
	CHAZYAN	BURGEN		0~100	White to yellow, hard, massive sandstone with thin bed of sandy dolomite and green shale.
	CANADIAN	COTTER		± 200	Gray to buff, finely crystalline dolomite with thin beds of white sandstone.
PRE-CAMBRIAN		SPAVINAW		?	Red, coarse-grained granite near Spavinaw

GENERALIZED COLUMNAR SECTION FOR NORTHEASTERN OKLAHOMA
FIGURE 3.

Reprinted from Shale Shaker, Vol. 2, November, 1951.

The Ozark uplift occupies parts of Ottawa, Craig, Delaware, Mayes, Wagoner, Muskogee, Cherokee, Adair, and Sequoyah Counties. Its western boundary coincides approximately with the Grand and Spring Rivers and their east-flowing tributaries. The southern boundary is the northern side of the Arkansas River Valley. Westward the strata pass beneath the gently dipping beds of the Prairie Plains homocline and southward beneath the Arkansas Valley syncline.

Topography and Drainage

The northern three-fourths of the northeastern Oklahoma area is in the Springfield Structural Plain. A small part west of the Grand River extends into the Prairie Plains province, and the southern one-fourth lies in the Boston Mountains.

The topography of the Springfield Plain is that of a deeply dissected plateau. The upland surface formed on the cherts and limestones of the Boone formation is characterized by flat divides separated by sharp, V-shaped stream valleys. A characteristic dendritic drainage pattern is formed. The surface slopes to the west, southwest, and south. In general the valleys have been cut 200 to 300 feet below the upland surface, and on this surface outliers and ridges locally rise 250 to 400 feet.

South of the Springfield Structural Plain is a narrow belt of rugged topography of the Boston Mountains. Here a series of northeast-trending normal faults separate the area into a series of prominent fault blocks with steep escarpment faces and gentle dip slopes capped by the Atoka sandstone. Major drainage lines have developed in the softer shales and limestone valleys paralleling the major faults, but some deep valleys have been cut through the ridges.

Dissection in the Boston Mountains is greater and major valleys are 500 to 1000 feet deep. Tilted fault blocks give a stair-step effect resulting in long, high, narrow ridges capped by gently dipping strata.

West of the Grand River, thin upper Mississippian and Pennsylvanian beds dip gently to the west, to form the Prairie Plains homocline. Here the surface is gently rolling with low, east-facing escarpments and isolated buttes capped by resistant sandstones. Obsequent and subsequent streams join the superimposed Grand River.

The entire region lies in the drainage basin of the Arkansas River. The northern part is drained by the Grand River which is formed by the confluence of the Neosho and Spring Rivers near Wyandotte, Ottawa County, and which flows southward into the Arkansas River near Fort Gibson. The southern and southeastern parts are drained by Bayou Manard, Boudinot Creek, Greenleaf Creek, Cedar Creek, Illinois River, Vian Creek, Sallisaw Creek, and Lee Creek.

Relief and Elevations

The maximum relief in this area is approximately 1,300 feet. Highest elevation of 1,750 is on the north end of Bugger Mountain (Sec. 11, T. 16 N.; R. 26 E.). The lowest point of 450 feet is along the Arkansas River (Sec. 34, T. 13 N., R. 20 E.).

STRATIGRAPHIC SEQUENCE

The rocks exposed at the surface over this area range in age from pre-Cambrian, represented by the Spavinaw granite, to middle Pennsylvanian Atoka and "Cherokee" formations. Locally these are overlain by a thin veneer of terrace gravels and alluvium of Pleistocene and Recent age. (See figure 3.)

The pre-Cambrian Spavinaw granite is overlain unconformably by the lower Ordovician Cotter dolomite near Spavinaw, Oklahoma (T. 22 N., R. 22 E.). In the subsurface of Ottawa County, 1,200 feet of Cambrian and lower Ordovician strata intervene(44). The Cotter is exposed near Qualls (Cherokee County) in section 35, T. 15 N., R. 21 E. where it is succeeded by the Burgen sandstone, the Tyner shale, Fite limestone, Fernvale limestone, and Sylvan shale of Ordovician age. Late Ordovician Sylvan shale is overlain unconformably by the

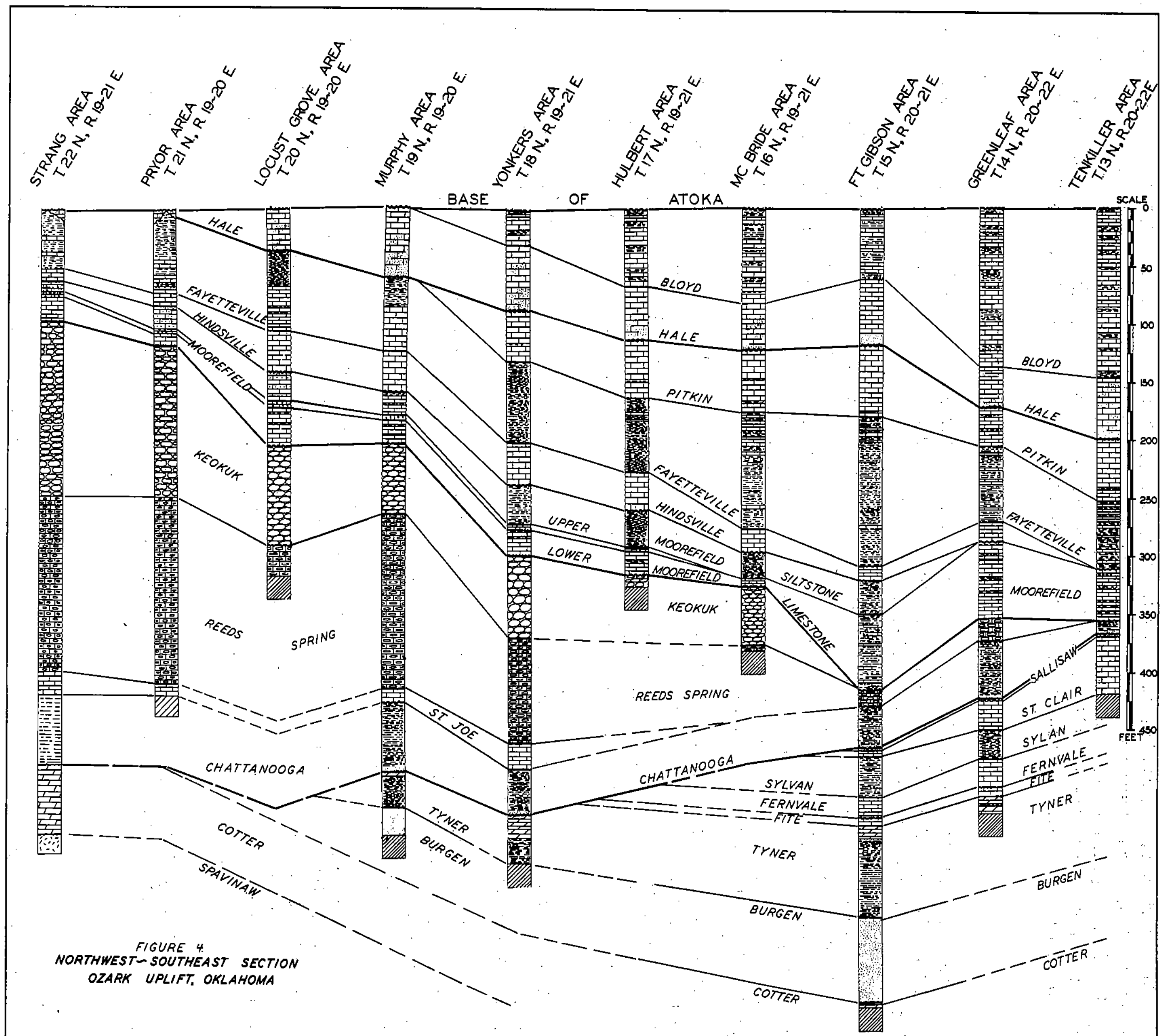


FIGURE 4
NORTHWEST-SOUTHEAST SECTION
OZARK UPLIFT, OKLAHOMA

Modified from Tulsa Geological Society Digest, Vol. XIX, 1951.

St. Clair limestone of Silurian age, which in turn is succeeded by the Frisco limestone and the Sallisaw sandstone and chert of Devonian age.

Devonian, Silurian, and Ordovician units are beveled northward by unconformity and are overlapped by the Chattanooga black shale and its basal Sylamore sandstone member (Late Devonian or early Mississippian) which lie on the Sallisaw formation (Devonian) near Marble City and on the Cotter dolomite (Lower Ordovician) near Spavinaw.

The succeeding Osagian series includes the Boone formation which has been divided into the St. Joe, Reeds Spring, and Keokuk members in ascending order. In Ottawa and northern Delaware Counties a bed of white oolite 2 to 10 feet thick known as the Short Creek (bed M of the Tri-State District) is present in the upper Keokuk. There succeeding cherty, glauconitic limestones are classed as Warsaw. Local isolated patches of oolite in Cherokee and Adair Counties are considered equivalent to the Short Creek of Ottawa County, southeastern Kansas, and southwestern Missouri. The Boone thins southwestward by unconformity to extinction in T. 13 N., R. 21 E. where basal "Mayes" lies on the eroded surface of the Chattanooga.

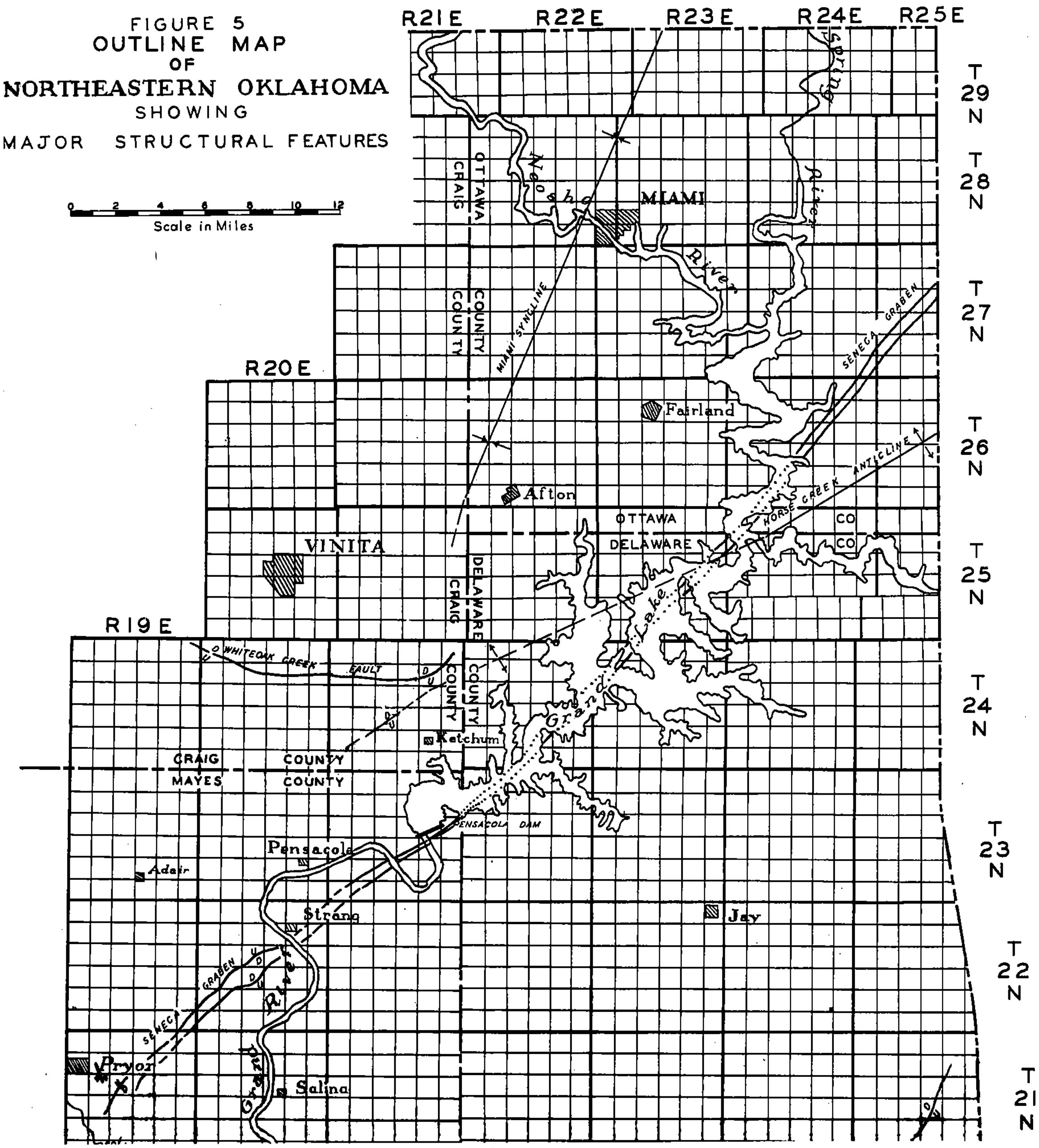
The "Mayes" limestone (38) rests unconformably on the erosional surface of the Boone and older beds. In Mayes County it can be divided into four lithic units as demonstrated by Brant (4). In descending order these include (a) gray, medium crystalline, oolitic limestone (Grand River of Brant); (b) yellow-brown, calcareous siltstone and shale (Batesville of Brant); (c) gray, granular limestone with angular chert fragments (Hindsville of Brant); and (d) blue-black, argillaceous limestone (Moorefield of Brant). Near Tahlequah and Marble City, the lower argillaceous limestone member rests conformably on gray, medium crystalline, partly oolitic, glauconitic, phosphatic, crinoidal, and locally cherty limestone. This limestone grades westward into black, crinoidal limestone interbedded with nodular black chert and argillaceous limestone near Cookson and Blackgum, Ts. 13 and 14 N., R. 22 E.

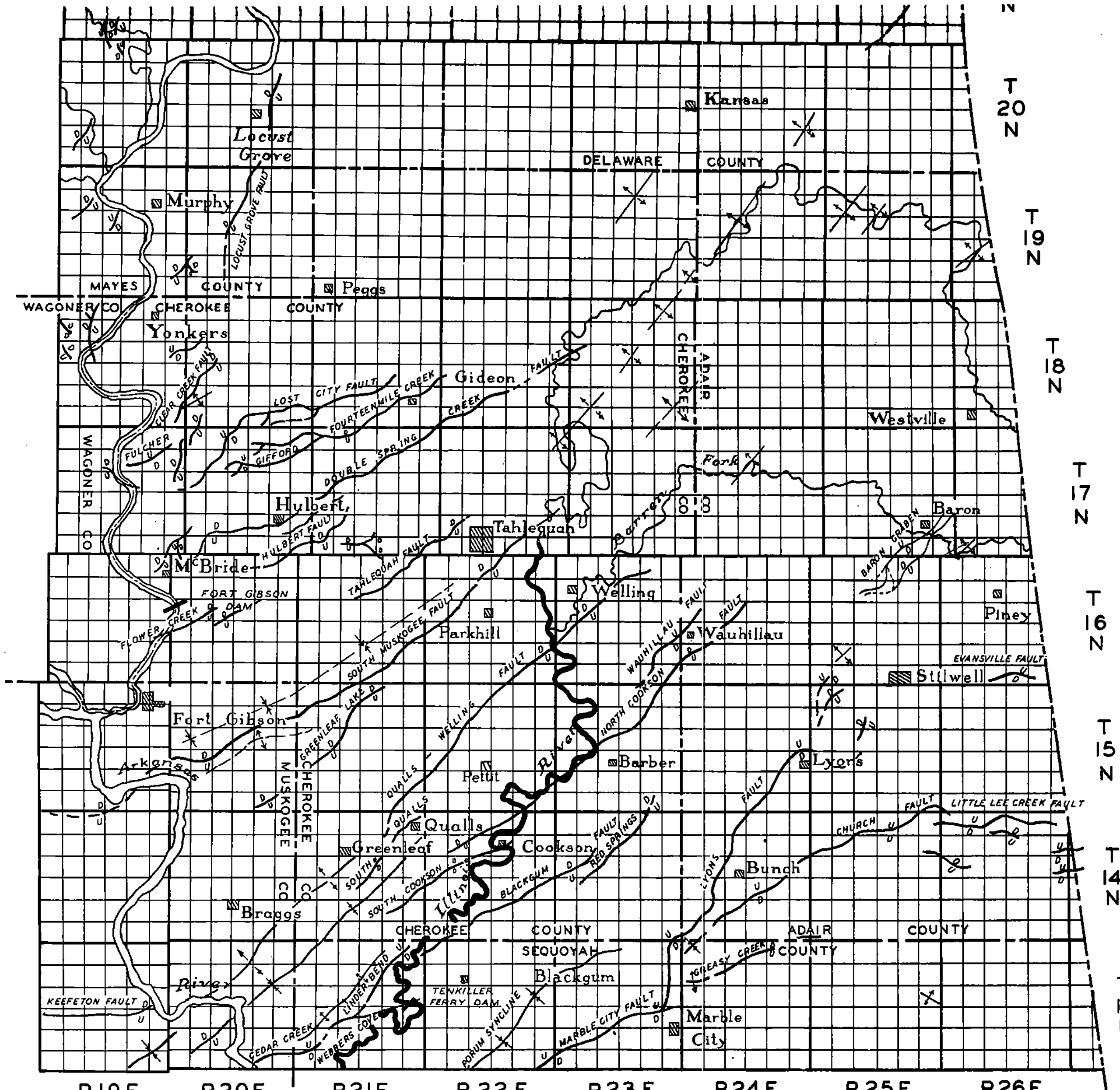
The "Moorefield," "Hindsville," and "Batesville" of Brant (1941) are lithologically and faunally similar, containing abundant *Nudirostra carboniferum, Moorefieldella eurekensis, Spirifer arkansanus, Dictyoclostus coloradoensis, Griffithides pustulosus* and other forms common to the Moorefield formation of Arkansas. Upper shaly portions resemble the Ruddell shale but faunal ties have not been established. It is believed that the term Moorefield should be applied to these beds and that the lithic subdivisions should be regarded as members of the Moorefield formation in Oklahoma. The lower gray, glauconitic limestone carries *Syringothyris textus, Orthotetes keokuk, Nudirostra carboniferum, Moorefieldella eurekensis,* and other forms. It is believed to represent a facies of the lower Moorefield and may correspond to the gray, glauconitic limestone (Warsaw) of Ottawa County. The lower argillaceous facies rests unconformably on the Keokuk in Mayes, Ottawa, and western Cherokee Counties; on the white oolite (Short Creek) southeast of Tahlequah in sec. 35, T. 16 N., R. 23 E.; and on the Chattanooga in northwestern Sequoyah County, sec. 10, T. 13 N., R 21 E. The lower glauconitic facies rests on the Keokuk chert near Tahlequah; on white oolite in sec. 2, T. 15 N., R. 23 E.; and on the Reeds Spring chert near Marble City (sec. 13, T. 13 N., R. 24 E.), and north of Blackgum on Snake Creek (sec. 33, T. 14 N., R. 22 E.).

The upper "Mayes" (Grand River of Brant) (term preoccupied) lies unconformably on older units. It overlaps the Moorefield northward into Craig and Ottawa Counties where it lies with unconformity and basal conglomerate on the Boone. In Cherokee and Adair Counties, it lies on remnants of the Moorefield or on the Boone chert. Where resting on the Boone, the "Grand River" contains a thick basal conglomerate of rounded chert pebbles and cobbles. In western Cherokee, eastern Wagoner, and Mayes Counties, it rests on the upper calcareous siltstone member of the Moorefield formation. It is composed of gray, medium crystalline, oolitic limestone characterized by the association of *Agassizocrinus, Diaphragmus cestriensis, Spirifer leidyi, Cliothyridina sublamellosa, Dictyoclostus inflatus, Torynifera setigera, Paladin mucronatus,* and others. It can be traced laterally into the Hindsville of Ottawa County, Oklahoma, and southwestern Missouri where it underlies the true Batesville sandstone. It has been mapped from Mayes County southeastward to the Arkansas line where it is homotaxial with the Hindsville of the Prairie Grove region. It thins southwestward to extinction south of Braggs Mountain, T. 15 N., R. 20 E.

The upper "Mayes" or Hindsville is succeeded by the Fayetteville shale and the overlying Pitkin limestone. The Hindsville, Fayetteville, and Pitkin comprise a conformable sequence of beds characterized by a Chesterian fauna.

FIGURE 5
OUTLINE MAP
OF
NORTHEASTERN OKLAHOMA
SHOWING
MAJOR STRUCTURAL FEATURES





Reprinted with revisions from Shale Shaker, Vol. 2, November, 1951.

The Pitkin is beveled northward by pre-Hale erosion and is absent north of Yonkers in T. 19 N. The succeeding Morrowan series, including the Hale and Bloyd formations, is truncated by pre-Atoka unconformity and overlapped northward by the Atoka and younger sediments. The Bloyd is absent north of Union Mission in T. 19 N. Near Pryor the middle Pennsylvanian Atoka formation rests on the Fayetteville shale. Northward, units of the younger Pennsylvanian "Cherokee" formation overlap the Atoka in Craig and Ottawa Counties.

Several prominent regional pre-Atoka unconformities are present. These are (a) post-pre-Cambrian, pre-Canadian; (b) pre-Chattanooga, (c) post-Keokuk, pre-Moorefield, (d) post-Moorefield, pre-Hindsville ("Grand River"); (e) post-Pitkin, pre-Hale, and (f) post-Morrow, pre-Atoka. The "Cherokee" sandstones and shales in turn lie unconformably on Atoka and older beds. Other stratigraphic breaks of smaller magnitude are recognized. The stratigraphic relations are shown in figure 4.

STRUCTURE

General Regional Picture

Northeastern Oklahoma lies on the southwestern flank of the Ozark Uplift. The formations strike in an arcuate pattern and dip away from the axis of the Uplift, toward the west in northern part and to the southwest and south in the southern part of the area. The general regional dip of 25 to 50 feet per mile is interrupted by a series of northeast-trending folds and faults whose alignment is roughly parallel to the axis of the Ozark uplift (See figure 5). Steeper dips are associated with beds in proximity to major faults.

Faulting is most pronounced in the Boston Mountain area in Cherokee and Adair Counties where a system of large, parallel, normal faults divide the rocks into a series of fault blocks which are tilted to the southeast.

In the northern part of the area, the folds and faults die out to the west and grade imperceptably into gently westward-dipping strata of the Prairie Plains homocline. In the southern part, the faults disappear northeastward in the Boone chert and pass southwestward into gentle anticlinal folds which continue across the Arkansas River into the Muskogee-Porum district.

Structural development in northeastern Oklahoma is closely associated with that of the Ozark geanticline which underwent successive submergences and emergences during Paleozoic time. Southward tilting in pre-Chattanooga time is indicated by northward truncation and overlap of older beds by the Chattanooga shale from south to north. Renewed southward tilting in both pre-Hale and pre-Atoka time is shown by northward truncation of the Pitkin and Bloyd formations respectively.

The major deformation took place during Pennsylvanian time. The faults and folds are post-Atoka in age inasmuch as they affect Atoka rocks. In Ottawa County, folding of the Pennsylvanian "Cherokee" shale coincides with that of pre-Pennsylvanian beds, although the "Cherokee" is distorted to a lesser degree than are older beds.

Parallelism of the folds and faults of this area with those of the Arkansas Valley syncline and the Ouachita Mountain area suggest a genetic relationship.

Major Structures

The principal structural features in the Ozark Uplift of northeastern Oklahoma include the Miami syncline, Seneca graben, Horse Creek anticline, Whiteoak fault (new), Locust Grove fault, Lost City fault (new), Clear Creek fault, Fourteenmile Creek fault, Gifford fault (new), Double Spring Creek fault, Hulbert fault, Tahlequah fault, South Muskogee fault, Qualls-Welling fault, Greenleaf Lake fault (new), South Qualls fault (new), North Cookson fault, South Cookson fault (new), Wauhillau fault (new), Blackgum fault, Red Springs fault (new), Linder Bend fault (new), Webber's Cove fault (new), Cedar Creek fault (new), Marble City fault, Lyons fault, Church fault, Little Lee Creek fault (new), Evansville fault, the North and South

Davidson faults and the Baron graben (new). The location and trend of these are indicated in Stratigraphic displacement on the major faults varies from a few feet to over 700 feet.

Minor Folds and Faults

Well-defined anticlinal uplifts are present along Spavinaw Creek near Spavinaw, Oklahoma; on Salina Creek sec. 31, T. 21 N., R. 20 E.; on Flint Creek T. 20 N., R. 24 E.; west of Grand River in T. 19 N., R. 19 E. near Union Mission; on Chouteau Creek sec. 32 T. 20 N., R. 19 E.; along Clear Creek T. 18 N., Rs. 19 and 20 E.; on Ranger Creek near the Fort Gibson Dam; along the Illinois River from Tahlequah northeastward to the vicinity of Watts (secs. 17, 19, 20 in T. 19 N., R. 26 E.); along Barren Fork east of Proctor (T. 17 N., R. 24 E.) and near Baron (sec. 36, T. 17 N., R. 25 E); and along the Qualls-Welling fault from Tahlequah southwestward to Qualls. Other anticlinal folds include Nigger Hollow anticline south of the Muskogee fault; Qualls Dome sec. 35, T. 15 N., R. 21 E.; McBride anticline T. 16 N., Rs. 19 and 20 E.; and Greasy Creek anticline secs. 7 and 8, T. 13 N., R. 24 E. The crest of a small anticline is exposed in Salt Branch Creek, sec. 36, T. 14 N., R. 21 E.

Synclinal flexures include the Flat Rock syncline (28) which parallels Bayou Manard north of the South Muskogee fault and the Iron Springs syncline (new) in sec. 6, T. 13 N., R. 24 E. The central part of the Blackgum fault block between the Blackgum and Marble City faults has been depressed into a broad shallow syncline which according to Moore (31) may be a northward extension of the Porum syncline of southern Muskogee County. Other synclinal folding is present in proximity to major faulting.

Minor faults include (1) the Crittenden fault south of the Hulbert fault; (2) Flower Creek faults along Flower Creek, T. 16 N., Rs. 19 and 20 E.; (3) Pecan Creek faults in secs. 31, 32, 33, T. 18 N., R. 21 E.; (4) Hickory Creek faults in T. 17 N., Rs. 19 and 20 E.; (5) Fulcher fault in secs. 1, 10 and 11, T. 17 N., R. 19 E.; (6) Nigger Creek fault secs. 9 and 16, T. 17 N., R. 19 E.; (7) "Highway 51" fault in sec. 22, T. 17 N., R. 19 E.; (8) McBride faults associated with the McBride anticline; and (9) the Ranger Creek faults in Secs. 7 and 8, T. 16 N., R. 20 E. Numerous small, unnamed faults are present as indicated in figure 5.

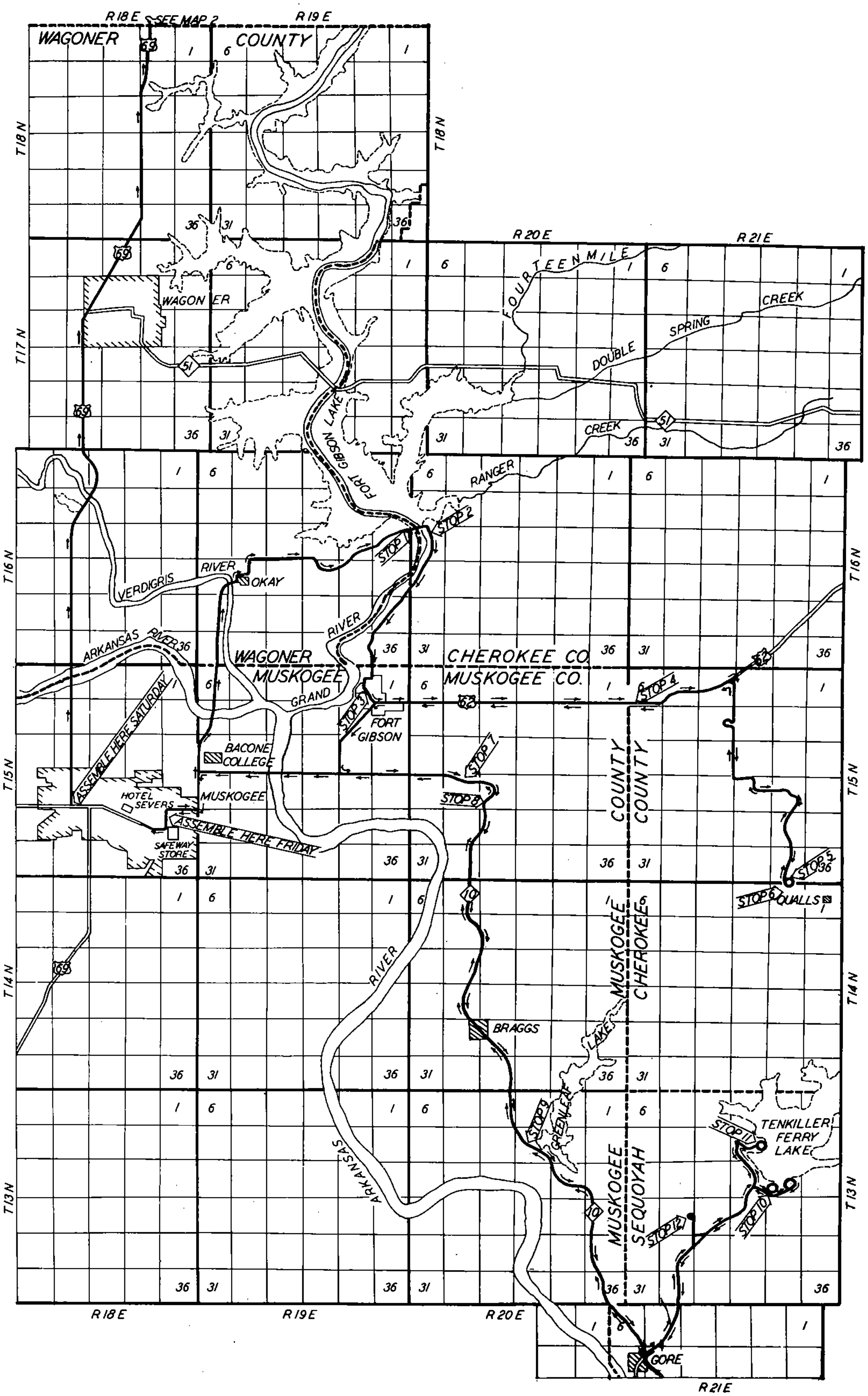
OIL AND GAS PROSPECTS

The prospects for oil and gas in the Ozark Uplift have been summarized by Cram (11) and Ireland (22). Except for a small depleted gas field near Mazie (secs. 26 and 27, T. 19 N., R. 18 E.) bordering the western edge of the area included in this study, commercial production of oil or gas has not been established.

Abundant reservoir rocks, source rocks, and favorable structural anomalies are present but the strata which produce at depth a few miles to the west are exposed at or near the surface in this area and any oil that may have been present has escaped or has been flushed out by water.

Potential reservoir rocks include the Burgen sandstone, various sands in the Tyner, the Sylamore sandstone, the Wedington sandstone member of the Fayetteville formation, the Hale sandstone, and the sandstones of the Atoka as well as numerous limestone, cherts, and dolomites with local porosity. Source rocks include the Tyner shales, Sylvan shale, Chattanooga shale, Moorefield and Hindsville formations, Fayetteville shale, Bloyd shale, and black shales in the Atoka.

Slight indications of oil and gas have been observed in the progress of this study. Several formations, especially the Moorefield and Hindsville, are characterized by a strong petroliferous odor and hollow interiors of fossil shells in the Moorefield formation have yielded small amounts of live, green oil. Gas seeps are present along Chouteau Creek (sec. 32, T. 20 N., R. 29 E.), on Nigger Hollow anticline (secs. 14 and 15 T. 15 N., R. 20 E.), and on Salt Branch anticline (sec. 36, T. 17 N., R. 21 E.). Traces of oil and gas have been reported from water wells and sufficient gas is obtained from the Boone chert (sec. 10, T. 22 N., R. 20 E.) and from the Atoka sandstone (sec. 1, T. 14 N., R. 21 E.) for domestic purposes. Staining and asphaltic residue have been found in the Atoka sandstone southeast of Vinita. Asphalt is reported in lead and zinc mines near Picher and seepage of heavy bitumen occurs at the base of the "Cherokee" shale along Tar Creek north of Miami (22). Several structures have been drilled in the region, but no commercial production of oil or gas has been found.


R 18 E
SEE MAP 2
R 19 E
WAGONER COUNTY
T 18 N
R 20 E
R 21 E
FOURTEEN MILE
CREEK
SPRING
DOUBLE
CREEK
WAGONER
T 17 N
FORT GIBSON LAKE
RANGER
STOP 2
STOP 1
T 16 N
VERDIGRIS RIVER
OKAY
ARKANSAS RIVER
RIVER
WAGONER
MUSKOGEE
CHEROKEE CO.
MUSKOGEE CO.
GRAND
STOP 3
FORT GIBSON
STOP 4
STOP 7
BACONE COLLEGE
ASSEMBLE HERE SATURDAY
HOTEL SEVERS
MUSKOGEE
STOP 8
ASSEMBLE HERE FRIDAY
SAFEWAY STORE
COUNTY
COUNTY
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STOP 6
QUALLS
MUSKOGEE
CHEROKEE
RIVER
T 14 N
BRAGGS
LAKE
GREENLEAF
STOP 9
TENKILLER FERRY LAKE
STOP 11
STOP 10
ARKANSAS
MUSKOGEE
SEQUOYAH
STOP 12
T 13 N
R 18 E
R 19 E
R 20 E
GORE
R 21 E

FIRST DAY OF FIELD CONFERENCE

April 24, 1953

Fort Gibson, Qualls, Tenkiller Ferry

Driving Distance 111.6 miles

Starting time - 7:30 A.M.

Leader - George G. Huffman

ROAD LOG FOR FIRST DAY

DIRECTIONS FOR ASSEMBLY: Drive ½ block south of Hotel Severs turning left on Broadway Street. Continue east to Highway 62, turn left and assemble in single file on east side of street at the new Safeway Store.

Mileage:

0.0 Assembly point, Safeway Store, Highway 62, east side of Muskogee

0.6 *Turn right on Highway 62 at Conoco filling station*

1.0 R.R. crossing. Continue east on Highway 62

1.5 *Turn left on Highway 62*

2.5 Junction of Highway 62 and road to Fort Gibson Dam. Brockway Glass Company on right. *Continue north at intersection.*

3.2 Entrance to Bacone College

4.3 Arkansas River

8.4 Verdigris River. *Note Webbers Falls sandstone member of the Atoka formation below bridge*

8.5 R.R. crossing. Entering town of Okay, Oklahoma

8.8 *Turn right in Okay at Fort Gibson Dam sign*

9.2 *Turn left* (north)

9.7 *Turn right.* Note high level terrace materials

11.5 Atoka sandstone at crest of hill. *Note lake to left.*

11.9 Atoka sandstone in road cut

14.3 Fort Gibson Dam Marker. *Drive slowly*

14.4 *Turn right to Observation Point.*

14.7 STOP I. **OBSERVATION POINT, FORT GIBSON DAM.** (Sec 13, T. 16 N., R. 19 E.)
Looking below, one sees the Fort Gibson Dam, a concrete structure now nearing completion. This dam is 2850 feet long, 110 feet high, creates a reservoir of 51,000 acres with 1,287,000 acre feet of storage, of which 922,000 acre feet is for flood control. Total cost over $22,000,000, when completed will house 6 turbines (12,330 K.W. capacity),

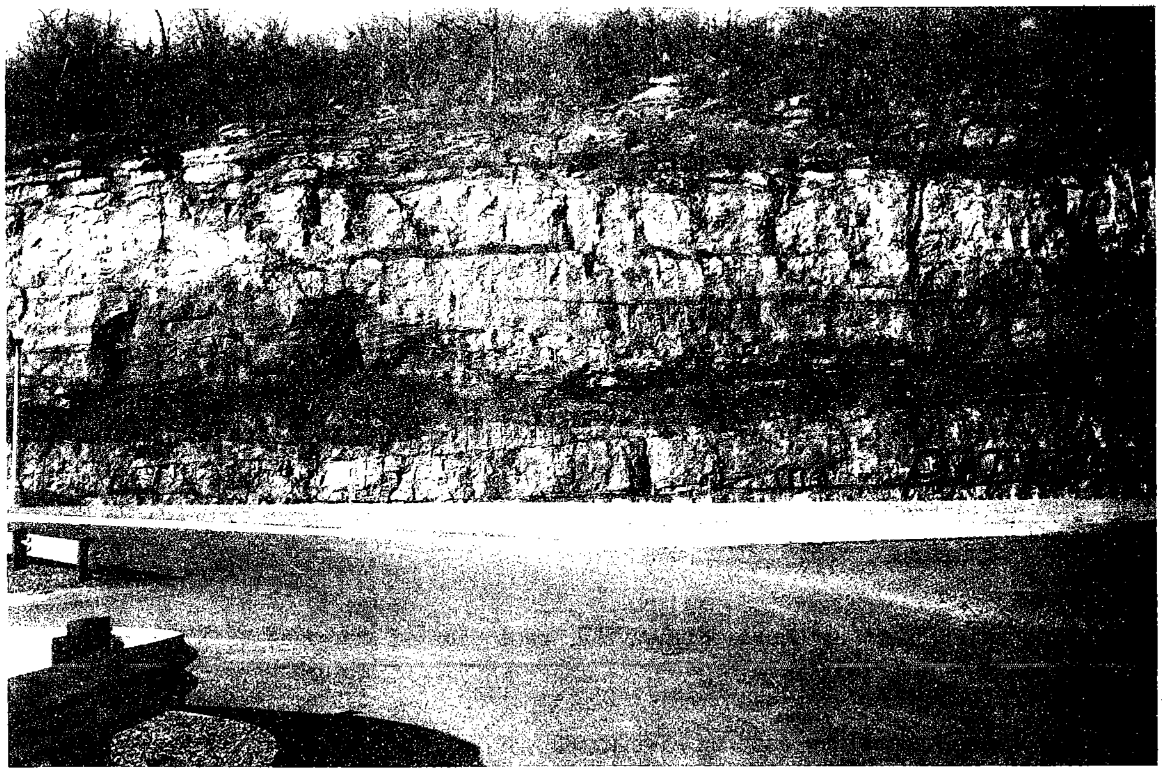
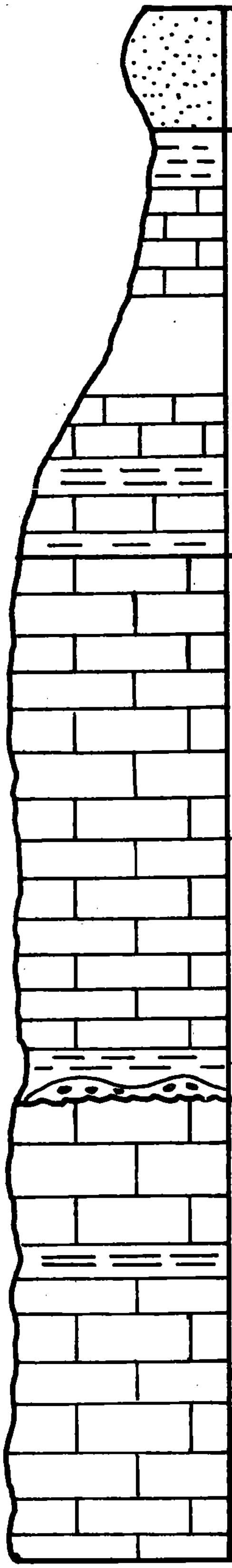


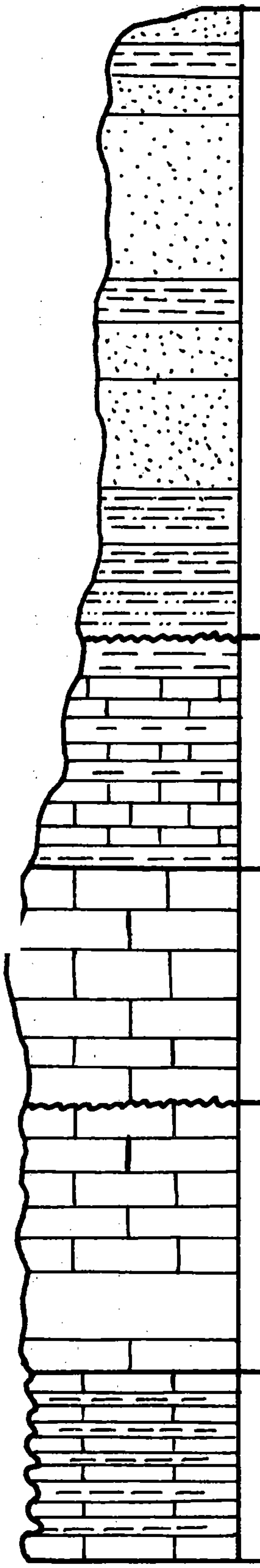
Figure 7. Pitkin, Hale, Bloyd sequence, west end of Fort Gibson Dam, Sec. 13, T. 16 N., R. 19 E. Note basal Hale conglomerate.

Figure 8. Fayetteville, Pitkin, Hale, Bloyd sequence, east end of Fort Gibson Dam, Sec. 18, T. 16 N., R. 20 E. (photo by Chandler)



PENNSYLVANIAN	
ATOKA FORMATION: 16 feet measured	
Buff to brown, fine-grained sandstone	16.0
BLOYD FORMATION: 39.5 feet	
Shale, blue-gray, calcareous	3.3
Limestone, blue-gray, silty	9.5
covered	12.5
Limestone, blue-gray, finely crystalline, crinoidal with occasional thin shale parting	13.2
Shale, gray to black and green, fissile	1.0
HALE FORMATION: 47.1 feet	
Limestone, gray-brown, medium crystalline, weathers iron-stained, fluted, and pitted.	20.2
Limestone, reddish-brown to gray, medium crystalline, weathers fluted, iron stained	20.2
Shale, gray-black, fissile, calcareous	4.7
Conglomerate, reddish, shaly, irregular	2.0
MISSISSIPPIAN	
PITKIN FORMATION: 34.5 feet	
Limestone, gray, finely crystalline, oolitic in part, occasional shale partings	9.5
Basal portion now concealed by fill at west end of dam	25.0
Base rests on Fayetteville shale	

I. Measured Section, west end of Fort Gibson Dam, Sec. 13, T. 16 N., R. 19 E.



ATOKA FORMATION: 175.3 feet to top of exposure		PENNSYLVANIAN
Sandstone, white to iron stained, coarse	7.7	
Shale, gray to iron stained, irregular	6.6	
Sandstone, gray, shaly, fine-grained	5.6	
Sandstone, gray-brown, fine-grained, heavy bedded, weathers platy at base	59.6	
Shale, dark, ferruginous, sandy	11.1	
Sandstone, dark, iron-stained, weathers platy	17.0	
Sandstone, buff to cream, medium-grained, ripple marked; alternates with beds of gray, platy to concretionary shale	31.7	
Siltstone, blue-gray, massive	16.2	
Shale, blue-gray to black, sandy	6.6	
Siltstone, blue-gray, cross laminated, iron-stained, blue-black shale near top	13.2	
BLOYD FORMATION: 33.1 feet		
Shale, blue-black with thin limestone interbeds	9.5	
Limestone, blue-gray, dense to medium crystalline, interbedded with blue-gray, calcareous shale	23.6	
HALE FORMATION: 30.6 feet		
Limestone, gray-brown, coarsely crystalline, massive, pitted, sandy; thin shale bed at the base	30.6	
PITKIN FORMATION: 39.2 feet		MISSISSIPPIAN
Limestone, gray to gray-brown, medium crystalline, weathers nodular; shaly partings, <u>Archimedes</u> and <u>Pentremites</u>	20.2	
Covered	13.0	
Limestone, blue-gray, nodular, shaly	6.0	
FAYETTEVILLE FORMATION: 18.5 exposed		
Limestone, black, dense, lithographic, interbedded with black fissile shale	18.5	
Base of exposure at east end of dam		

II. Measured Section, east end of Fort Gibson Dam, Sec. 18, T. 16 N., R. 20 E.

total output 73,800 K.W. and 180,700,000 KWH per year. The east end of the dam built against the Fayetteville shale and the west side against the Pitkin limestone. Excellent exposures may be seen at each end of dam. *Return to car and proceed slowly down hill to the right.*

15.3 **WEST END OF FORT GIBSON DAM.** (Sec. 13, T. 16 N., R. 19 E.)

Park on oval in single file. At the base of the section is the Pitkin limestone of upper Mississippian age. This is overlain unconformably by the Hale formation with basal shale and conglomerate. Overlying massive limestone is the Hale which weathers with a pitted and fluted appearance. Upper portion of exposure comprises green shales and thin limestones of the Bloyd with the Atoka sandstone capping the ridge. (See figure 7 and section I.)

16.1 **STOP II. EAST END OF FORT GIBSON DAM.** (Sec. 18, T. 16 N., R. 20 E.)

Park in single file behind lead car and after short discussion, walk up hill to examine units. The sequence of alternating black shales and thin limestones belong to the Fayetteville formation. These grade upward through rubbly-weathering limestones into the Pitkin formation which is characterized by large numbers of *Archimedes*. Overlying Morrow series includes the cross-bedded Hale limestone and overlying Bloyd formation. Thick bedded Atoka sandstones form a resistant cliff near top of exposure. (See measured section II and figure 8.)

17.6 Flower Creek. *Caution - Narrow Bridge*

19.6 *Keough Quarry and R.R. Crossing.* Quarry in Hale and Bloyd formations. Atoka sandstone capping cliff. Famous collecting locality for the blastoid *Pentremites* from the Bloyd shale.

20.8 *Turn right. Entering town of Fort Gibson.*

21.0 *Turn left.* The buildings are part of Historic Fort Gibson.

21.5 *Turn right*

21.7 *Turn right*

22.0 STOP III. **RECONSTRUCTED FORT GIBSON.** 15 minute stop

22.3 *Turn right. Continue through town of Fort Gibson*

22.8 **CAUTION.** *Turn Left on Highway 62 at Standard Station*

You will be driving across the Atoka formation for several miles. The mountain to the right is the Braggs Mountain escarpment which is on the upthrown side of the South Muskogee fault.

28.6 Bayou Manard which occupies a synclinal trough on the north (downthrown) side of the South Muskogee fault.

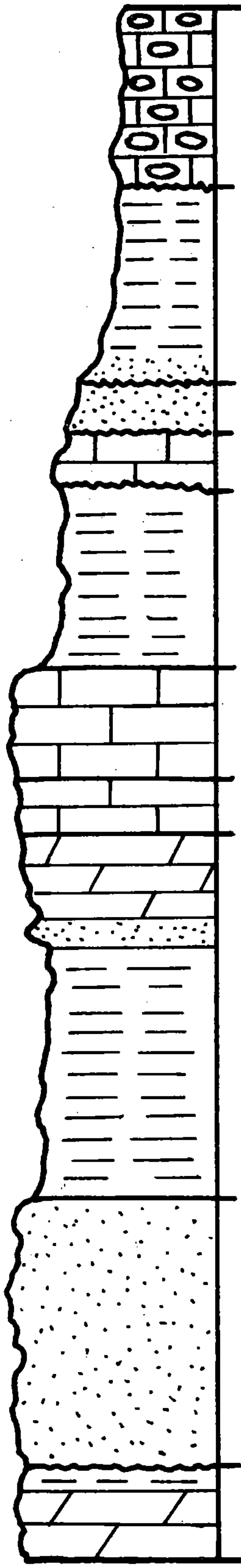
29.7 Atoka sandstone in road cut

30.0 Steeply dipping Atoka sandstone on north side of South Muskogee fault.

30.2 STOP IV. **SOUTH MUSKOGEE FAULT.** (Secs. 6 and 7, T. 15 N., R. 21 E.)

The south Muskogee fault passes between the flat-lying Moorefield formation exposed in the road and the north-dipping Atoka sandstone in the pasture north of the fence. Stratigraphic displacement is about 400 to 500 feet.

31.0 Keokuk chert (Boone) in road side. Note white, brecciated appearance.



BOONE (REEDS SPRING) FORMATION: 14.0 feet present		MISSISSIPPIAN
Chert, tan to gray, thin bedded with lenses of gray, finely crystalline limestone	14.0	
CHATTANOOGA FORMATION: 38.0 feet		
Shale, black, iron-stained, fissile	36.0	
Sandstone, brown, conglomeratic (Sylamore)	0.6-2.0	
SALLISAW FORMATION: 1.0+ feet		Dev.
Sandstone, brown, calcareous, fine-grained	1.0	
ST. CLAIR FORMATION: 4.0 feet		Sil.
Limestone, blue-gray, nodular, cherty	4.0	
SYLVAN FORMATION: 36.0 feet		ORDOVICIAN
Shale, dark green, fissile, weathers yellow-green	36.0	
FERNVALE FORMATION: 18.0 feet		
Limestone, white to pink, coarsely crystalline, massive; <u>Lepidocyclus capax</u>	18.0	
FITE FORMATION: 7.0		
Limestone, gray, lithographic, birdseye	7.0	
TYNER FORMATION: 79.5 feet		
Dolomite, yellow-brown, weathers silty	12.0	
Sandstone, brown, fine to medium grained	1.5	
Shale, blue-green, fissile	66.0	
BURGEN FORMATION: 72.0 feet		
Sandstone, white to iron-stained, loosely cemented, surface case-hardened, occasional fucoidal marking	72.0	
COTTER FORMATION: 4.5 feet exposed		
Shale, yellow, fissile	0.5	
Dolomite, buff, dense, weathers silty	4.0	

III. Measured Section, Qualls Dome, Sec. 35, T. 15 N., R. 21 E.

33.0 *Turn right on graveled road.* Driving on Boone chert.

33.2 *Turn sharply to right (south)* Boone chert.

34.0 Contact of Boone chert and Moorefield formation in creek

34.3 *Curve and Hill. Ascending Rider Mountain.* Fayetteville black shale at base of hill, Atoka sandstone at top with poorly exposed Pitkin, Hale and Bloyd formations intervening.

35.0 Rider School House

35.2 Zeb filling station and grocery store

35.4 *Entering Camp Gruber Military Reservation.* Driving on Atoka sandstone for several miles.

40.8 Top of Bloyd shale. *Proceed slowly down hill,* noting Hale formation, Pitkin, and Upper Fayetteville.

41.6 Boone chert in hill to left side of road.

41.8 *Turn sharply to the left on graveled road*

42.3 STOP V. **QUALLS DOME.** (Sec. 35, T. 15 N., R. 21 E.)

Qualls Dome is a small, elongate, anticlinal uplift, faulted along the crest. Here the Burgen sandstone and Tyner shale (Ordovician) are brought into fault contact with Chattanooga shale and Boone chert (Mississippian). On the south wall of this eroded and faulted dome, the Cotter, Burgen, Tyner, Fite, Fernvale, Sylvan, St. Clair, Chattanooga, and Boone formations may be seen. (See figure 9 and measured section III.) *Enter cars and return to main road.*

42.9 *Turn left on main road leading south*

43.1 STOP VI. **SYLVAN SHALE AND OVERLYING ST. CLAIR.** (Sec. 2, T. 14 N., R. 21 E.)

The Sylvan Shale and overlying St. Clair faulted against the Boone chert. Here *Dicellograptus complanatus*, a guide fossil of upper Ordovician Sylvan shale, has been found. (See figure 10.) *Return to car and turn caravan around. Retrace route northward to Highway 62.*

51.9 *Turn left on Highway 62.* Boone chert

62.4 *Entering town of Fort Gibson.* Continue on Highway 62 through town.

63.0 Arkansas River alluvium. Note broad, flat expanse.

64.9 Junction of Highway 62 and 10. *Continue straight ahead.*

65.1 *Turn left on Highway 10.* Arkansas River Alluvium

66.9 Ascending to Arkansas River Terrace level with terrace gravels and wind-blown material resting on Atoka sandstone.

68.3 Bayou Manard

68.7 Atoka sandstone south side of road dipping 7° N 80° W

68.9 STOP VII. **ATOKA SANDSTONE** (Sec. 20 T. 15 N., R. 20 E.)

Atoka sandstone resting on Bloyd shale and limestone. Note 8 to 10 inch coal seam and thin underclay near base of Atoka. (This coal was formerly assigned to the top of the Bloyd by other workers.)

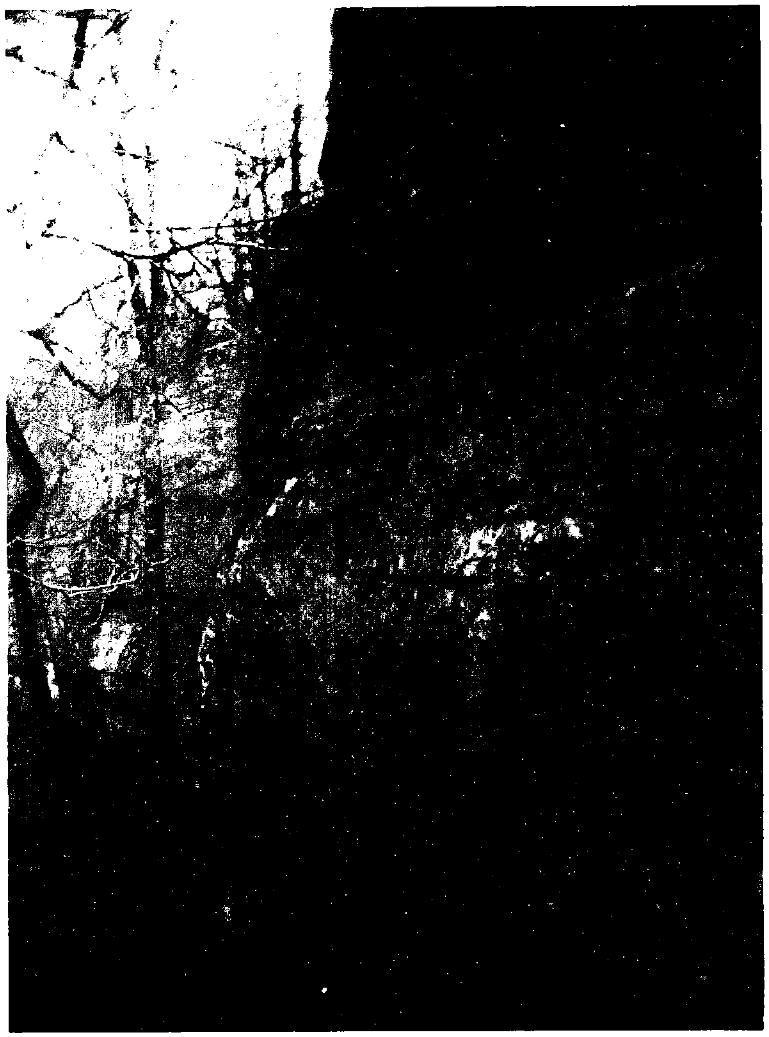


Figure 9. Tyner, Fite, and Fernvale formations, Qualls Dome, Sec. 35, T. 15 N., R. 21 E. (photo by Beckwith)

Figure 10. Sylvan shale and overlying St. Clair limestone faulted against the Boone chert, Sec. 2, T. 14 N., R. 21 E. (photo by Mondy and Siemens)

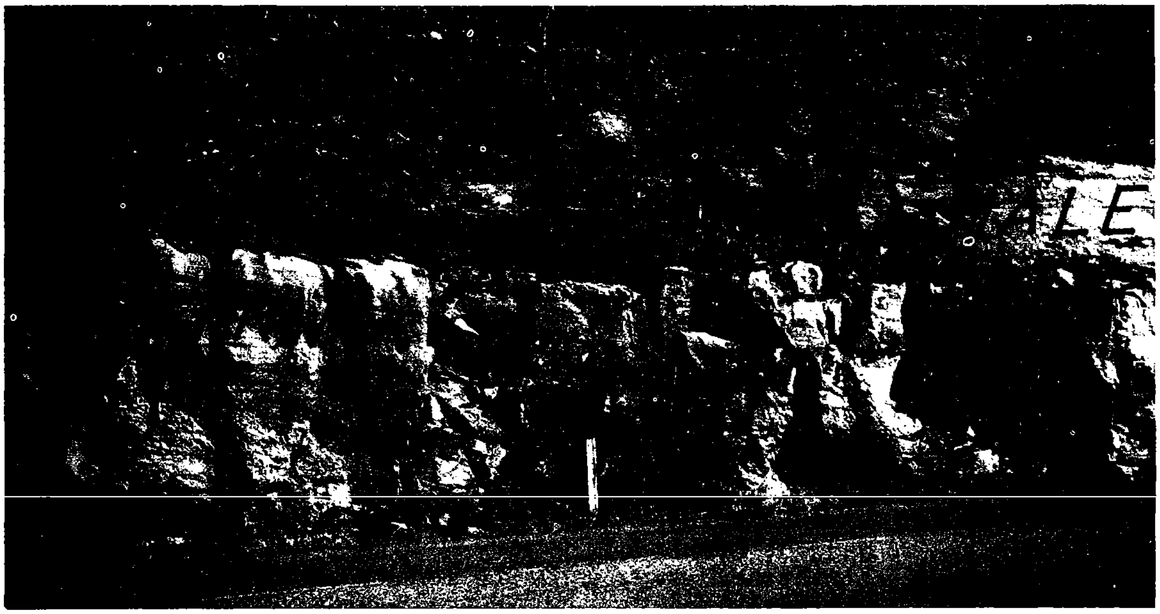


Figure 11. Pitkin-Hale contact, Braggs Mountain, Secs. 21-28, T. 15 N., R. 20 E.

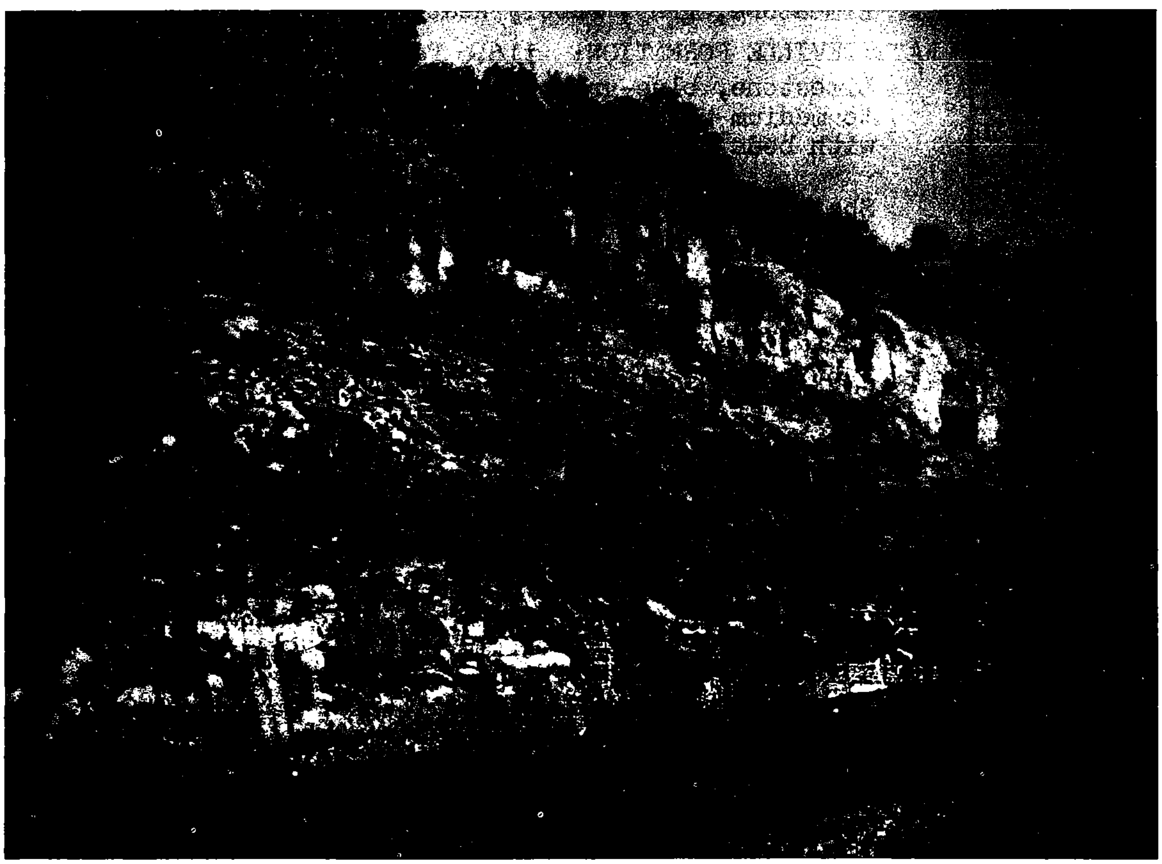
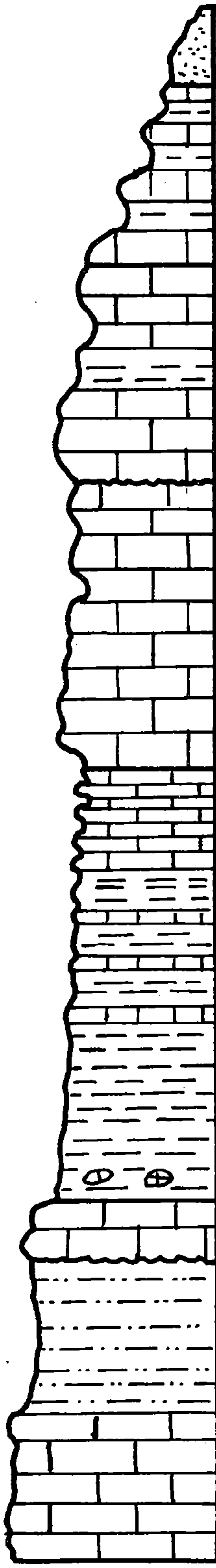


Figure 12. Typical upper Fayetteville in contact with overlying Pitkin limestone, Braggs Mountain, Secs. 21-28, T. 15 N., R. 20 E. (photo by Beckwith)



ATOKA FORMATION: 8.0 feet measured		PENNSYLVANIAN
Sandstone, tan to buff, fine-grained	8.0	
BLOYD FORMATION: 57.9 feet		
Alternating beds of blue-gray, fossiliferous limestone and gray, fissile shale Numerous <u>Pentremites</u>	57.9	
HALE FORMATION: 57.7 feet		
Limestone, gray-brown, coarse to medium crystalline, occasional shale beds	24.0	
Shale, gray, fissile, largely covered	10.0	
Limestone, brown, sandy, cross-bedded, weathers pitted, fluted; thin conglomerate at base	23.7	
PITKIN FORMATION: 59.6 feet		MISSISSIPPIAN
Limestone, blue-gray, coquinal, cross-bedded, crinoidal	11.0	
Limestone, gray, dense to medium crystalline	8.0	
Shale, gray, nodular	6.0	
Limestone, blue-gray, dense to medium crystalline, oolitic in part, few thin shale beds; fossiliferous	28.1	
Limestone, gray, rubbly weathering	6.5	
FAYETTEVILLE FORMATION: 116.6 feet		
Limestone, blue-gray to black, dense to medium crystalline, alternating with beds of black, fissile shale	22.4	
Shale, black, fissile with a few thin beds of black, dense limestone	36.1	
Shale, black, fissile with large septarian concretions in basal portion	58.1	
HINDSVILLE FORMATION: 5.0 feet		
Limestone, black, medium crystalline with <u>Agassizocrinus</u>	5.0	
MOOREFIELD FORMATION: 55 feet exposed		
Upper calcareous siltstone member:		
Siltstone, brown to black, weathers shaly, fissile and concretionary (Resembles Ruddell shale of Arkansas)	29.0	
Lower argillaceous limestone member:		
Limestone, black to gray, lithographic, weathers platy and shaly, abundant <u>Nudirostra carboniferum</u>, <u>Spirifer arkansanus</u>, <u>Moorefieldella</u> (North of Road)	26.0	

IV. Measured Section, Braggs Mountain, secs. 21 and 28, T. 15 N., R. 20 E.

69.3 *Slow.* You are crossing the South Muskogee fault with northwest dipping Bloyd formation on the north faulted against flat-lying Moorefield on the south and flooring large valley. Stratigraphic displacement about 350 feet.

70.2 STOP VIII. **BRAGGS MOUNTAIN SECTION.** (Secs. 21 and 28, T. 15 N., R. 20 E.)
At the base of the hill is 30 feet of brown to black, silty shale assigned to the upper Moorefield. This is succeeded by 4 feet of Hindsville limestone, then overlying Fayetteville, Pitkin, Hale, Bloyd, and Atoka formations. (See measured section IV and figures 11 and 12.)

76.7 Main entrance to Camp Gruber, now largely dismantled.

77.9 Town of Braggs, Oklahoma

81.9 Greenleaf Creek

82.2 STOP IX. **BLOYD LIMESTONE, SPILLWAY OF GREENLEAF LAKE.** (Sec. 10, T. 13 N., R. 20 E.)
This is a famous collecting locality for the blastoid, *Pentremites.* (15 minutes).

86.3 Atoka-Bloyd contact

87.4 Moorefield Formation, Cedar Creek locality, Sec. 36, T. 13 N., R. 20 E. This is an excellent locality for collecting the Moorefield fauna.

90.4 *Turn left, northeast corner of Gore, Oklahoma, to the Tenkiller Ferry Dam.*

96.2 Atoka sandstone, east roadside

96.5 Steeply dipping Atoka sandstone just south of the Linder Bend-Webber's Cove fault.

97.6 STOP X (A). **OBSERVATION POINT, TENKILLER FERRY DAM.** (Sec. 14, T. 13 N., R. 21 E.)
This structure is of the earthen fill type construction. The length is 3000 feet, height 190 feet. The Reservoir covers 20,800 acres with 1,230,000 acre feet of storage with 600,000 acre feet of flood control reservoir. Cost in excess of $25,000,000, two turbines with 34,000 KW capacity, 107,000,000 KWH per year.

97.8 Turn left onto Tenkiller Ferry Dam.

98.0 STOP X (B). **TENKILLER FERRY INTAKE STATION**
Examine the Atoka shales and sandstones. Note small normal fault in the Atoka(figures 13 and 14).

99.4 *Turn around east of the dam and retrace route across dam.*

101.9 *Turn right on graveled road.* Sharp turn.

103.8 *Turn right at the quarry. Quarry in Bloyd limestone*

104.3 STOP XI. **MOOREFIELD FORMATION LYING ON THIN SECTION OF CHATTANOOGA SHALE AND ST. CLAIR LIMESTONE.** (Sec. 10, T. 13 N., R. 21 E.)
The Boone formation is entirely missing in this area, having been truncated by erosion. Valley floored with St. Clair limestone succeeded by thin Chattanooga black shale and overlying Moorefield limestone.

106.0 *Turn left at Quarry in Bloyd formation*

108.9 Intersection with Tenkiller Ferry Road. *Continue straight ahead*

109.8 *Turn right on graveled road*

Figure 13. (Above) Black shales and thinly laminated sandstones, Atoka formation, Tenkiller Ferry Dam, Sec. 14, T. 13 N., R. 21 E.

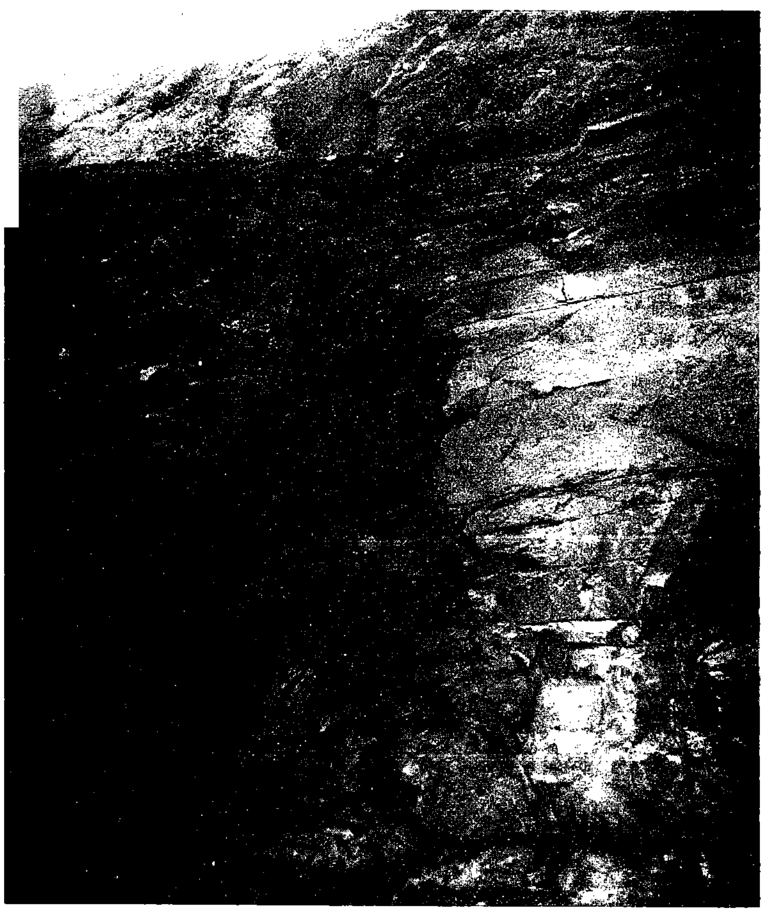


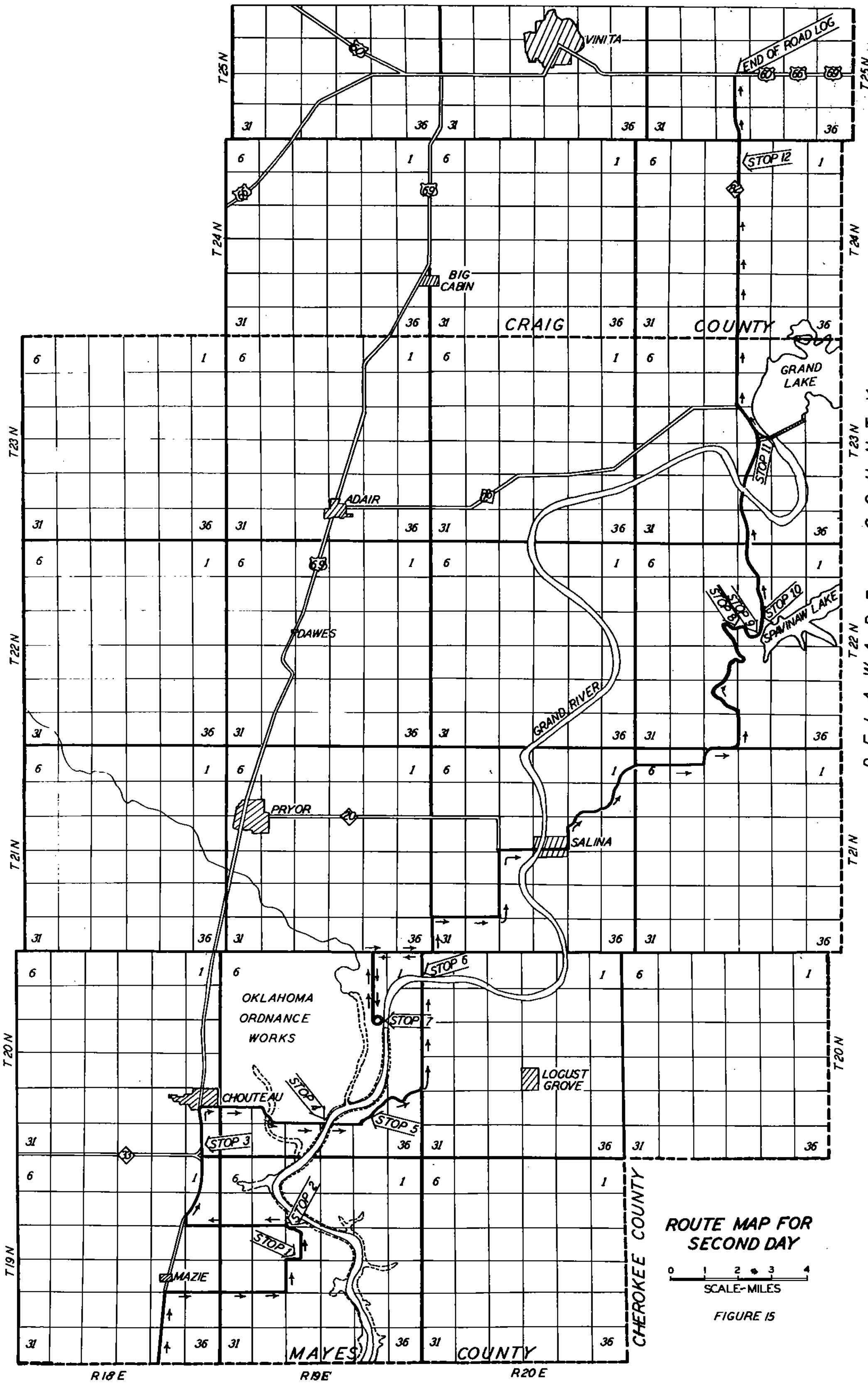
Figure 14. (Left) Small fault in the Atoka formation, Tenkiller Ferry Dam, Sec. 14, T. 13 N., R. 21 E.

110.3 *Turn right. Drive slowly.*

111.6 STOP XII. **ST. CLAIR LIMESTONE.** (Secs. 20-21, T. 13 N., R. 21 E.)

Here the St. Clair limestone is overlain by a few inches of Chattanooga and succeeding Moorefield. Boone chert absent. Return to Hotel Severs, Muskogee, Oklahoma. See route on map.

NOTES



ROUTE MAP FOR SECOND DAY

FIGURE 15

SECOND DAY OF FIELD CONFERENCE

April 25, 1953

Muskogee, Spavinaw, Pensacola Area

Driving Distance - 98.8 miles

Starting time - 7:30 A.M.

Leader - George G. Huffman

ROAD LOG FOR SECOND DAY

DIRECTIONS FOR ASSEMBLY: Drive south from Severs Hotel to Okmulgee Street (1½ blocks) (Highway 62), thence west on Highway 62 to the intersection of Highway 69, west side of town. Turn right (north) onto Highway 69 and assemble on east side of road.

0.0 Starting point - east side Highway 69 north of Jct. with 62

2.5 Leave Arkansas River terrace level to drive on alluvium of the Arkansas River Valley

3.5 Arkansas River

3.7 Terrace of the Arkansas River. Includes large amounts of wind-blown material.

5.7 Underpass M.K.T. railroad

7.1 Alluvium of the Verdigris River Valley

8.7 Vans Lake

9.1 Verdigris River

9.2 Terrace on Verdigris River

12.3 *Black shale and overlying sandstone of the Savanna formation*

14.8 Entering Wagoner, Oklahoma. Located on the Spaniard limestone

15.6 *Slow.* Missouri-Pacific overpass. *West of overpass in R.R. cut is an excellent exposure of the Spaniard limestone*

16.5 Overpass

17.4 Exposure of the Warner or Little Cabin sandstone

23.5 Mayes County line

25.5 *Turn right on graveled road* (east)

28.3 R.R. crossing

29.3 *Turn left* (north)

30.4 *Turn right* (east)

30.5 *Slow. Hill and sharp curve.* Here we cross the outcrops of the Atoka, Bloyd, Hale, and Fayetteville formations. Fayetteville is well exposed near base of hill.

Figure 16. Hale limestone in quarry, Sec. 36, T. 20 N., R. 18 E. Note distinctive weathering.

Figure 17. Heavy-bedded siltstone and overlying silty shale in the upper Moorefield just below the contact with overlying Hindsville limestone, west bank of Grand River north of Highway 33 bridge.

30.9 *Turn left* (north)

31.3 STOP I. **UNION MISSION** . (Sec. 16, T. 19 N., R. 19 E.)

This stop is of historic and geological interest. The marker on the east side of the road is the site of Union Mission, one of the early missions of Oklahoma. Here the first printing press in Oklahoma was established. On the west side of the road is the grave of Reverend Chapman, the first Missionary to the Osages.

In the first railroad cut west of Union Mission, is an excellent exposure of the upper Boone (Keokuk) chert. This is overlain unconformably by the Moorefield formation and various members of the Moorefield can be seen to overlap the chert knob. This behavior is typical of Boone-Moorefield relations in Mayes County and is indicative of the great unconformity which separates the "Mayes" from the "Boone."

The second railroad cut reveals a complete section of Fayetteville while succeeding cuts expose the Hale, Bloyd, and Atoka formations.

31.6 *Turn left on curving road*

32.1 Keokuk (Boone) chert in road cut

32.3 Keokuk chert in second road cut

32.4 Approximate contact with Moorefield formation

32.5 *Turn left* (west)

32.6 STOP II. **HINDSVILLE LIMESTONE.** (Secs. 9 and 16, T. 19 N., R. 19 E.)

Here the upper formation of the "Mayes" is exposed in contact with the underlying siltstones of the Moorefield and overlain by the Fayetteville. The Hindsville limestone is the zone of a small crinoid, *Agassizocrinus* which is considered a valid guide fossil of lower Chester age.

32.9 North side of hill has a fair exposure of upper Fayetteville black shale overlain by a thin section of Hale and Atoka.

35.5 *Turn right* (north)

35.7 **CAUTION.** *Enter Highway 69. Turn right.*

36.9 Cat Creek floored by Hale limestone

37.2 Bloyd shale overlain by Atoka sandstone, west side of road

37.5 Atoka sandstone in road cut

37.7 Junction with Highway 33 from west. Morrow limestone exposed at intersection.

38.0 STOP III. **HALE LIMESTONE.** (Sec. 36, T. 20 N., R. 18 E.)

Note characteristic fluted and pitted weathering of the Hale surface in the quarry. Thin Atoka sandstone overlies Hale at this point. (figure 16).

39.5 *Entering Chouteau. Turn right on Highway 33.* Surface rock for next two miles is the Atoka sandstone.

41.8 Chouteau Creek. Creek is floored by fossiliferous Fayetteville limestone and shale.

43.3 Terrace gravels on the left.

43.4 *Turn right into fishing camp*

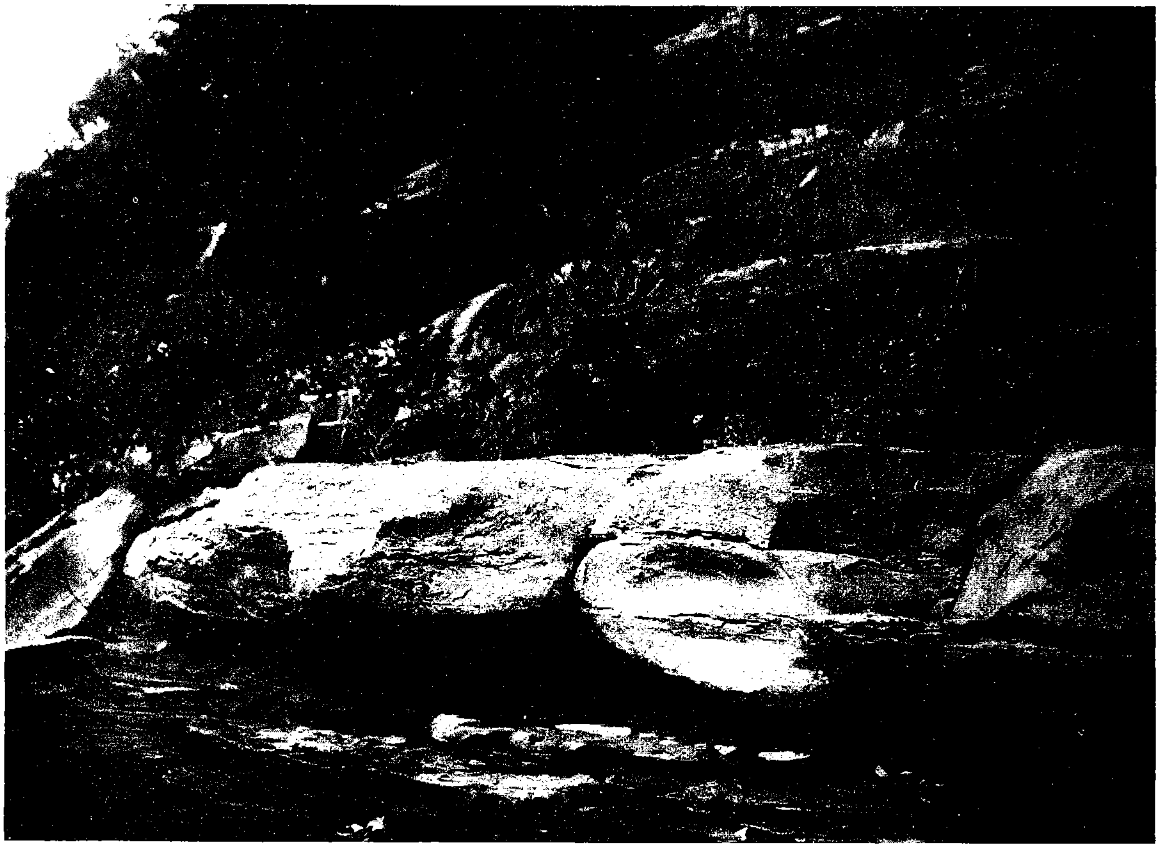


Figure 18. Upper calcareous siltstone member of the Moorefield formation, west side of Grand River north of Highway 33 bridge. Note concretionary weathering of lower ledges.

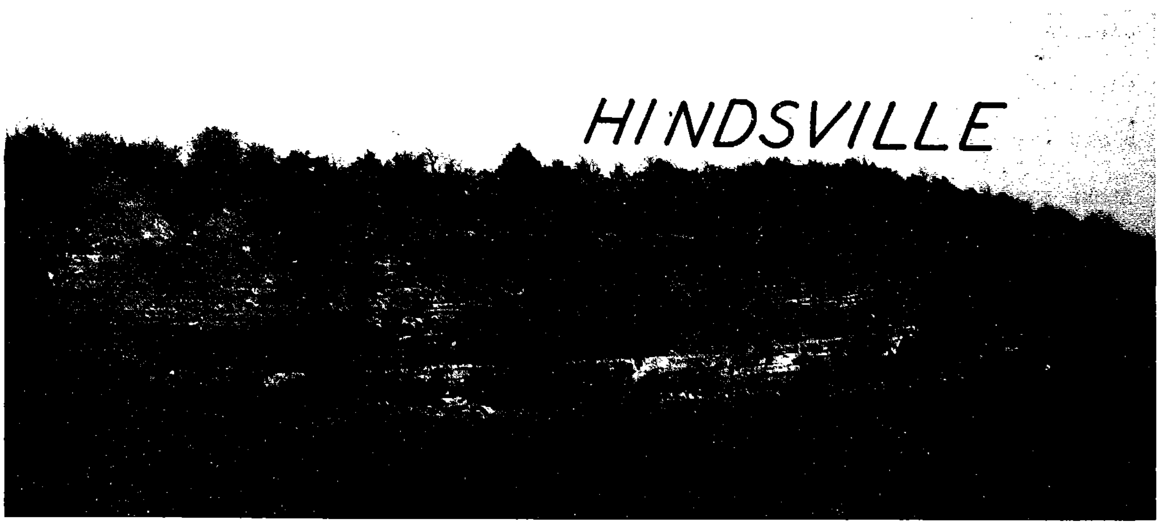
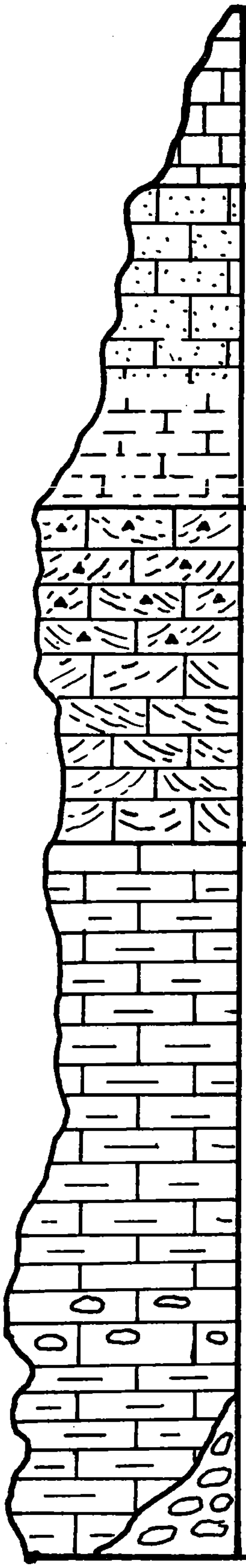


Figure 19. Moorefield formation lying unconformably on the Keokuk chert, north side of Grand River, Sec. 6, T. 20 N., R. 20 E. Note the large scale cross-bedding in the middle portion of the Moorefield.



HINDSVILLE FORMATION: 15.0 feet

Limestone, gray, coarsely crystalline, with abundant Diaphragmus, Agassizocrinus; caps small hill top — 15.0

MOOREFIELD FORMATION: 98.9 feet

Upper Siltstone Member:

Siltstone, yellow-brown, sandy weathering, heavy ledges separated by covered intervals — 16.5

Cover with thin beds of yellow-brown, calcareous siltstone, abundant small Nudirostra carboniferum — 7.3

Middle Calcarenite Member:

Limestone, gray, medium crystalline, heavy bedded, with finely disseminated chert fragments; forms prominent cliff — 13.5

Limestone, fine to medium crystalline, weathers thin bedded in upper portions, exhibits large scale cross-bedding when viewed from a distance — 11.0

Lower Argillaceous Member:

Limestone, gray, dense, in 2 - 3 inch beds separated by thin shaly weathering beds — 17.3

Limestone, gray, argillaceous, weathers to thin, platy shale alternating with thin, resistant limestone layers, surface covered with platy rubble — 16.5

Limestone, gray-blue, dense, heavy bedded, abundant black nodular chert — 5.5

Limestone, dark gray, dense, in heavy beds separated by bands of black, nodular chert; shaly in upper portions — 3.6

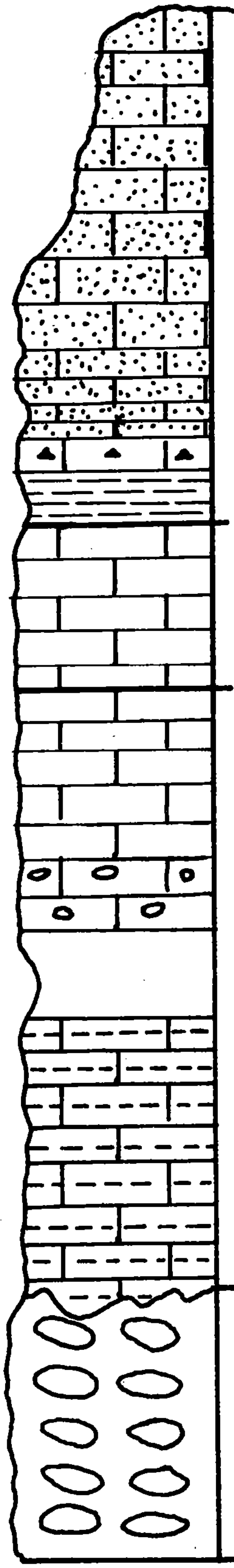
Limestone, gray, dense, weathers shaly; Griffithides pustulosus common — 4.7

Cover to water level — 3.0

Keokuk chert knob 100 yards to east

MISSISSIPPIAN

V. Measured Section east of the Lindsey Bridge, Sec. 6, T. 20 N., R. 20 E.



MOOREFIELD FORMATION: 50.1 feet

Upper calcareous siltstone member:

Siltstone, blue-gray, calcareous, weathers yellow and into thin, platy layers. Abundant *Nudirostra* (formerly *Leiorhynchus*) *carboniferum*	15.0
Partially covered with ledges of gray-blue, calcareous siltstone	5.0
Limestone, dense to coarsely crystalline with rounded chert fragments	1.4
Shale, gray, silty, calcareous	2.0

Middle Calcarenite member:

Limestone, gray, medium crystalline; in two heavy ledges separated by thin shale break; welded to underlying unit	6.6

Lower dense, argillaceous member:

Limestone, light gray, lithographic, in 4 - 10 inch layers separated by thin shale breaks; upper 4 inches with splotches of gray, medium crystalline limestone (worm burrows?)	3.5
Limestone, gray, hard, heavy bedded with abundant black, vitreous, nodular chert, forms quarry floor, west end of dam	2.1
Covered (section moves south 50 yards)	3.0
Limestone, gray-brown, dense, weathers nodular to platy, heavy beds separated by thin shale breaks; *Spirifer arkansanus*, *Griffithides pustulosus*,; rests with unconformity on Keokuk chert	11.5

KEOKUK FORMATION: 9.0+ feet

Chert, white, fractured, massive; in matrix of gray, finely crystalline limestone	9.0

MISSISSIPPIAN

VI. Composite Section, West End of Low-water Dam, Sec. 14, T. 20 N., R. 19 E.

43.5 STOP IV. **HINDSVILLE LIMESTONE AND OVERLYING TERRACE GRAVELS.** (Sec. 34, T. 20 N., R. 19 E.)

Here the Hindsville with the *Agassizocrinus* zone at the base is resting on the upper siltstone beds of the Moorefield. The contact is now under water from the Fort Gibson Dam.

43.7 *Return to Highway 33, turn right across Grand River.* Note heavy siltstone ledges of the upper Moorefield on west side of river north of bridge. (figures 17 and 18).

45.2 STOP V. **MOOREFIELD ONLAPPING KEOKUK KNOB IN CREEK** (Sec. 26, T. 20 N., R. 19 E.)

Here the middle Moorefield with the chert fragment-bearing limestone rests on the Keokuk. Upper Moorefield siltstone member well developed along creek bank. Note heavy, yellow-weathering upper beds which resemble Sycamore lithology. Overlying Hindsville limestone exposed on hill to east. Northward along Grand River, lower Moorefield argillaceous member intervenes between Keokuk chert and the beds seen here.

45.9 Contact Fayetteville and Hindsville formations

46.0 **CAUTION.** *Sharp curve.* On the left is the Grand View Cabin Site area. The hill north of the road has a complete section of Fayetteville limestone and shale, Hale sandstone and limestone, and a thin capping of Atoka.

47.2 *Turn left.* Driving on Boone chert surface

48.0 Terrace gravels in pit, west side of road

48.3 Junction with Locust Grove Road. *Continue straight ahead.* Note Boone chert knobs projecting through the terrace gravels.

50.3 Contact of terrace deposit with alluvium of the Grand River Valley. Moorefield limestone is exposed at the base of the terrace.

50.5 STOP VI. **GRAND RIVER, LINDSEY-MAYES BRIDGE SECTION** (Sec. 6, T. 20 N., R. 20 E.)

Looking across the river from the south end of the bridge, one can see various members of the Moorefield formation draped across the knobs of keokuk chert. At the north end of the bridge, the contact of the Keokuk and Moorefield can be seen. By walking eastward across the brow of the hill, successive members of the Moorefield and the overlying Hindsville may be observed. (See figure 19 and measured section V.)

51.1 Contact of upper Moorefield siltstone member and the overlying Hindsville limestone

51.3 *Turn left.* Driving across Hindsville limestone

52.3 Terrace Gravels of the upper level

52.9 *Turn left into Oklahoma Ordnance Area.* Note extensive terrace deposits to the right where gravels have been quarried.

53.8 Hindsville limestone

54.3 Upper Moorefield

54.9 Keokuk chert knob projecting through Moorefield

55.1 STOP VII. **LOW WATER DAM SECTION.** (Sec. 14, T. 20 N., R. 19 E.)

Here the subdivisions of the Moorefield formation and their relations to the Keokuk chert may be seen. Note the black, nodular chert in the Moorefield as opposed to the white, fractured chert of the Keokuk. Note also that the Moorefield contains pebbles of rounded Keokuk-type chert in middle portions. (Figures 20 and 21 show sharp contact of Moorefield and Keokuk in abandoned railroad cut in Sec. 11, T. 20 N., R. 19 E. just north of Stop VII.) *Return to car and retrace route.*

Figure 20. Contact of the middle calcarenite member of the Moorefield formation with the underlying lithographic limestone member. Note splotches of coarsely crystalline limestone in the upper portion of the lithographic phase. Low Water Dam, Sec. 14, T. 20 N., R. 19 E.

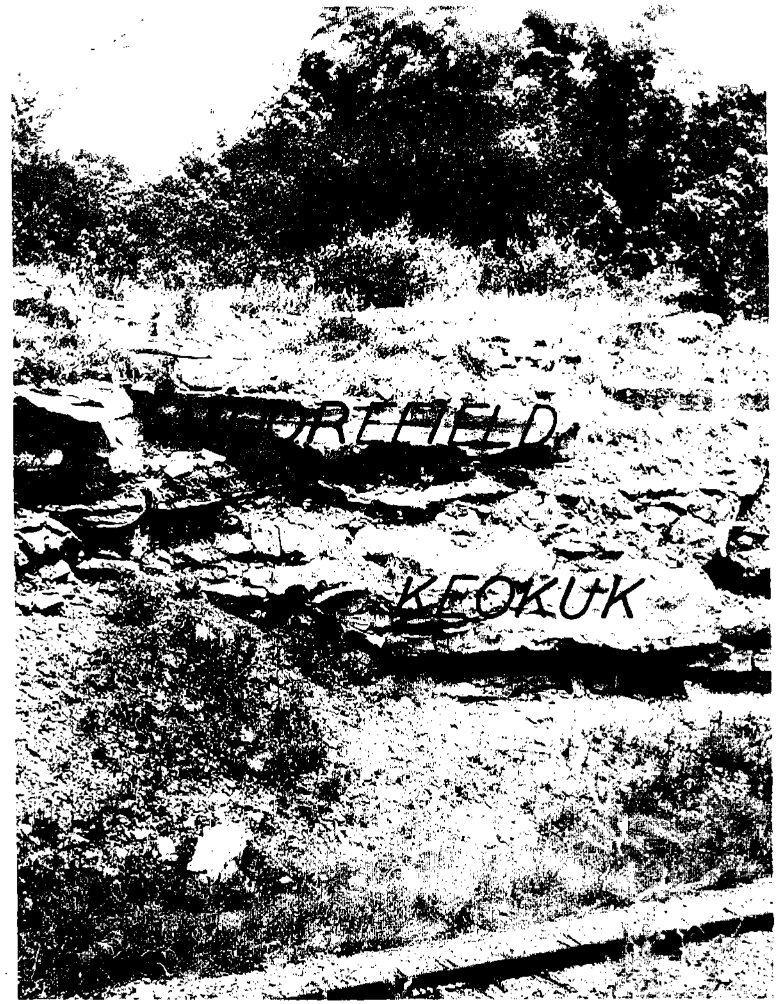


Figure 21. Unconformable contact of the Moorefield limestone and the underlying Keokuk chert. Railroad cut, Pryor Ordnance Plant, Sec. 11, T. 20 N., R. 19 E.

57.3 *Turn right at Ordnance Plant gate*

59.2 *Sharp turn to left*

60.0 Outlier of Fayetteville shale and limestone capped by Hale limestone and thin Atoka sandstone.

60.2 *Sharp turn to right*

61.2 Moorefield formation at intersection

61.5 Keokuk chert

62.1 Moorefield formation with black, nodular chert preserved in shallow syncline

62.3 *Sharp left turn.* Driving on Boone chert covered with occasional patches of Moorefield

64.4 *Turn right.* Leaving Boone chert to travel on terrace gravels of Grand River

64.8 Alluvium of the Grand River Valley

65.6 Grand River

65.9 *Entering Salina*

66.7 *Turn left,* follow black-topped road

66.8 Terrace deposits

67.6 Reeds Spring chert along north roadside. For next several miles we will be driving on the Boone chert surface with Keokuk chert on higher areas and Reeds Spring bedded chert and limestone in valleys. The Keokuk weathers reddish in this area, giving rise to a thick, red residium. **DANGER.** *Curving road for several miles.*

78.6 **DANGER,** *Slow. Sharp curve.* Spavinaw Lake can be seen in distance.

79.0 Chattanooga black shale

79.2 STOP VIII. **COTTER DOLOMITE WITH THIN STRINGERS OF SANDSTONE.** (Sec. 16, T. 22 N., R. 21 E.) Overlain by Chattanooga black shale. (See measured section VII)

79.4 Spavinaw Creek

79.7 STOP IX. **SPAVINAW GRANITE.** (Sec. 15, T. 22 N., R. 21 E.) Core of anticlinal uplift

80.2 STOP X. **SPAVINAW DAM AND LAKE.** (Sec. 15, T. 22 N., R. 21 E.)

This is the water supply for the City of Tulsa. South end of dam is against the Chattanooga black shale with overlying St. Joe and Reeds Spring limestone and chert forming cliff.

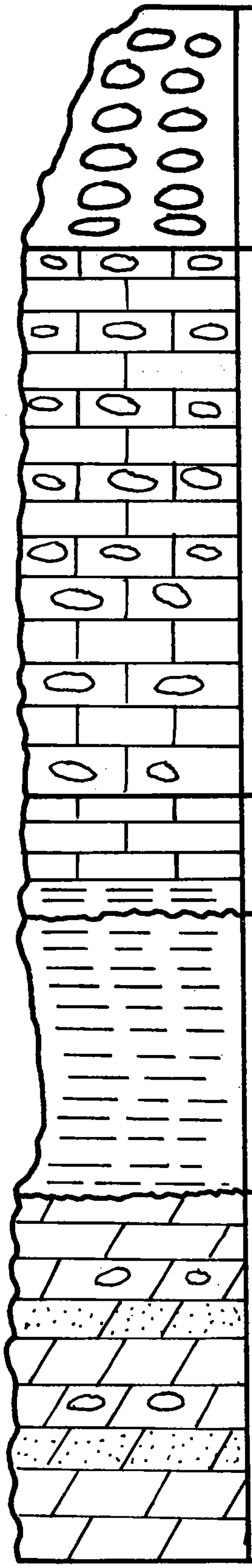
80.5 *Entering Spavinaw, Oklahoma*

80.9 Chattanooga black shale, east side of road

81.2 Chattanooga black shale

81.8 Shaly, basal Hindsville formation.

81.9 *Turn left on Highway 82.* Boone chert (Keokuk)



BOONE FORMATION:

Keokuk member: 64.0 feet

Chert, white, massive, jointed and fractured, weathers yellowish to reddish-brown, tripolitic; fossils common as molds and casts — 64.0

Reeds Spring Member: 132.0 feet

Limestone, gray, hard, thin to medium bedded, alternating with 3 - 4 inch beds of tan to blue-gray chert — 132.0

St. Joe Member: 25.3 feet

Limestone, light gray, dense, crinoidal, weathers nodular — 24.0

Shale, green, calcareous — 1.3

MISSISSIPPIAN

CHATTANOOGA FORMATION: 65.3 feet

Shale, black, platy to fissile, pyritic, jointed into rectangular blocks; cone-in-cone structure common; weathers iron stained — 65.3

DEV. - MISS.

COTTER FORMATION: 85.0 feet

Dolomite, white to buff, finely crystalline, medium to heavy bedded, some layers distinctly sandy, others contain nodular chert — 85.0

Base of exposure at water level

ORDOVICIAN

VII. Measured Section south of Spavinaw Creek Bridge, Sec. 16, T. 22 N., R. 21 E.

84.8 Grand River

85.0 Terrace Gravels on right.

86.5 *Entering Langley.* Turn right at intersection

86.9 **STOP XI. PENSACOLA DAM AND LAKE OF THE CHEROKEES** (Grand Lake). (Secs. 14 and 15 T 23 N., R. 21 E.)

This dam, the largest of its type in the world, is built on the Boone chert. Good exposure at west end of dam. Total cost of dam $27,000,000, six turbines, yearly output 180,000,000 KWH. Seneca fault is just south of the main dam and cuts the east spillway at Disney.

87.0 *Turn right* onto highway. Boone chert.

87.5 **STOP SIGN.** *Turn right on Highway 82.* Boone chert

88.3 Junction of Highway 28 and 82. *Continue north on 82.*

90.4 Craig County line

90.7 Kansas-Oklahoma-Gulf Railroad Crossing

91.5 Junction with Highway 85. *Continue north on 82.*

91.9 Boone chert, deeply weathered

93.3 Crest of Horse Creek anticline. *Note small fault in roadcut at crest of fold.* (figure 22)

95.1 White Oak Creek fault. Boone chert on south faulted against Atoka sandstone on north

95.3 Atoka sandstone in road cut

95.4 Fayetteville shale with heavy limestone bed at top

95.8 **STOP XII. CHANNEL SANDSTONES IN THE ATOKA FORMATION RESTING UNCONFORMABLY ON THE FAYETTEVILLE SHALE.** (Secs. 3 and 4; T. 24 N.; R. 21 E.)

This is perhaps the northernmost exposure of the Atoka which is truncated northward by the overlap of the Warner or Little Cabin sandstone (figure 23).

96.0 Hindsville limestone flooring area.

97.3 Locust Creek flowing on Hindsville limestone

97.8 Fayetteville shale on east side of road. *Archimedes*

97.9 Atoka sandstone in road cut

98.3 Fayetteville shale and overlying heavy bedded limestone

98.5 Hindsville limestone flooring entire valley. Fayetteville shales forming cuestas above Hindsville level.

98.8 Junction of Highway 82 with Highways 60, 66, and 69. Field party is dismissed at this point. *Turn west for Tulsa and Oklahoma City.*

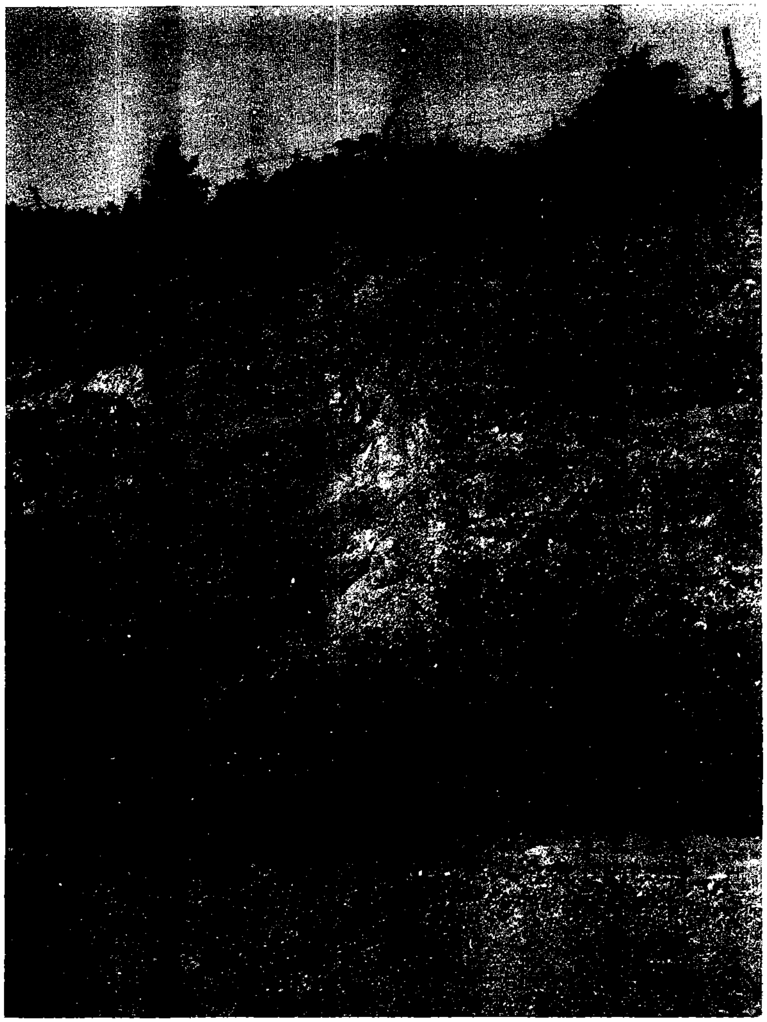


Figure 22. Small fault along the crest of the Horse Creek anticline, Sec. 21, T. 24 N., R. 21 E.

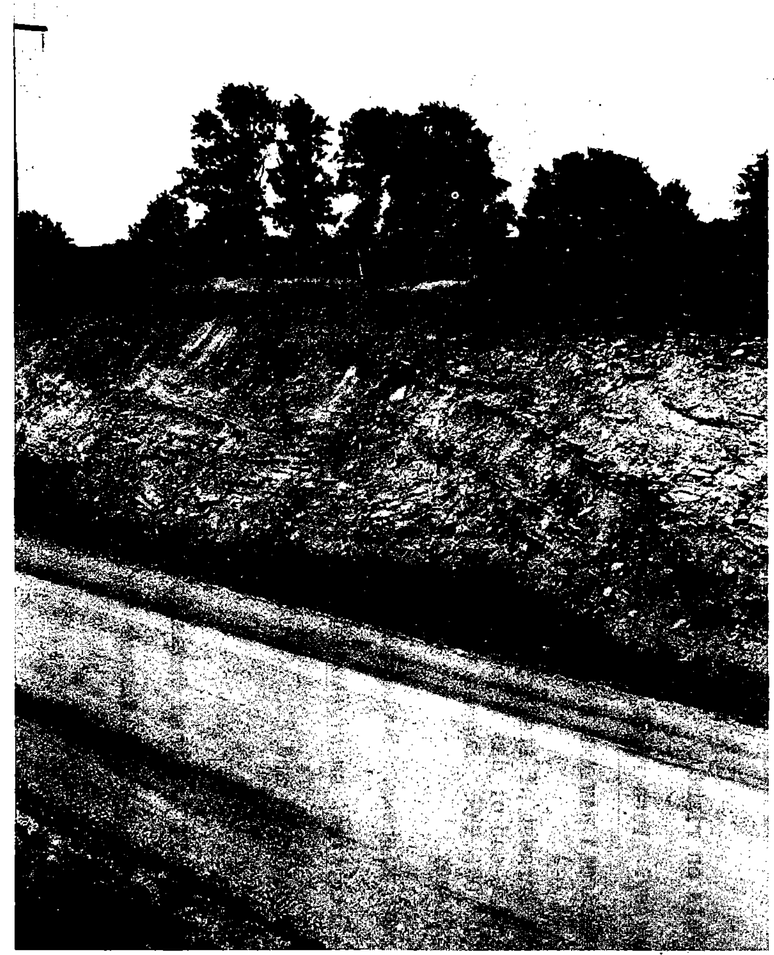


Figure 23. Channel sandstones in the Atoka formation resting unconformably on the Fayetteville shale, Sec. 3, T. 24 N., R. 21 E.

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TENTATIVE CORRELATION OF MISSISSIPPIAN AND LOWER PENNSYLVANIAN OF OKLAHOMA

SYSTEM	SERIES	EAST ARDMORE BASIN	WEST ARDMORE BASIN	ANADARKO BASIN	McALESTER BASIN	N.E. OKLA. N.W. ARK.
PENNSYLVANIAN	MORROWAN	LOWER DORNICK HILLS: Otterville Ls., Wapanucka Sh., Jolliff Ls., Primrose	LOWER DORNICK HILLS: Otterville Ls, Wapanucka Sh, Jolliff Ls, Primrose	LOWER DORNICK HILLS: Unnamed Ls ("Morrow ls."), Primrose	WAPANUCKA: Wapanucka Ls, Wapanucka Sh; Union Valley Ls, Primrose	BLOYD: Kessler, Brentwood; UPPER HALE: Prairie Grove
PENNSYLVANIAN OR MISSISSIPPIAN	SPRINGERAN	SPRINGER: Lake Ardmore Sd, Overbrook Sd, Rod Club Sd; ?: Grindstone Sd?	SPRINGER: Markham Sd, Aldridge Sd, Humphrey Sd, Velma Sd ([illegible] sd), Goodwin Sd	SPRINGER: Woods Sd, Henderson Sd, Cunningham Sd, Britt Sd, Spiro Sd, Boatwright Sd	SPRINGER: Cromwell Sd, Springer Sd?, Phosphatic Bed	LOWER HALE: Cane Hill?
MISSISSIPPIAN	CHESTERAN	GODDARD: Goddard Sh, Red Oak Hollow Sd; CANEY	GODDARD: Goddard Sh, Unnamed Thin Sd; CANEY	GODDARD; CHESTER; CANEY	GODDARD?: Goddard Sh?; CANEY	PITKIN; FAYETTEVILLE: Wedington, Hindsville
MISSISSIPPIAN	MERAMECIAN	SYCAMORE	SYCAMORE	SYCAMORE; MISSISSIPPIAN LIME	ADA-MAYES	[illegible]; MOOREFIELD; (Spring Creek)
MISSISSIPPIAN	OSAGIAN	WELDEN	WELDEN	WELDEN; MISSISSIPPIAN LIME	WELDEN	KEOKUK, REEDSPRING, ST. JOE
MISSISSIPPIAN	KINDERHOOKIAN	WOODFORD SHALE	WOODFORD SHALE	WOODFORD SHALE	WOODFORD SHALE	CHATTANOOGA SHALE

Source
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Tulsa, Oklahoma
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