OKLAHOMA GEOLOGICAL SURVEY

GUIDE BOOK II

FIELD CONFERENCE

ON DESMOINESIAN ROCKS

of

NORTHEASTERN OKLAHOMA

by

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Sponsored by

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The following students of the School of Geology, University of Oklahoma, have mapped and studied parts of the area to be seen on this field trip.

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Others who have contributed substantially to the current work in the area are:

Hugh D. Miser . . . . . .United States Geological Survey
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John H. Warren. . . . . Oklahoma Geological Survey
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GEOLOGY OF THE ROCKS OF DESMOINESIAN AGE IN WESTERN OTTAWA, CRAIG, NOWATA, ROGERS, WESTERN MAYES, AND WAGONER COUNTIES, OKLAHOMA

by Carl C. Branson

During Desmoinesian time, northeastern Oklahoma was at most times a stable shelf upon which thin stratigraphic units with widespread distribution accumulated, and which was the site of fairly well developed cyclical sedimentation. On the south edge of the shelf lay the McAlester Basin, a basin of geosynclinal nature, which received more and more sediment as weight accumulated and the bottom sank in response to the load. The area of the basin was actually under shallower water than was the shelf, and there were longer and more extensive times of emergence. For the Desmoinesian section as a whole, the margin of the basinal sediments against the shelf sediments was more or less along the line of the Arkansas River. During Savanna time, shelf sediments were laid down as far south as Warner, and during a large part of upper Boggy and early Senora time, basinal sediments were deposited as far north as southern Craig County.

The ideal cyclical sequence, the cyclothem, consists of ten units

dark shale, thin limestone beds	marine fauna
limestone	fusulinids
limestone	brachiopods and bryozoans
calcareous shale	molluscan fauna
cap rock, limestone, clay-ironstone, or black fissile shale	phosphatic fossils
coal	
underclay	rootlets
underlime, nodular, pisolitic	fresh water mollusks
silty shale, micaceous sandstone, shale	plant remains
sandstone, conglomerate	
disconformity	

No geologist has ever seen an ideal cyclothem, but the pattern is approached by many sequences. Cyclothems are fairly well developed in northeastern Oklahoma, particularly in the lower part of the Des Moines series, but none is close to the ideal section. The normal type of cyclothem in northeastern Oklahoma is:

shale, clay-ironstone concretions
limestone, or clay-ironstone, the limestone fusulinid-bearing
coal
underclay
micaceous silty shale
sandstone

Only one underlime is known, and there are few instances of typical development of the marine upper portion of the cyclothem.

The stratigraphic nomenclature of the rocks of the shelf area is in need of much clarification. The Oklahoma Geological Survey has made some modifications:

1) the term "Cherokee" is dropped from formal nomenclature
2) the Des Moines series is divided into three groups, in ascending order, Krebs, Cabaniss, Marmaton

3) the formation names of the McAlester Basin are extended throughout northeastern Oklahoma excepting for the Marmaton rocks

4) the base of the Boggy formation is drawn at the base of the Bluejacket sandstone

5) the base of the Savanna formation is defined as the base of the Spaniard limestone

A conference was held in Nevada, Missouri, in 1953 and representatives of the geological surveys of Missouri, Oklahoma, Nebraska, and Kansas, reached an agreement on many nomenclatorial problems:

1) in the shelf areas, mapping units are defined as the rocks from the top of one coal bed to the top of the next coal bed. These were proposed as formations, but the Oklahoma Geological Survey refers to these units as coal cycles.

2) the name Croweburg is adopted for the coal which in Oklahoma is called the Broken Arrow

3) the name Verdigris is adopted in preference to the older, but less precise name Ardmore

4) names were adopted or selected for several coal beds and for the coal cycle in which they occur

5) it was agreed that shales, minor sandstones, and limestone beds of little regional significance would not be named

6) names for time units (substages) were adopted

As a result of these agreements and other work, the present conception of the stratigraphic column in northeastern Oklahoma is:

Holdenville shale

Lenapah limestone (consisting of Sni Mills ls., Perry Farm shale, Norfleet limestone, members)

Marmaton group

Nowata shale (with Walter Johnson sandstone member)

Altamont limestone (consisting of Worland ls., Lake Neosho sh., Amoret ls.)

Bandera shale (with Bandera Quarry sandstone)

Pawnee limestone (consisting of Coal City ls., Mine Creek sh., Myrick Station ls., Anna sh., unnamed ls.)

Labette shale (with Lexington coal, Wimer School ls., "Peru sand")

Fort Scott limestone (consisting of Higginsville ls., shale, Blackjack Creek ls.)

Excello shale

Breezy Hill limestone

Kinnison shale

Iron Post coal

Lagonda member (with "Prue sand", Bevier coal, Wheeler coal)

Verdigris limestone

unnamed shale

Croweburg coal

Cabaniss group

McNabb limestone

shale (with Sequoyah coal)

Fleming coal (with cap rock, underclay, shale)

?Robinson Branch coal (with cap rock, underclay, shale)

Russell Creek limestone

Mineral coal

Chelsea sandstone

Tiawah limestone

Tebo coal

underclay, shale, sandstone

shale (with thin coal)

Upper Taft sandstone

Weir-Pittsburg coal

Middle Taft sandstone

Lower Taft sandstone

shale

"Inola No 1" limestone

coal, underclay, shale

"Inola No. 2" clay-ironstone, coal, underclay

"Inola No. 3" clay-ironstone, underclay, shale

Inola limestone

coal

underclay, shale, sandstone

Bluejacket sandstone

coal

shale

Krebs group

Doneley limestone

Rowe coal

unnamed shale

Sam Creek limestone

unnamed shale

Spaniard limestone

coal

unnamed underclay, shale, sandstone

shale

coal

underclay, shale

dark shale, clay-ironstone concretions, 2 coals

Warner sandstone
Riverton coal
shale

"Elm Creek limestone"

shale

Taonurus siltstone
coal
underclay, shale, sandstone, conglomerate

The rocks of the Krebs and Cabaniss groups, as now understood, contain the following coal cycles with the members indicated.

	Excello shale (not in a coal cycle)
Mulky coal cycle	Mulky coal and underclay (lacking in Oklahoma) Breezy Hill limestone, fusulinids Kinnison shale, limestone cap rock at base
Lagonda coal cycle	Iron Post coal (Fort Scott coal of authors) Upper Lagonda sandstone Lagonda shale Lagonda sandstone
Bevier coal cycle	thin and recognized at few places in Oklahoma
Verdigris coal cycle	Wheeler coal, thin, few exposures Verdigris limestone, fusulinids Verdigris black shale shale, sandstone
Croweburg coal cycle	Croweburg coal (Broken Arrow coal of Oklahoma) underclay McNabb limestone (an underlime?) shale
unnamed coal cycle	Sequoyah coal shale, sandstone limestone or clay-ironstone, fusulinids
Fleming coal cycle	Fleming coal underclay shale limestone or clay-ironstone
Robinson Branch coal cycle	Robinson Branch coal (not known in Oklahoma) shale, sandstone Russell Creek limestone, fusulinids
Mineral coal cycle	Mineral coal underclay, shale
Scammon coal cycle	Scammon coal (not recognized in Oklahoma) Chelsea sandstone shale Tiawah limestone, fusulinids Tiawah black shale
Tebo coal cycle	Tebo coal shale Upper Taft sandstone black shale
unnamed coal cycle	unnamed coal shale sandstone shale, thin black shale at base

Cabaniss
~~KREBS GROUP~~
Senora formation

Krebs GROUP	Boggy formation	Weir coal cycle	Weir-Pittsburg coal underclay shale Middle Taft sandstone shale Lower Taft sandstone shale Seville limestone (Inola No. 1 limestone)
		unnamed coal cycle	coal, underclay, shale clay-ironstone, fossiliferous
		unnamed coal cycle	coal, underclay, shale clay-ironstone, fossiliferous
		Inola coal cycle	underclay, shale (coal not found) Inola limestone, fusulinids
		Bluejacket coal cycle	Bluejacket coal underclay, coal, sandstone Bluejacket sandstone limestone cap rock (one occurrence known)
	Savanna formation	Drywood coal cycle	Drywood coal underclay, shale, sandstone shale Doneley limestone
		Rowe coal cycle	Rowe coal underclay, shale Sam Creek limestone, fusulinids shale Spaniard limestone, fusulinids
	McAlester formation	unnamed coal cycle	coal, underclay, shale, sandstone, shale
		unnamed coal cycle	coal, underclay, shale
		unnamed coal cycle	coal, underclay, shale
		Warner coal cycle	Neutral (?) coal underclay, siltstone, shale Warner sandstone black shale
	Hartshorne fm.	Riverton coal cycle	Riverton coal underclay, shale "Elm Creek" limestone shale siltstone
		unnamed coal cycle	coal underclay, shale sandstone, conglomerate

The section given above indicates the presence in the Krebs and Cabaniss groups of the platform of 25 coal cycles. All but one or two are definitely recognized and differentiated, but many can never be mapped on surface because they are thin and are rarely exposed. Sixteen of these cycles are recognized in Kansas and Missouri.

Some of the limestones are persistent on surface and make good marker beds in subsurface. The best of these are the Lenapah limestone (of use locally), the Verdigris limestone, the Tiawah limestone, the Inola limestone, and the Spaniard limestone. The Altamont and Pawnee limestones can be used if the pinching out to the south of the Bandera shale is taken into consideration. The two Fort Scott limestones are logged in subsurface with the Breezy Hill limestone. The top of this limestone group is not a good contour datum because the upper member pinches out southward. The sandstones are of erratic behavior and are useful as structural datums only for lack of something better. Herbert Ware is just completing a study of the rocks of the Cabaniss group on surface and in subsurface, and the above expresses his findings. A correlation of the surface and subsurface units is shown in the table, and both columns are compared with that of the McAlester Basin.

CORRELATION OF STRATIGRAPHIC UNITS OF THE DES MOINES SERIES OF NORTHEASTERN OKLAHOMA

		PLATFORM		McALESTER BASIN		SUBSURFACE
DES MOINES SERIES	Marmaton group	Holdenville		Holdenville		
		Lenapah				Lenapah lime
		Nowata				
		Altamont				
		Bandera				Big lime
				Wewoka		
		Pawnee				
		Labette				Peru sand
				Wetumka		
		Fort Scott		Calvin		Oswego lime
	Cabaniss group		Breezy Hill			
			Iron Post			
			Lagonda			Prue sand
			Verdigris			Verdigris lime
			unnamed			Upper Skinner sand
		Senora	Croweburg	Senora	Henryetta ?	Henryetta coal zone
			Fleming			
			Mineral			
			Chelsea			Skinner sand
			Tiawah			Pink lime
			Weir-Pittsburg		Secor ?	
			Taft	Boggy		Red Fork sand
		Boggy	Inola			Inola lime
			Bluejacket			Bartlesville sand
	Krebs group		Drywood		Lower Witteville ?	
			Doneley			
			Rowe			
		Savanna	Sam Creek	Savanna		Brown limes
			Spaniard			
			coal		Stigler ?	
		McAlester	Warner		Warner	Booch, Tucker, Taneha
			Riverton		Upper Hartshorne?	
			"Elm Creek"			
		Hartshorne	Taonurus siltstone		Hartshorne ?	
			coal		Lower Hartshorne?	
			conglomerate			Burgess

FIGURE 1

FIRST DAY OF FIELD CONFERENCE

May 14, 1954

Miami, Welch, Lenapah, Sequoyah, Claremore

Driving distance 180 miles

Starting time from assembly point - 7:30 A.M.

Directions for reaching assembly point. Drive south from Hotel Miami on North Main Street, U.S. Highways 66, 69. At 0.2 miles, TURN WEST (RIGHT) *with the highways. At 0.7 miles, bridge over Neosho River.* Note Hindsville limestone (Chester) in stream banks near bridge. *At 1.7 miles, cross section line road.* Now on terrace deposits. At 2.2 miles, ASSEMBLY POINT. *Line up off highway facing south on U.S. Highways 66–69.* This is just north of the intersection at which Highway 59 comes in from the west. Assembly point is on the low terrace above the flood plain of the Neosho River. This point was under 10 feet of water in the flood of 1952. Intersection is on the south line of sec. 36, T. 28 N., R. 22 E., Ottawa County, Oklahoma. The escarpment to the south is that of the Warner sandstone member of the McAlester formation, which here caps outliers on the east side of the Miami syncline. The axis of the syncline is one mile west.

Set speedometers at 0.0.

ROAD LOG FOR FIRST DAY

Mileage

00.0 *Drive south on U.S. Highways 59–66–69.*

00.3 *Overpass Frisco (St. Louis and San Francisco) Railway.*

00.4 Warner sandstone at edge of an outlier. The sandstone is locally known as the Little Cabin sandstone, but has been traced into the Warner at the type locality. The sandstone is notably persistent and uniform in character on the shelf area. It is light-buff, cross-bedded, and is 8 to 12 feet thick. In subsurface, this sandstone is variously called the Booch sand, Tucker sand, Tameha sand.

1.1 TURN WEST (RIGHT) *at cross-roads and continue west through the* four corners at the SE cor. sec. 2-27N-22E.

1.6 **DANGER. GRADE CROSSING** *over Frisco tracks.*

2.2 *Bridge over Coal Creek.* Warner sandstone in west bank is on axis of Miami syncline. TURN NORTH (RIGHT) *at cross-roads, SE cor. sec. 3.*

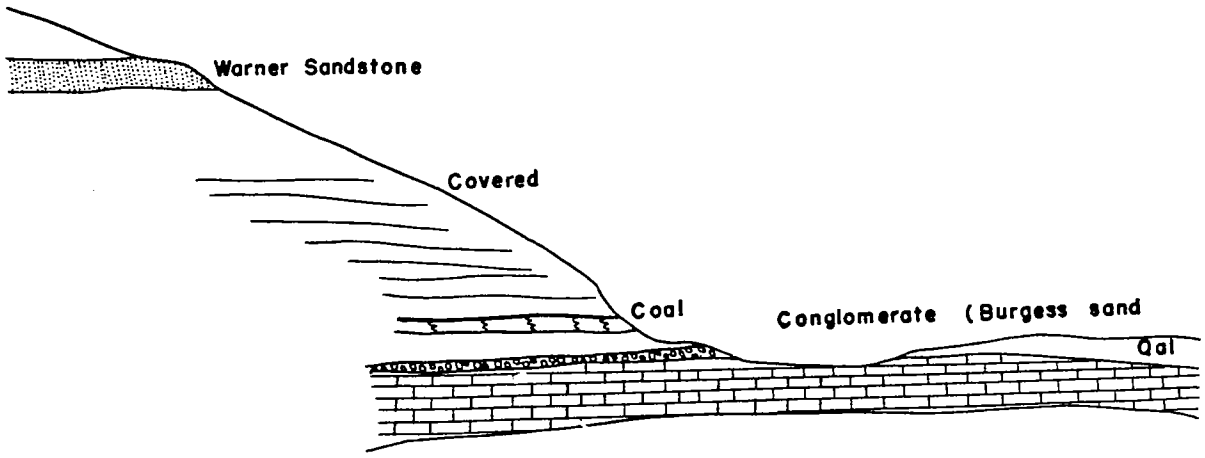
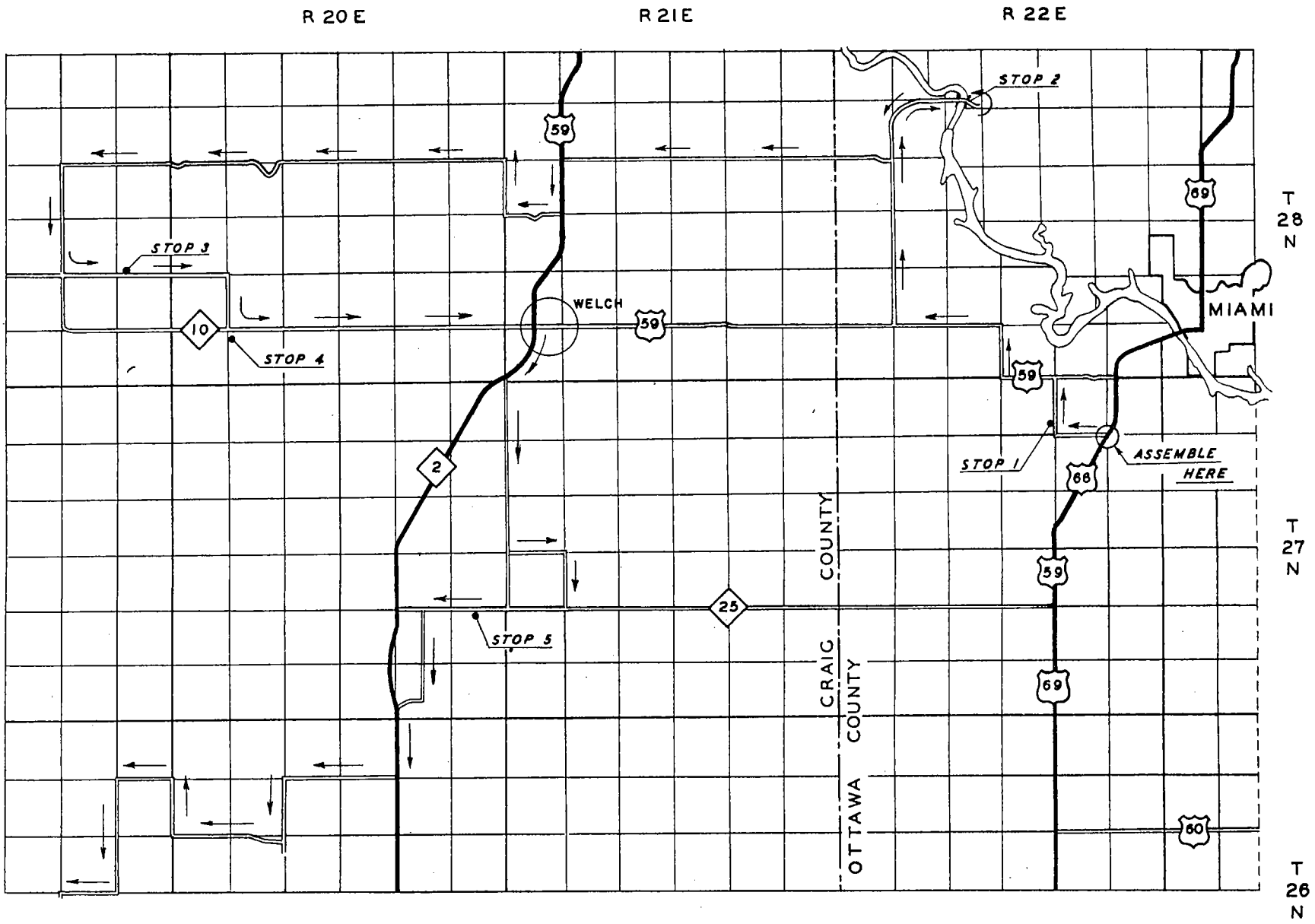


FIGURE 2 - Geologic Section at Stop 1



MAP 1. Western Ottawa County and Eastern Craig County

2.5 **STOP I.** Coal Creek bridge, axis of Miami syncline. (NE¼SE¼ sec. 3-27N-22E) The creek is floored by Hindsville limestone (Chesterian), a gray, crystalline limestone with abundant rounded buttons which are the fused basal plates of a species of *Agassizocrinus*. On the surface of the Hindsville is the basal conglomerate of the Des Moines series, which unconformably overlaps the Morrow, Atoka, higher Chester, and farther north rests on the Boone. The conglomerate contains rounded cobbles of Hindsville. This bed is the "Burgess sand" of subsurface in the northern area.

In the creek bank above the conglomerate is an underclay, a coal, and a few feet of shale. The coal is in the stratigraphic position of the Lower Hartshorne coal of the McAlester Basin. The covered section in the hillside probably contains the "Elm Creek limestone", a *Taonurus* siltstone, dark shale with clay-ironstone concretions, and the Riverton coal. The rim of the hill is supported by Warner sandstone, indicated by the characteristic tree line. (See Figure 2)

2.7 *Second bridge over Coal Creek.* Hindsville limestone on floor of creek.

3.2 **CAUTION. TURN WEST (LEFT)** *on U.S. Highway 59 (Oklahoma Hy. 10).* At SE cor. sec. 34-28N-22E. Gravel pits in terrace ½ mile to north.

3.8 Cross escarpment of Warner sandstone, here weak and almost imperceptible.

4.2 **TURN NORTH (RIGHT)** *with highway at SE cor. sec. 33.*

5.2 **TURN WEST (LEFT)** *with highway at SE cor. sec. 28.*

5.6 *Bridge over branch of Cow Creek.* Warner sandstone poorly exposed. Pit in chert gravel of upland terrace south of road.

6.2 *Cross-roads at SE cor. sec. 29.* Potato Hill, ahead on north, is capped by a tiny remnant of Bluejacket sandstone. The bench in the side of the hill is supported by a persistant twelve-foot sandstone tongue about 35 feet below the Bluejacket. A small coal opening in the Rowe coal was once dug low on the slope of the hill.

6.7 *Mound Valley School on south side of road.*

7.0 *Culvert over branch of Cow Creek.*

7.2 **TURN NORTH (RIGHT)** *at cross-roads on SE cor. sec. 30. Mound Valley Baptist Church in SE corner of intersection.*

7.6 Hill to west is Dawes Hill (Little Timbered Hill), an outlier with remnants of the Bluejacket sandstone cap, and with bluffs on the sides supported by the twelve-foot sandstone.

8.2 *Road west at SE cor. sec. 19.* On alluvium.

8.8 *Bridge over Cow Creek.*

9.9 *Culvert over small stream.* Cross concealed trace of Steppe Ford fault.

10.4 *Gravel road enters from west.*

10.5 *Bridge over Mud Creek.*

11.1 *Road turns eastward, winds along section line.*

12.6 *Bridge over Neosho River (Steppe Ford Bridge).* **CAUTION.** *Keep space between cars so as not to overload the bridge.* Look downstream (south) to see Hindsville limestone flooring the channel. These crops are covered by water at normal level of the stream.

12.7 SLOW. TURN LEFT INTO PRIVATE DRIVE *just west of Steppe Ford Grocery. Follow crushed rock drive. If the ground is dry, follow through dip into field, drive around to face south, and park.*

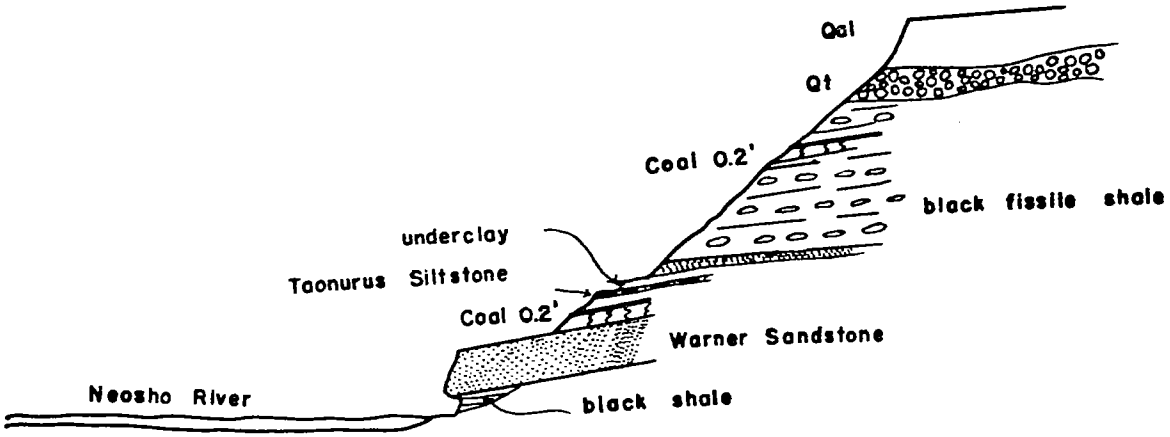


FIGURE 3. Geologic section at stop 2

13.0 STOP 2. West half of the SE½ of the part of irregular sec. 5 north of the Neosho River, T. 28 N., R. 22 E. Walk west and climb down bank to edge of river. The Hindsville limestone seen below the bridge is on the upthrown side of the Steppe Ford fault. Warner sandstone in this outcrop is on the downthrown side and shows drag dips of 2 to 4 degrees to the northwest. Normal dip in this area is 40-50 feet per mile.

Dark fissile shale is exposed below the Warner. Warner is extensively cross-bedded and highly irregular. A few feet above the Warner is a siltstone with *Taonurus*, which has been interpreted as tide-flat markings of marine algae. *Taonurus* has been cited as indicative of Atokan age, but it is a facies fossil associated with dirty shallow-water siltstones.

The section above the Warner consists of black shales with many layers of clay-ironstone concretions. Two thin coal beds are exposed, and there is an underclay of a third coal horizon. The exposure is of rocks which can be seen well at no other place in northeastern Oklahoma.

Above the bed rock is 2 to 6 feet of rounded chert gravel, and this is overlain by alluvium of the flood plain. At several places up and down stream the gravel is dug for road metal. The clay-ironstone here was once dug for ochre, but the project failed.

Return to cars and retrace route to gravel road.

13.3 TURN WEST (RIGHT) *on graveled road back the way we came.*

13.4 *Bridge over Neosho River.*

14.5 *Follow winding road* on alluvium, *turn south onto section line.*

15.5 *Bridge over Mud Creek.*

15.6 SLOW. TURN SHARPLY WEST (RIGHT) ONTO GRAVELED ROAD.

16.7 *Cross-roads at SE cor. sec. 12-28N-21E. Leave Ottawa County, enter Craig County.* Now in area mapped by Charles D. Claxton.

17.0 Base of the twelve-foot sandstone below the Bluejacket.

17.7 *Cross-roads at SE cor. sec. 11.* Base of Bluejacket sandstone (Bartlesville sand of subsurface). Underclay of Drywood coal is one foot below the sandstone.

18.2 *School-house on north side of road.*

18.7 *Cross-roads at SE cor. sec. 10*

19.5 Bluejacket sandstone is here conglomeratic in the base. Drywood coal is just below Bluejacket and is here 3 inches thick.

19.7 *Cross-roads at SE cor. sec. 9.*

20.5 SLOW. *Narrow bridge.*

20.7 *Cross-roads at SE cor. sec. 8.* On top of Bluejacket sandstone.

21.7 CAUTION. TURN SOUTH (LEFT) *onto U.S. Highway 59 (Oklahoma Highway 2). SE cor. sec. 7*

22.7 SLOW. TURN WEST (RIGHT) *onto gravel road at SE cor. sec. 18. Cities Service Gas Co., Welch Compression Station. Cross M.K.&T. Railway tracks.*

23.1 Curve over and around toe of ridge supported by a sandstone above the Mineral coal. Strip pit west of house and barn is in Mineral coal. The large pieces of limestone are from the Russell Creek limestone, the cap rock of the coal. The sandstone can be seen in the rim of the pit under the trees. It is here 7 feet thick, but 6 miles north it is locally 20 feet thick and lies almost upon the coal.

23.8 TURN NORTH (RIGHT) *at SE cor. sec. 13-28N-20E.*

24.5 Old strip pit in Mineral coal on west.

24.8 TURN WEST (LEFT) *at cross-roads at SE cor. sec. 12.*

25.5 Hill is supported by sandstone above the Mineral coal.

25.8 *Cross-roads at SE cor. sec. 11. Culvert over Deer Creek.*

26.3 Sandstone above Mineral coal. Old strip pit north of road.

26.6 *Culvert over branch of Deer Creek.* Old coal pit south of road.

26.8 *Cross-roads at SE cor. sec. 10.*

27.6 *Bridge over Wolfe Creek.* Cap rock of Tebo coal (Tiawah limestone) exposed below bridge. The Tiawah is here two thin layers of clay-ironstone separated by black shale. The Tebo coal is named from a Missouri locality, the Tiawah from a village southeast of Claremore, Oklahoma.

27.8 *Cross-roads at SE cor. sec. 9.*

27.9 Old strip pit in Mineral coal on south side of road. The cap rock here bears well-preserved specimens of a new species of Fusulina.

28.8 *Cross-roads at the SE cor. sec. 8.* We are here at the level of the Croweburg (Broken Arrow) coal, and it has been stripped in the section on the north.

30.0 *Road curves southward around hill.* Ledge in road is Verdigris limestone.

31.0 *Cross-roads at SE cor. sec. 7.* Rogers School on northwest. Hill to north is supported by Breezy Hill limestone. Road north leads to pits in black fissile shale with phosphatic concretions (Excello shale), which is used for surfacing county roads. The Excello lies above the Breezy Hill limestone and below the Blackjack Creek limestone (Lower Fort Scott).

31.4 *Road north.* A little more than two miles north on this road is the type section of the Kinnison shale and of the Iron Post coal. These units were named in 1951 by Wallace B. Howe.

31.7 *Concrete causeway over Cabin Creek.*

32.0 Verdigris limestone ledge next to road.

32.3 Hill is supported by Lagonda sandstone ("Prue sand"). *Cemetery on south.*

32.4 Ledge of Breezy Hill limestone, the highest limestone ledge of the "Cherokee", which is at the base of the Fort Scott Escarpment.

32.5 Blackjack Creek limestone member of the Fort Scott limestone formation. Fusulinids are abundant in the Lower Fort Scott. Shale pits are in Excello shale.

33.0 *Abandoned road on south at SE cor. sec. 11.*

34.0 TURN SOUTH (LEFT) *at cross-roads at SE cor. sec. 10-28N-19E.*

35.0 *Cross-roads at SE cor. sec. 15. Plateau School on southeast.* On Upper Fort Scott (Higginsville) limestone.

36.0 TURN EAST (LEFT) *at cross-roads at SE cor. sec. 22. Oklahoma Highway 10 goes west and south from this intersection.*

37.0 *Cross-roads at SE cor. sec. 23.* Base of Upper Fort Scott.

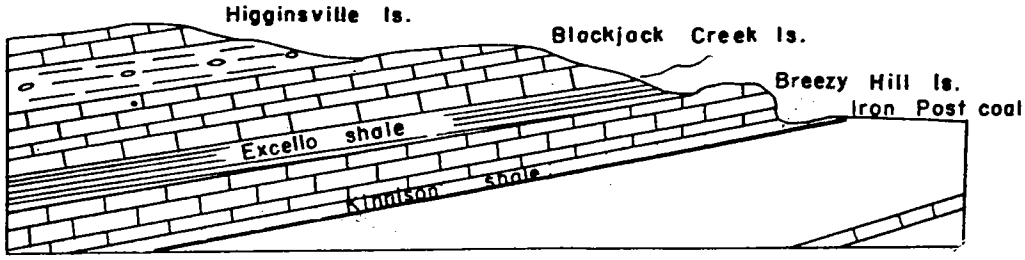


FIGURE 4. Oswego lime section

37.3 STOP 3. Lower Fort Scott (Blackjack Creek) limestone at rim of hill. Excello shale identifiable by phosphatic concretions weathered out along ditches. Breezy Hill limestone in road and along rim of abandoned strip pit on north side of road. The Breezy Hill is here a gray to brown, massive, silty limestone with abundant fusulinids. Three feet of Kinnison shale exposed beneath Breezy Hill. Coal stripped here is Iron Post coal, the coal bed long called the Fort Scott coal in Oklahoma and correlated with the Mulky coal. Howe has shown that this is not the Mulky, which lies above the Breezy Hill limestone instead of below. See Figure 4.

37.7 *Culvert over branch of Wolfe Creek.*

39.0 TURN SOUTH (RIGHT) *at cross-roads, SE cor. sec. 19-28N-20E.*

39.8 Old strip pits to east are in Mineral coal. Large blocks around pits are chunks of the cap rock limestone.

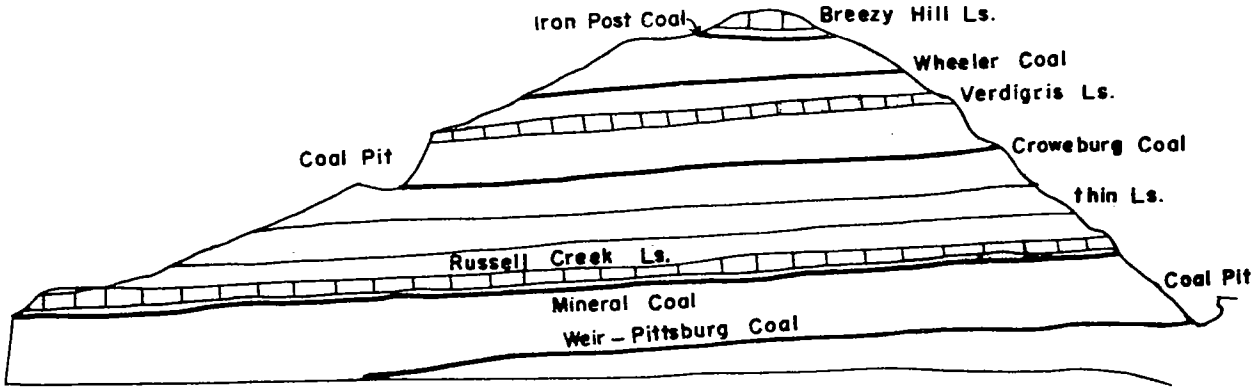


FIGURE 5. Section exposed at and near Grandview School.

40.0 TURN EAST (LEFT) *onto Oklahoma Highway 10 at cross-roads and park at side of road.* STOP 4. Escarpment one mile west is supported by Breezy Hill limestone. Outlier to north has small cap of Breezy Hill. Verdigris limestone is rim above strip pit behind barn; pit is an active opening in the Croweburg coal. The upper of the two thin limestones in the road ditch is the cap rock of the Fleming coal (coal not found here), and the lower thin limestone may be the cap rock of the Robinson Branch coal. The cap rock of the Mineral coal crosses the road just west of the intersection. The active strip pit in the field on the southeast is in the Weir-Pittsburg coal, a coal which is capped only by a few inches of black fissile shale. The Tebo coal has not been found here, but with its cap rock (Tiawah limestone) it is exposed within a few miles north and south. The Tiawah is the "Pink lime" of subsurface. SE cor. sec. 30-28N-20E.

40.5 *Grandview School on north.* Strip pit on north is in Mineral coal.

41.0 *Cross-roads at SE cor. sec. 29.* Strip pits to north are in Mineral coal; those to south in Weir-Pittsburg coal.

41.9 Strip pits are in Weir-Pittsburg coal. *Bridge over Wolfe Creek.*

42.5 *Bridge over Dee Creek.* Top of Bluejacket exposed in creek bank.

43.0 *Cross-roads at SE cor. sec. 27. Prairie Center School on southeast.* On Bluejacket sandstone. Cross trace of Welch fault.

44.0 *Cross-roads at SE cor. sec. 26.*

44.4 Base of Bluejacket sandstone approximately here. Cemetery Hill to northeast capped by a Bluejacket outlier.

45.0 *Cross-roads at SE cor. sec. 25.*

45.5 CAUTION. TURN SOUTH (RIGHT) *on Oklahoma Highway 2.* WELCH *town center is east.* The Mineral coal has been known locally as the Welch coal.

46.2 CAUTION. TURN SOUTH (LEFT AT Y) *onto country road on township line.*

47.8 *Cross-roads at SE cor. sec. 1-27N-20E.* On Bluejacket sandstone. Now in area mapped by Louie P. Chrisman.

48.4 Base of Bluejacket sandstone. Drywood coal is 1 inch thick and is just beneath the base of the Bluejacket.

49.4 Ledge of Doneley limestone crosses road in hillside. The Doneley is the upper of three "Brown limes".

49.9 TURN EAST (LEFT) *at SE cor. sec. 13-27N-20E.*

50.0 Base of Bluejacket sandstone.

50.9 TURN SOUTH (RIGHT) *at SE cor. sec. 18-27N-21E.*

51.3 Hill is an outlier of the 12-foot sandstone below the Bluejacket.

51.9 TURN WEST (RIGHT) *on Oklahoma Highway 25 at SE cor. sec. 19.*

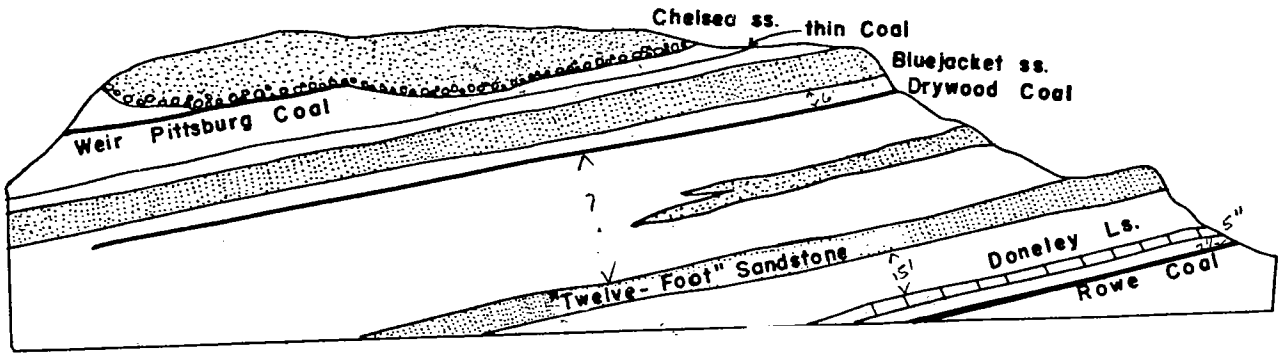


FIGURE 6. Geologic section exposed on Timbered Hill

52.4 STOP 5. Village of Bluejacket is 2 miles east. Hill to west is Timbered Hill. The hill is capped by an outlying remnant of Chelsea sandstone which lies disconformably on and through the Tiawah limestone, the Tebo coal, the Weir-Pittsburg coal, and at one place almost upon the Bluejacket sandstone. The type section of the Bluejacket sandstone, which is the Bartlesville sand of subsurface, is at the rim of the hill, a section designated by Wallace B. Howe in 1951. The Drywood coal is exposed in the roadside ditch 6 feet below the Bluejacket. The twelve-foot sandstone below the Bluejacket forms the ridge across the road in the valley. Fifteen feet below this sandstone is the Doneley limestone, here about 5 inches thick. The Rowe coal is about 2½ feet below the Doneley. There is but one small pit in the Rowe in Craig County.

52.9 *Cross-roads at SE cor. sec. 24.*

53.4 *Road south at S¼ cor. sec. 24.* On type section of Bluejacket sandstone.

53.7 Conglomeratic Chelsea sandstone with thin coal below. Chelsea is "Skinner sand" of subsurface.

53.9 *Cross-roads at SE cor. sec. 23.*

54.4 TURN SOUTH (LEFT) *on road at S¼ cor. sec. 23.*

54.9 *Road west at center of section.*

55.1 Old shaft on east is to 2½ foot coal at 60 foot depth.

55.4 *Cross-roads at S¼ cor. sec. 26. Timber Hill School on northwest.* On Chelsea sandstone.

55.9 *Turn westward with road.*

56.3 Coal drift to south is in a two-foot coal seam (Weir-Pittsburg?) with Chelsea resting directly upon it.

56.5 Small coal openings to north of road are in Bluejacket (?) coal.

56.6 CAUTION. TURN SOUTH (LEFT) *onto paved Oklahoma Highway 2.*

56.9 *Road west at SE cor. sec. 34.*

57.9 TURN WEST (RIGHT) *on county road. SE cor. sec. 3-26N-20E.*

58.9 *Road north at SE cor. sec. 4.*

59.4 Doneley limestone ledge in road on west slope of hill east of concrete slab over creek.

59.9 TURN SOUTH (LEFT) *at cross-roads at SE cor. sec. 5.*

60.2 Doneley limestone and Rowe coal crop out in bed of creek west of culvert. Hills ahead are outliers capped by Bluejacket.

61.1 TURN WEST (SHARP RIGHT). Type section of Doneley limestone is in stream bank east of the road and just south of this intersection.

61.7 *Bridge over Big Cabin Creek.*

62.2 *Road south at SE cor. sec. 7. Eureka School on southeast.*

62.7 Base of Bluejacket sandstone, here thin and easily eroded.

63.2 TURN NORTH (RIGHT) *at intersection, SE cor. sec. 12-26N-19E.*

64.2 TURN WEST (LEFT) *at intersection at SE cor. sec. 1.*

64.7 Drywood coal crops out in creek to north of road.

65.1 *Bridge over West Fork of Big Cabin Creek.* Tebo coal crops out 1½ miles upstream.

65.2 TURN SOUTH (LEFT) *at SE cor. sec. 2.*

66.7 Base of Bluejacket sandstone.

67.0 Coal openings in Bluejacket coal.

67.2 TURN WEST (RIGHT) *at cross-roads, SE cor. sec. 14.*

68.2 TURN SOUTH (LEFT) *at cross-roads, SE cor. sec. 15.*

70.2 TURN WEST (RIGHT) *at SE cor. sec. 27.*

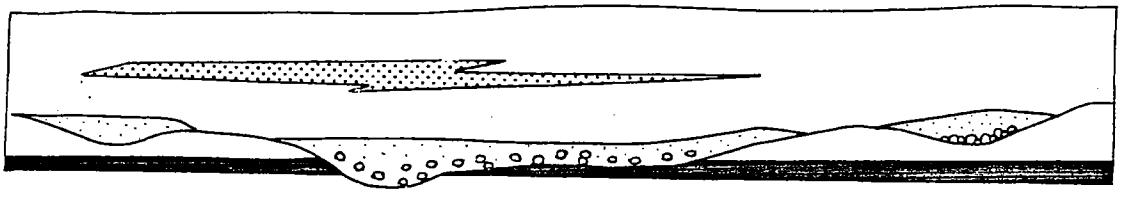
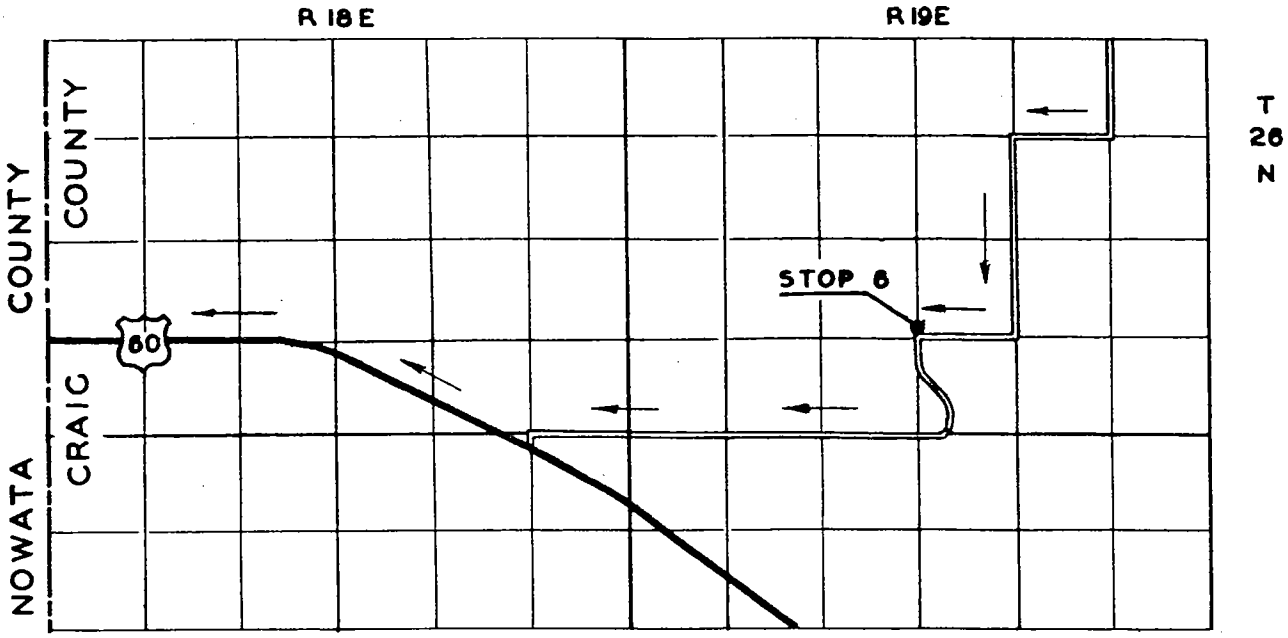


FIGURE 7. Cross-section of exposures in McNabb strip pit



MAP 2. Map of western Craig county

71.2 STOP 6. *Turn into stripping area, turn around and park facing southwest.* In the adjacent part of the pit a coarse conglomerate rests directly upon the coal and includes coal pebbles. In the northern part of the pit sandstone rests upon the coal at places, shale at other places, and the conglomerate is above the working wall. The coal is Weir-Pittsburg, the conglomerate is Chelsea. Tiawah, Tebo, and associated beds are cut out. This is the contact of the Krebs and Cabaniss groups.

Return to cars and drive south on graveled road.

71.8 *Road east.*

73.0 TURN WEST (RIGHT) *at intersection.*

73.1 *Bridge over Pawpaw Creek.* The Weir-Pittsburg coal is locally called Pawpaw.

73.2 *Cross-roads at SE cor. sec. 33.* Sandstone ledge.

73.6 Pits north and pits and shaft south are in Weir-Pittsburg coal.

74.2 *Estella School on south.*

74.7 Coal pit on south is in Bluejacket coal.

75.2 *Cross-roads at SE cor. sec. 31.*

76.2 *Cross-roads at SE cor. sec. 36-26N-18E.*

76.6 Base of Chelsea sandstone

77.2 TURN SOUTH (LEFT) *at cross-roads at SE cor. sec. 35.* Fort Scott escarpment on west. To north one mile is outcrop of Verdigris limestone, Iron Post coal, Breezy Hill limestone.

77.3 CAUTION. TURN WEST (RIGHT) *onto U.S. Highway 60.*

77.7 Breezy Hill limestone over Iron Post coal, which has been dug in trench along brow of hill.

78.6 Strip pits are in Iron Post coal.

79.5 *Bridge over Lightning Creek.*

79.6 *Road north on east line of sec. 33.*

80.3 *Curve northward onto section line.* Pits to north are in Iron Post coal.

80.7 *Cross-roads at SE cor. sec. 29. School building on northeast.*

81.7 *Cross-roads at SE cor. sec. 30.* Pits in Iron Post coal on north.

82.1 *Bridge over Madden Creek.* Outcrop of Blackjack Creek limestone, Excello shale, Breezy Hill limestone, Iron Post coal.

82.7 *Cross-roads at SE cor. sec. 25-26N-17E. Leave Craig County, enter Nowata County. Now in area mapped by J.R. Faucette.*

83.7 *Cross-roads at SE cor. sec. 26.*

84.7 *Cross-roads at SE cor. sec. 27.*

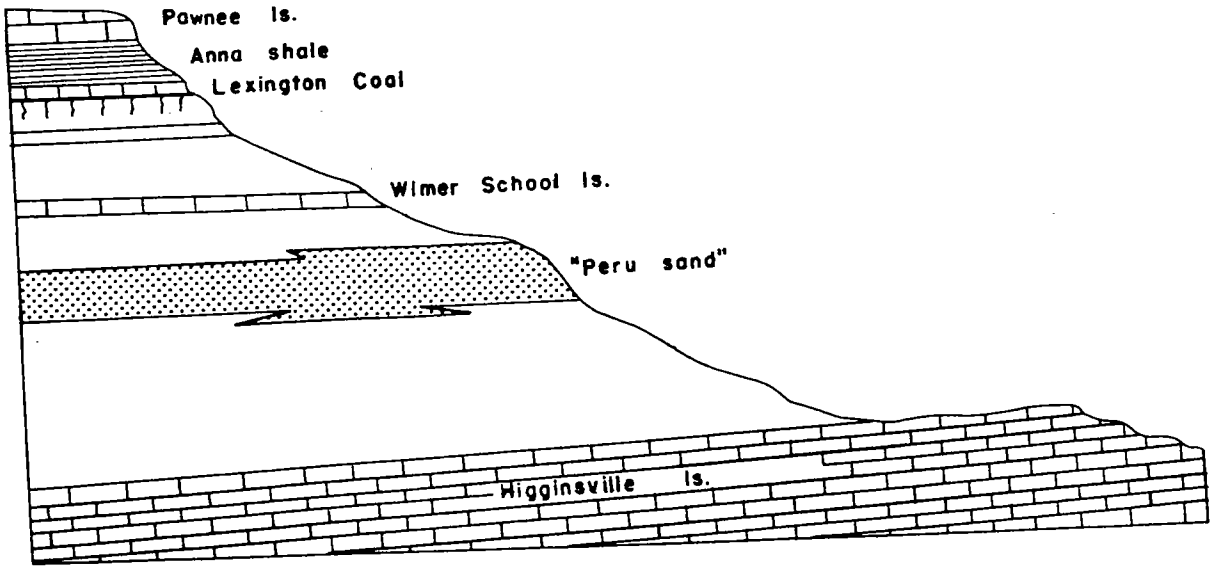
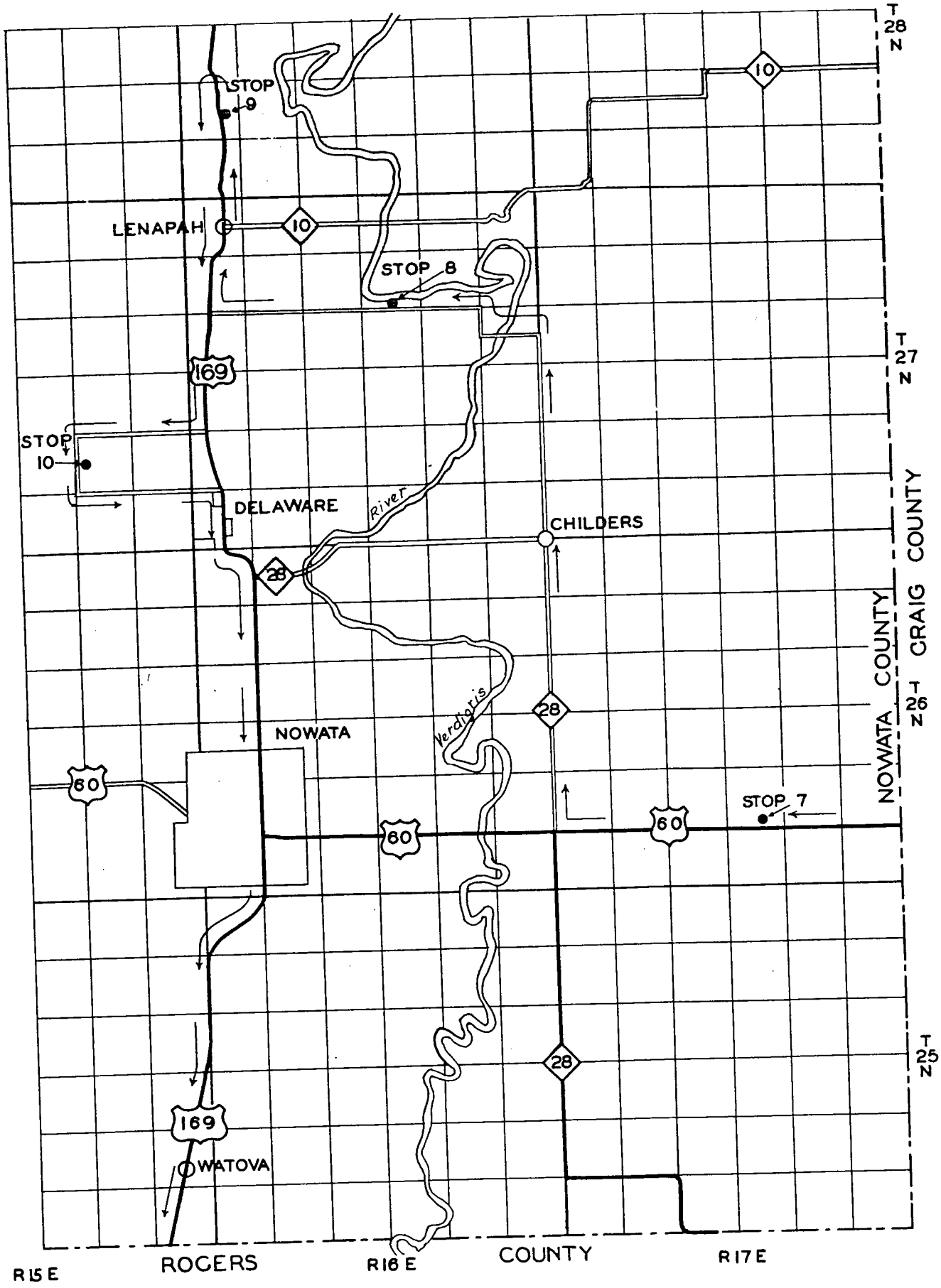


FIGURE 8. Section exposed at STOP 7 and westward

85.1 *Bridge over Salt Creek. Park west of bridge.* STOP 7. John Warren identified this exposure of Higginsville limestone (Upper Fort Scott limestone). The rock is gray, impure, unevenly bedded limestone with many dark shale partings. Fusulinids are abundant in the dark shale in the road cut and in the road-metal quarry north of the highway. The fauna consists of *Fusulina girtyi* and *Fusulina* n. sp. This is one of the few good exposures of Higginsville in Oklahoma. Locality is SE¼ SE¼ sec. 28, T. 26 N, R. 17 E.

85.7 *Cross-roads at SE cor. sec. 28.*

86.0 Base of Pawnee limestone on east edge of an outlier. Anna shale poorly exposed.



MAP 3. Nowata County

86.7 *Cross-roads at SE cor. sec. 29.*

87.6 Descend hill through Pawnee limestone, Wimer School limestone (blocks in ditch on south side of highway), "Peru sand" in Labette shale, and cross fault-line scarp. Fault is downthrown east to make outlier.

88.7 TURN NORTH (RIGHT) *onto Oklahoma Highway 28 at cross-roads and store. At SE cor. sec. 25-26N-16E.* On alluvium of the Verdigris River. In Coody's Bluff pool, a part of the shallow producing area in the Bartlesville sand.

89.3 *Bridge over Kentucky Creek.*

89.7 *Cross-roads at SE cor. sec. 24.* On Labette shale; Pawnee limestone escarpment to the northwest.

90.7 *Road east at SE cor. sec. 13.*

91.1 *Bridge over Big Creek.*

91.9 SLOW. *Turn into narrow bridge over small creek.*

92.7 *Road west at SE cor. sec. 1.* Outlier is Pawnee limestone on Labette shale.

93.7 *Straight ahead through intersection of five roads in village of CHILDERS.* In northern part of Nowata County shallow oil field in Bartlesville sand. *SE cor. sec. 36-22N-16E.*

95.0 Curve around west edge of outlier of Bandera shale capped by Altamont limestone. *Road west.*

95.8 *Cross-roads at SE cor. sec. 13.* On Quaternary.

97.4 TURN WEST (LEFT). Pawnee limestone makes the small escarpment just crossed.

98.1 *Bridge over Verdigris River.* CAUTION. KEEP WIDE SPACES BETWEEN CARS.

98.4 TURN NORTH (RIGHT) *at E¼ cor. sec. 14.*

98.9 TURN WEST (LEFT) *at SE cor. sec. 11.*

99.9 *Road south at SE cor. sec. 10.*

100.3 TURN RIGHT *off road into pasture. Drive to far end, circle around, and park.*

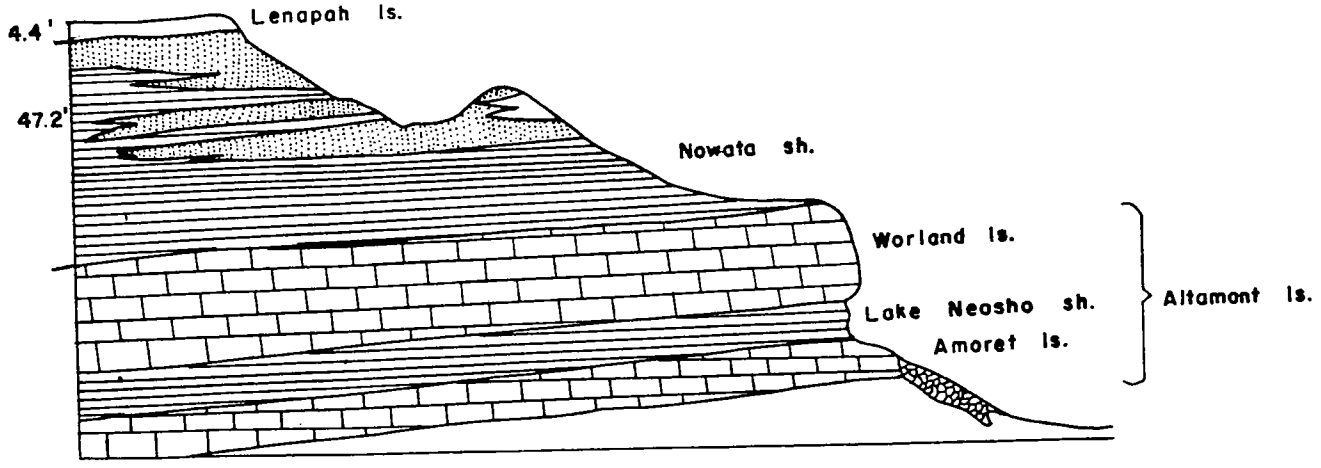


FIGURE 9. Altamont limestone along Verdigris River

100.6 STOP 8. Lenapah limestone caps the escarpment on the west. Nowata shale with Walter Johnson sandstone member makes shale slope. Altamont limestone in river bluff consists of Worland limestone (22.9′), Lake Neosho shale (9.3′), Amoret limestone (3.5′ exposed).

Return to graveled road.

100.9 TURN WEST (RIGHT) *on graveled road.*

101.2 Lenapah limestone escarpment.

102.5 *Road north at SE cor. sec. 8.* On Lenapah limestone.

103.5 *Cross-roads at SE cor. sec. 7.*

103.8 *Bridge over small creek.* On Seminole formation.

104.1 CAUTION. TURN NORTH (RIGHT) *on paved U.S. Highway 169*

105.1 *Cross-roads on south line of sec. 6.*

105.6 *Main intersection in village of* LENAPAH.

106.1 *Cross-roads on south line of sec. 31-28N-16E.*

107.1 *Cross-roads on south line of sec. 30.*

107.5 *Turn through gate onto graveled driveway to quarry. Turn and park out of truck drive.* STOP 9. Peerless Rock Co. quarry, a new quarry near the old flooded quarry at Bell's Spur which is the type locality of the Lenapah limestone. Walk past crusher into quarry. Upper algal gray limestone over irregular bed of green shale, nodular limestone, and phosphatic nodules. Fossils are well-preserved in this bed, with *"Marginifera" muricatina* most abundant form. Main quarry face is dense gray crystalline limestone. Good fossil collecting on spoil heaps in southeast part of quarry. *Return to U.S. Highway 169 and retrace route to south.*

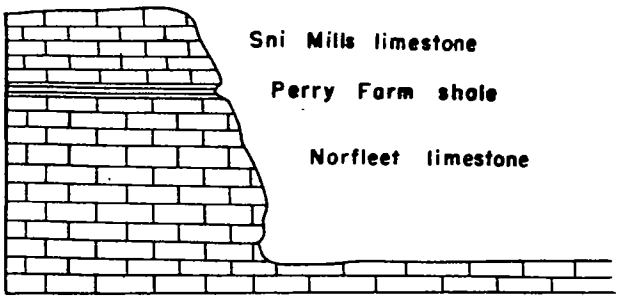


FIGURE 10. Peerless Rock Co. Quarry

109.4 *Center of town of* LENAPAH.

109.9 *Cross-roads.*

110.9 *Cross-roads where caravan entered highway from east.*

111.9 *Cross-roads on south line of sec. 18.*

112.9 TURN WEST (RIGHT) *at cross-roads at SE cor. sec. 19* CAUTION. *Cross Missouri Pacific Railroad tracks.*

113.2 *Cross-roads at SE cor. sec. 24.*

114.2 *Cross-roads at SE cor. sec. 23.* Lenapah limestone in road.

114.6 *Bridge over California Creek.* Nowata shale and Lenapah limestone in walls of valley. One-fourth mile south Seminole rests on Nowata shale.

127.0 *Overpass Missouri Pacific tracks.*

127.3 *City Route of U.S. 169 merges from the right.*

127.5 *Roads east and north at SE cor. sec. 1-25N-15E.*

127.6 *Bridge over North Fork of Double Creek.*

128.4 *Bridge over South Fork of Double Creek.*

128.7 *Cross-roads at SE cor. sec. 12. School building on northwest.*

129.7 *Cross-roads on south line sec. 13.*

138.8 *Cross-roads on south line of sec. 24.* Lenapah limestone outcrops two miles west.

139.4 *Village of WATOVA.*

140.0 *Cross-roads on south line of sec. 25.*

141.1 *Cross-roads on south line of sec. 36. Leave Nowata County, enter Rogers County.* Leave area mapped by J.R. Faucette, enter area being mapped by William Sparks.

142.2 *Cross-roads on south line of sec. 2.*

143.4 *Cross-roads on south line of sec. 11.*

143.8 *Bridge over North Fork of Talala Creek.*

144.2 *Bridge over South Fork of Talala Creek.*

144.6 *Road east on south line of sec. 15.*

145.4 *Cross-roads on south line of sec. 22.*

146.0 *Cross-roads in center of village of TALALA.*

NOTE - It has already been a long day. The trip from here to Claremore is over country roads and there is but one stop. Those who wish may go directly to the night headquarters in Claremore by following U.S. Highway 169 to Oklahoma Highway 88, then follow Highway 88 into Claremore, 20 miles from here. Cars leaving the caravan please pull onto the right shoulder here in town and wait until the last car of the caravan has passed before driving on. Road log for direct route to Claremore on page 41

146.4 TURN EAST (LEFT) *at cross-roads on south line of sec. 27.*

147.2 *Road south at SE cor. sec. 27.* On Oologah limestone.

148.2 *Cross-roads at SE cor. sec. 26.*

149.4 Oologah escarpment. Descend hill in Labette shale.

150.2 *School building on north side of road.*

150.7 *Cross-roads at S¼ cor. sec. 29-24N-16E.*

151.5 *Bridge over Verdigris River.*

152.3 *Main road turns north. Keep straight eastward. Near SE cor. sec. 27.*

153.3 TURN SOUTH (RIGHT) *near SE cor. sec. 26.* Higginsville limestone caps hill behind us, Blackjack Creek limestone and Breezy Hill limestone at intersection. Strip pits in Iron Post coal in creek to east and along left side of road after the turn.

153.4 *Bridge over Spencer Creek.*

154.4 TURN EAST (LEFT) *at SE cor. sec. 35. Narrow road.*

155.2 Verdigris limestone crop in bank. *Rough road for next mile.*

155.4 Breezy Hill limestone over "Prue sand".

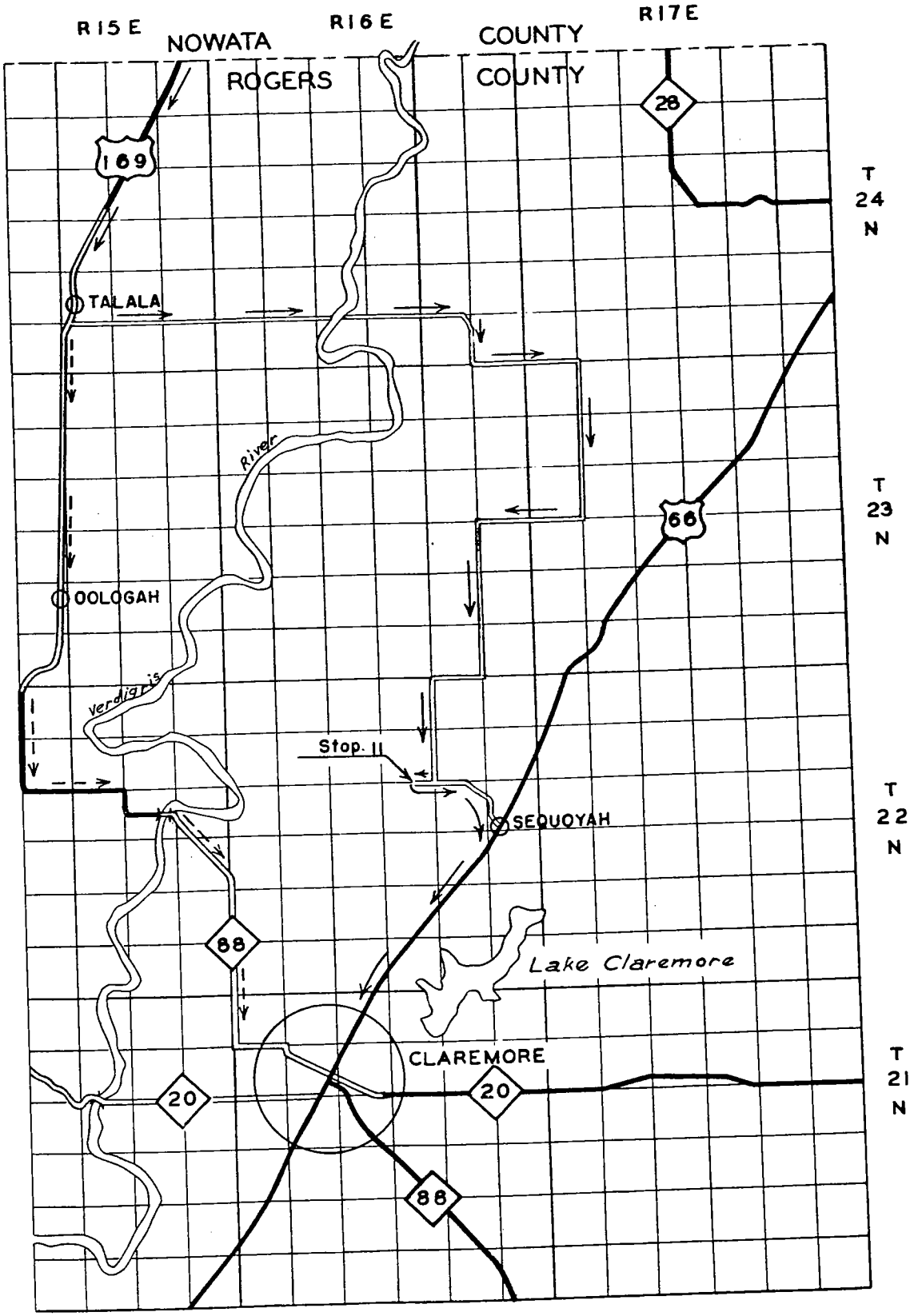
155.7 Breezy Hill limestone and "Prue sand".

156.1 *Shell production camp.* Blackjack Creek limestone. Excello shale with phosphatic nodules. Ware found many fossils in the nodules at this point. Breezy Hill limestone.

156.5 TURN SOUTH (RIGHT) *at SE cor. sec. 31-24N-17E.* Valley rim is Verdigris limestone, "Prue sand" above.

157.7 Strip pit to west is in Croweburg (Broken Arrow) coal.

158.5 *Cross-roads at SE cor. sec. 7.* Verdigris limestone and "Prue sand" to west of intersection. Pit in Iron Post coal on hilltop to west.



MAP 4. Northwestern Rogers County

159.3 Verdigris limestone crosses road.

159.5 TURN WEST (RIGHT) *at cross-roads at SE cor. sec. 18.*

161.5 TURN SOUTH (LEFT) *at cross-roads at SE cor. sec. 14.*

162.0 Cross Verdigris limestone, "Prue sand".

162.5 *Cross-roads at SE cor. sec. 23.* Hill to east capped by Breezy Hill limestone.

163.5 CAUTION. STOP SIGN. STOP, THEN CROSS GRAVEL. *SE cor. sec. 26.*

163.9 Outlier capped by Breezy Hill limestone.

164.4 TURN WEST (RIGHT) *at cross-roads at SE cor. sec. 35.* Strip pits are in Croweburg (Broken Arrow) coal.

165.1 Cross Verdigris limestone three times.

165.4 TURN SOUTH (LEFT) *at SE cor. sec. 34.*

166.1 Verdigris limestone on both sides of creek.

166.4 Strip pits in Croweburg coal.

167.5 TURN WEST (RIGHT) *at cross-roads at SE cor. sec. 10.*

167.8 *Pull onto wide area at mouth of strip pit, turn and park.* STOP 11.

Section in wall of pit measured by W.P. Gruman and H. Ware

Verdigris limestone	11.1
Shale, black, fissile, with phosphate nodules	6.0
Shale, gray, sandy, with large siliceous con.	22.8
Shale, light gray, silty, micaceous	24.8
Shale, gray, with small clay-ironstone conc.	9.7
Coal (Croweburg)	1.6
underclay	

At this stop is the thickest sand development in the Verdigris-Croweburg interval. The clay, sand, and silt is in long ripples which simulate small scale cross-bedding. This sandy zone is the "Upper Skinner sand" of subsurface.

Return to cars and drive back the way we came.

168.1 *Cross-roads at SE cor. sec. 10. Straight ahead.*

168.8 *Curves in road.* Driving in bottom of old strip pit.

169.2 *Keep right.* Verdigris limestone fragments in grass roots at top pit. "Upper Skinner sand" high in working face. Croweburg coal at bottom of pits.

169.9 **CAUTION.** *Cross Frisco tracks.* TURN SOUTHWEST (RIGHT) *on U.S. Highway 66. Village of Sequoyah.*

170.1 *Road east on south line of sec. 13.*

170.4 *Road south on east line of sec. 23. School and church to south.*

175.5 *Cross-roads on south line sec. 23.* On Chelsea sandstone.

176.0 *Cross-roads on east line sec. 28.*

176.8 *Road east on south line of sec. 28.*

177.6 *Cross-roads on east line of sec. 33.*

178.2 *Cross-roads on south line sec. 33.*

179.5 *Cross Missouri Pacific tracks.*

180.0 **STOP SIGN.** TURN EAST (LEFT) *one block to* WILL ROGERS HOTEL. Dinner will be a smörgasbord served at 7:00 P.M. in the hotel. The hotel manager, Walter C. Groce, has your room reservations.

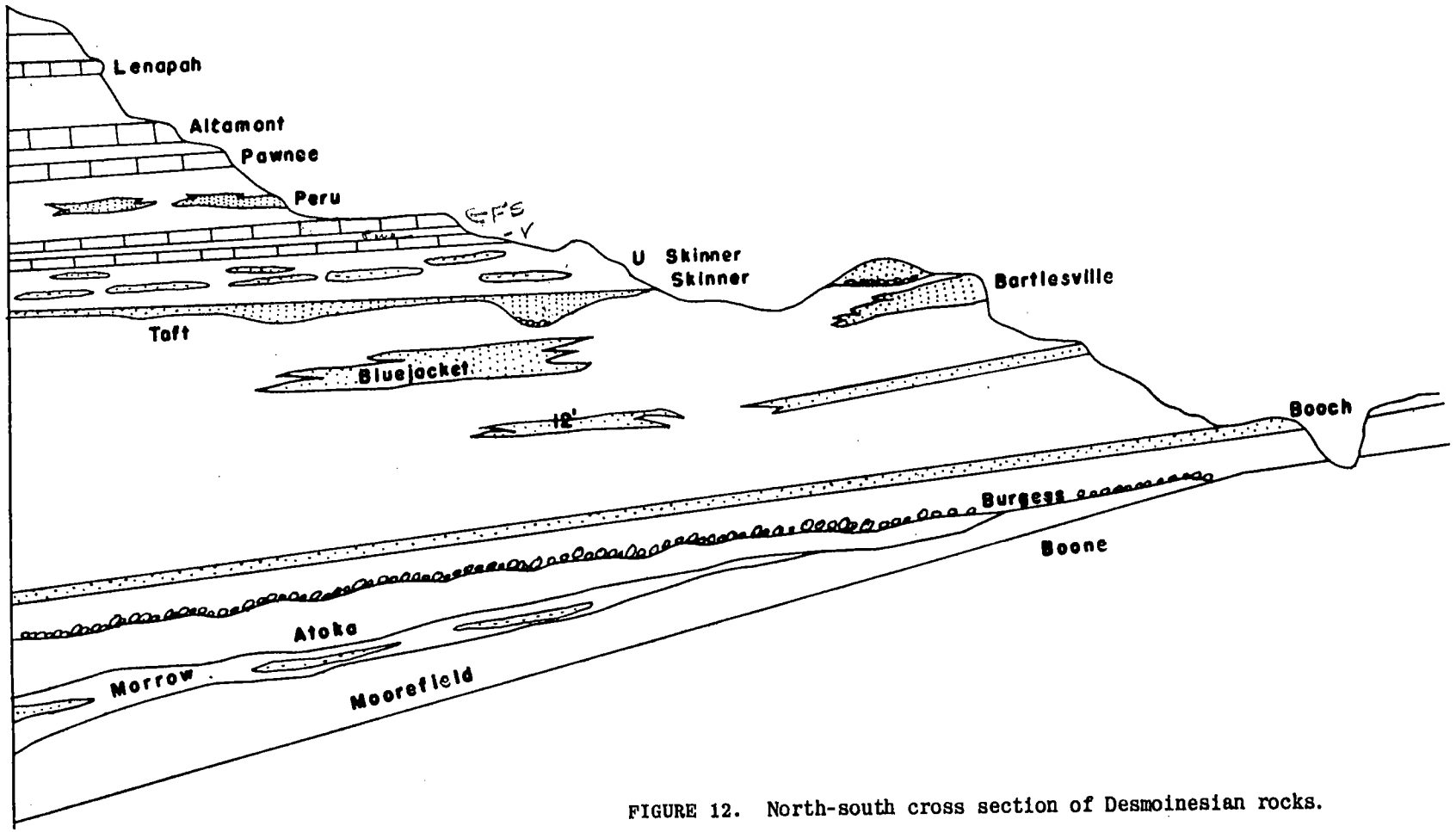
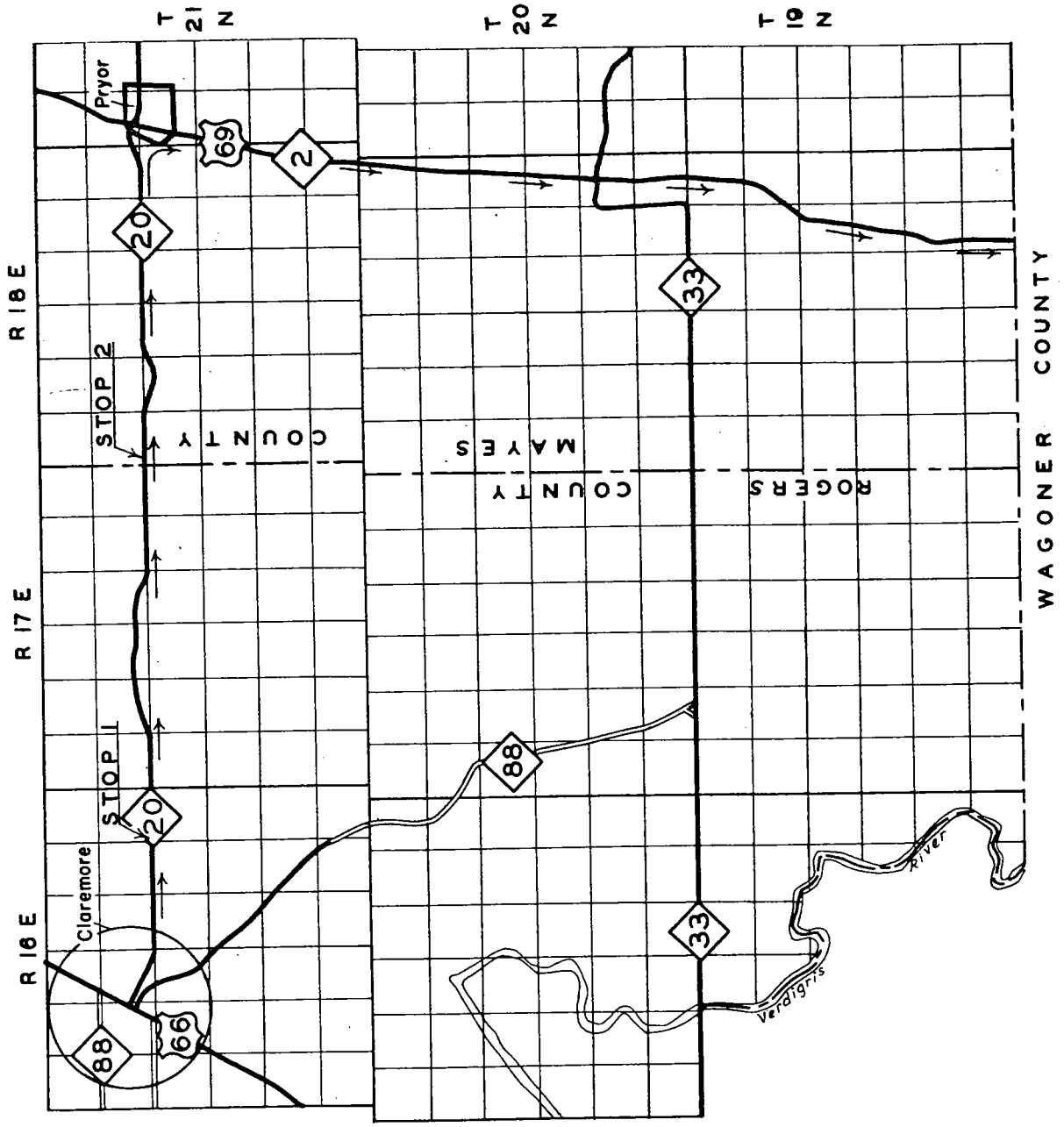


FIGURE 12. North-south cross section of Desmoinesian rocks.



MAP 5. Eastern Rogers and southwestern Mayes Counties

SECOND DAY OF FIELD CONFERENCE

May 15, 1954

Claremore, Pryor, Porter, Coweta, Concharty Mountain

Driving distance 93.2 miles

Starting time from assembly point 8:00 A.M.

Directions for reaching assembly point. *Drive east from Will Rogers Hotel on Will Rogers Boulevard with Oklahoma Highway 20. At 0.1 miles cross Missouri Pacific tracks at Claremore Station. At 0.8 miles park on right side of street facing east. Set speedometer at 00.0.*

00.3 Descend Chelsea sandstone escarpment.

00.5 *Bridge over Dog Creek.*

01.3 *Cross-roads at SE cor. sec. 10-21N-16E.*

02.0 Deep road cut in outlier capped by Tiawah limestone.

02.2 *Road north at SE cor. sec. 11.*

02.5 STOP 1. *Pull off highway onto shoulder. SE¼ SW¼ sec. 12.*, 21N, 16E

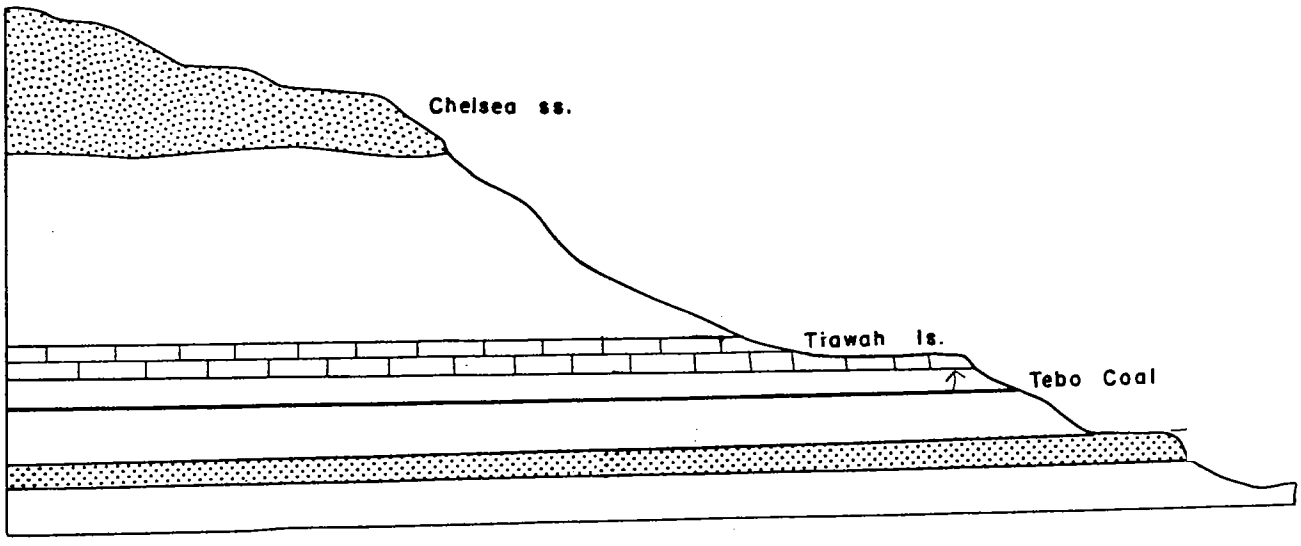


FIGURE 13. Chelsea sandstone and Tiawah limestone

Section measured by Jack L. Tillman

		Feet
Chelsea sandstone	Sandstone, ferruginous, cross-bedded, coarse to medium, conglomeratic at base, reddish brown	20
	Clay shale, black to gray, compact, ironstone	3.0
	Shale, gray, with *Stigmaria*, *Lepidodendron*, concretions at base on limestone surface	1.5
Tiawah limestone	Limestone, light gray, pinkish areas in lower part, molluscan faunule, rare fusulinids here	6.3
	Tebo coal. Coal smut and coal	0.1
	Underclay, gray	0.3
	Shale, gray in upper part, black, fissile, and with phosphatic concretions in lower part	2.5
	Siltstone, gray, compact	0.2
	Shale, gray	5.0
	Sandstone, white to light gray, saccharoidal	5.6
	Shale, gray, compact	14.0

The units exposed represent the "Skinner sand", the "Pink lime", and "Upper Red Fork". Twenty miles south of this point, the Chelsea is 40 feet above the Tiawah and there is a red sandy limestone 10 feet above the Tiawah. In Craig County, the Chelsea was seen only a few feet above the Bluejacket, and at places phosphatic concretions in the basal conglomeratic layers occur. These are interpreted as having been eroded from the black shale below the Tiawah. There are few fusulinids in the Tiawah here. Southward they become abundant, and in the Arkansas River area the Tiawah is a coquina of shells of mytiloids.

03.4 Descend hill through same section. *Cross-roads at SE cor. sec. 12.*

04.2 *Road north.* Isolated hill to north is capped by Tiawah rubble. Escarpment to northeast is Chelsea sandstone.

05.4 *Cross-roads at SE cor. sec. 8.* Middle Taft sandstone near road. Buttes are capped by rubble of Upper Taft sandstone. The Taft is the "Red Fork sand" and the "Burbank sand".

06.1 East Claremore oil and gas field. Oil is from Burgess, gas from "Tucker sand", ("Booch sand"), which is Warner.

06.3 *Cross-roads on east line of sec. 9.*

07.4 *Cross-roads at SE cor. sec. 10.*

08.4 *Road north at SE cor. sec. 11.*

09.4 *Cross-roads at SE cor. sec. 12. Leave Rogers County, enter Mayes County.*

09.7 STOP 2. Top of Bluejacket sandstone to Lower Taft sandstone.

Section measured by Jack L. Tillman, 1952

	Thickness
Lower Taft sandstone, ferruginous, of medium grain	12.0 exposed
Clay shale, gray	5.5
Shale, tan, silty	3.0
Shale, gray	2.5
Shale, black, with clay-ironstone concretions, siliceous concretions in upper part in one zone	16.0

Section measured by Jack L. Tillman, (Cont'd.)

	Thickness
"Inola No. 1" Limestone, light gray, compact, in two massive beds, fossiliferous, *Marginifera haydenensis*	3.5
Coal	0.2
Underclay	1.5
Shale, gray, lower part with chonetid faunule	2.5
"Inola No. 2" Calcareous clay-ironstone, gray to red, silty, with chonetid faunule	0.5
Shale, gray to tan, silty toward base	4.0
"Inola No. 3" Clay-ironstone, nodular, argillaceous, with faunule in which "Dictyoclostus" is predominant	2.1
Underclay, gray	1.5
Shale, gray, silty in upper part	3.0
Inola limestone (restricted). Limestone, gray, compact, with abundant fusulinids *(Eoschubertella gallowayi, Pseudostaffella hollingsworthi, Fusulinella trisulcata, Wedekindellina henbesti, Fusulina leei)*	1.9
Coal	0.1
Underclay	1.0
Shale, light gray, with carbonaceous sandstone	2.0
Bluejacket sandstone	

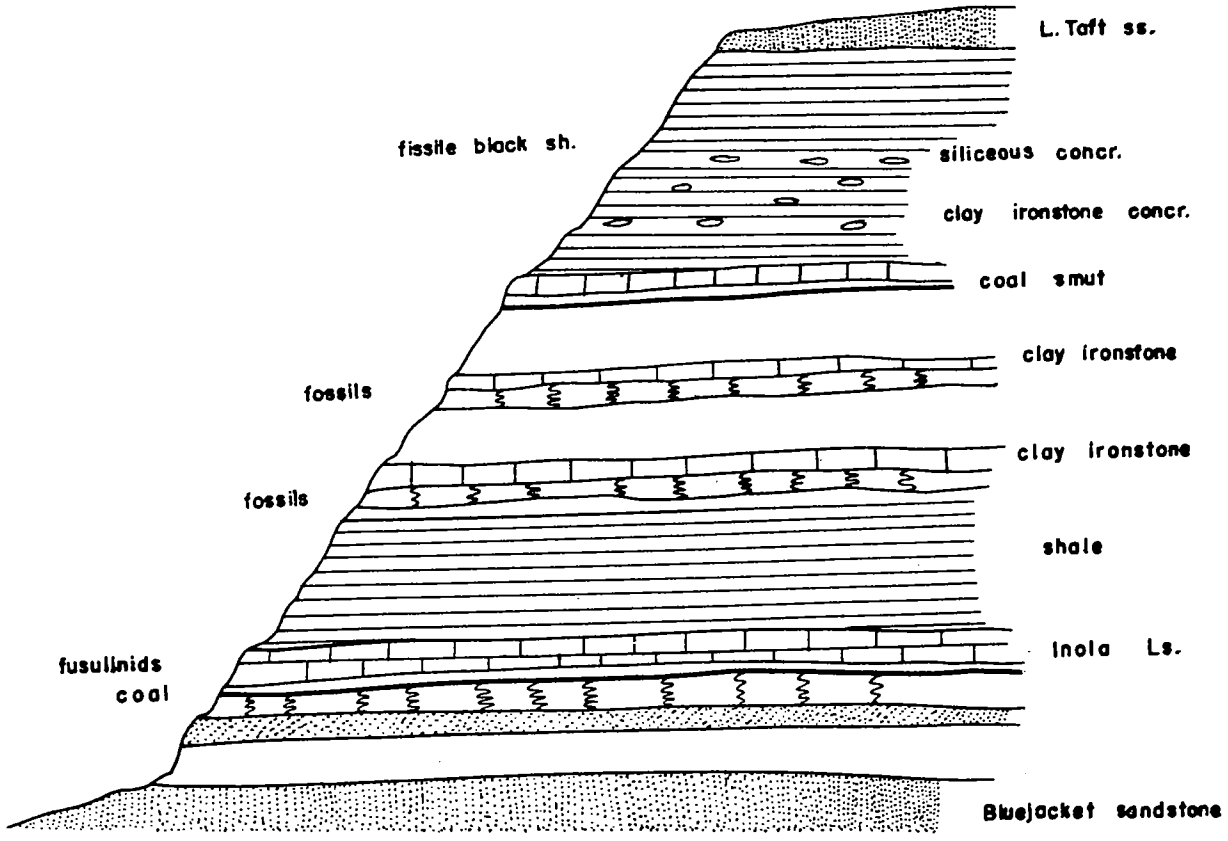


FIGURE 14. Detail of Crop at West Side of Stop 2

The section at this crop shows the presence of four cyclical units within the Inola limestone of former usage. Howe and Searight relate the upper unit to the Liberal limestone of Missouri, which they regard as the Seville limestone of Illinois. Coal occurs

at the base of Inola No. 2 south of here, but has not been observed at the base of Inola No. 3 although it is clearly a coal horizon. The Inola has been found northward to the Craig County line and has been identified southward to McIntosh County.

Drive slowly next 1.3 miles.

10.1 Inola limestone at hilltop. This is the type locality for some of the fusulinid species and they can be collected free of matrix.

10.5 Deep road cut in Bluejacket sandstone, here 55 feet thick. The Drywood coal is exposed at the base and here has a cap rock of lenticular limestone masses.

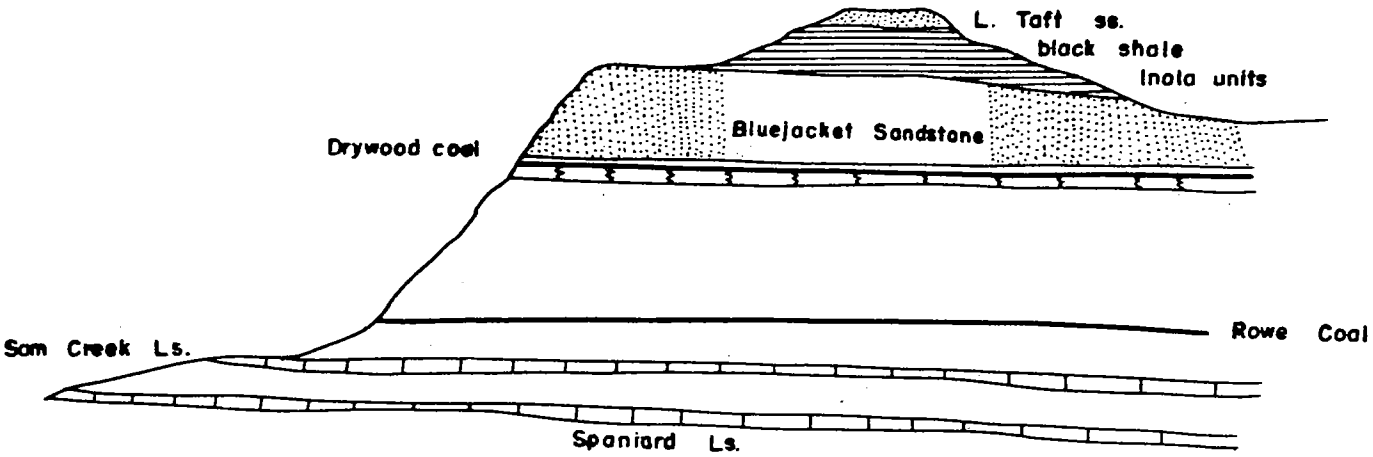


FIGURE 15. Geologic Section at Stop 2

10.9 Rowe coal exposed in south road cut. Fossiliferous clay-ironstone layers in north road cut represent the Doneley limestone.

11.5 *Road north on east line of sec. 8.* Sam Creek limestone with abundant fusulinellas exposed along Seminole Creek 1.3 miles north.

12.5 *Cross-roads at SE cor. sec. 9-21N-18E.*

13.5 *Road south at SE cor. sec. 10.* SLOW Spaniard limestone, here 6 inches of calcareous clay-ironstone, is exposed at the top of the west end of the cut. A thin coal is at the base of the Spaniard and has an underclay. Beneath the underclay is an impure sandstone, a second thin coal, underclay, and shale with clay-ironstone concretions.

13.7 *Bridge over Seminole Creek.*

14.5 *Bridge over Pryor Creek.*

16.2 TURN SOUTH (RIGHT) *onto U.S. Highway 69 in west part of town of PRYOR.* The town is underlain by Fayetteville shale (middle unit of the Chester).

18.3 *Bridge over Pryor Creek.* Morrow in bed of creek.

20.4 *Cross-roads on south line of sec. 36.* Oklahoma Ordnance Works in the township on the southeast.

21.4 *Road west on south line of sec. 1.* Atoka conglomerate rests on Fayetteville shale 2½ miles east, and Atoka sandstone rests on Fayetteville in small dome three miles west.

22.4 *Road west on south line of sec. 12.*

22.6 *Culvert.* Atoka shale and *Taonurus*-bearing sandstone in borrow pit on east.

23.4 *Bridge over Chouteau Creek.* Quarry in Hale sandstone (Morrow) under trees to east. Atoka limestone well developed ½ mile upstream. This limestone appears to be Muskogee lime of subsurface.

24.3 Atoka sandstone in road cut.

24.9 *Cross-roads. Village of Chouteau to west across tracks. Oklahoma Highway 33 goes east to Locust Grove.*

25.6 *Road east on south line of sec. 25.*

26.3 Quarry in Hale limestone in field to east. Slabs of Atoka sandstone on surface of field.

26.6 *Cross-roads. Oklahoma Highway 33 goes west to Tulsa.* Outcrops are Hale limestone. Atoka caps hill ½ mile west. Warner escarpment 2½ miles west.

27.5 *Bridge over Brush Creek.* Hale sandstone in banks.

28.6 *Road south on east line sec. 11.*

30.0 *Cross-roads on south line sec. 14.*

31.2 *Village of MAIZIE.* Atoka sandstone in road cut.

32.5 *Cross-roads on south line sec. 26.* Mounds to southeast are capped by Warner sandstone on downthrown side of fault.

33.5 *Cross-roads on south line of sec. 35.* Leave Mayes County, enter Wagoner County.

34.0 *Access road to lake shore park on east.*

35.0 *Road west.*

35.8 *Bridge over Flat Rock Creek.* On Atoka shales.

36.4 *Cross-roads on south line of sec. 14.*

37.7 **TURN EAST (LEFT)** *at cross-roads at SE cor. sec. 22-18N-18. LELIAETTA.* On Warner sandstone with east-facing escarpment.

38.4 *Cross K.O.&G. tracks. The railroad was relocated to be above the waters of the lake behind Ft. Gibson Dam.* Atoka limestone in cut 100 yards north.

39.2 On dip slope of an Atoka sandstone.

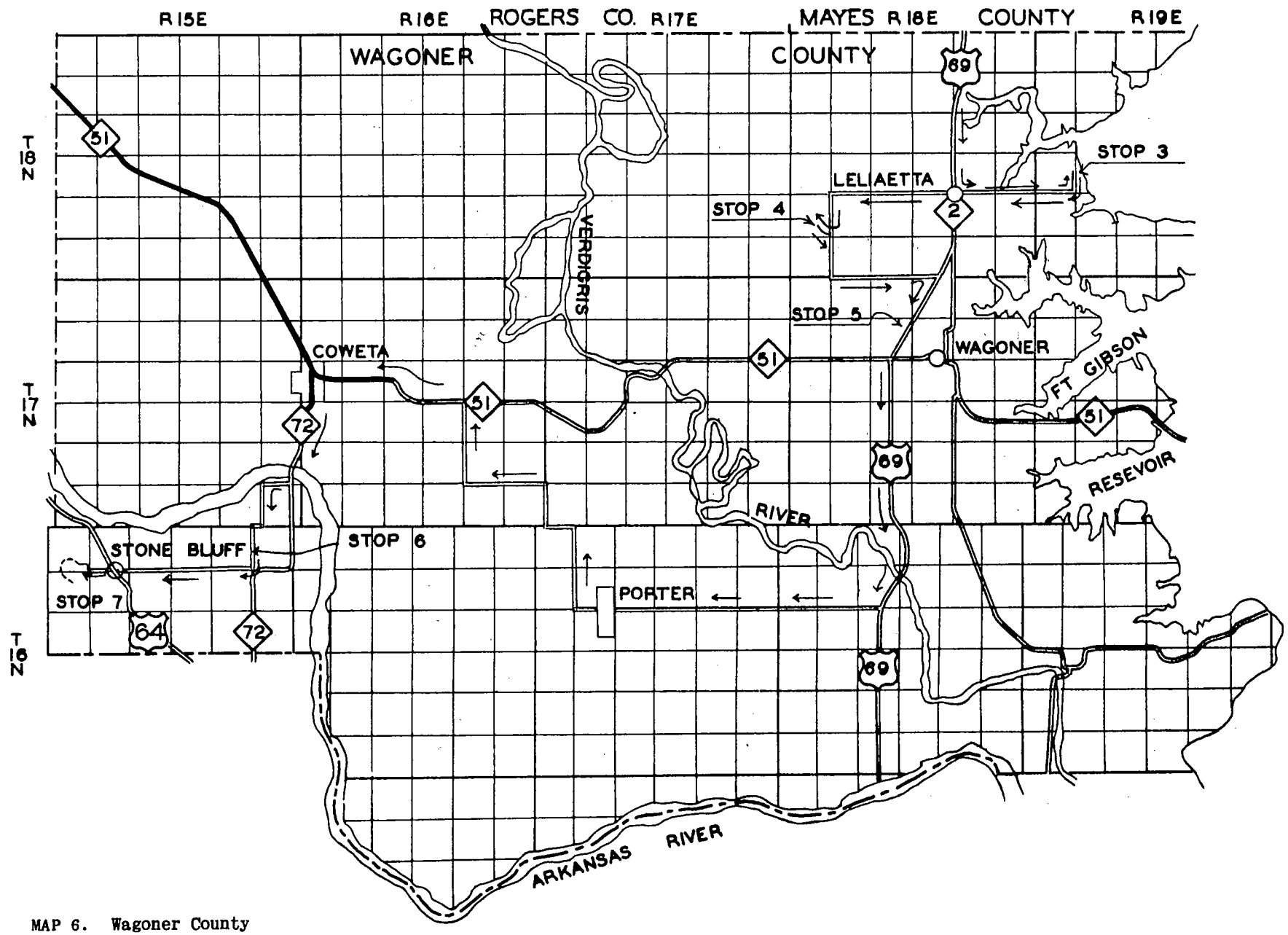
39.4 Escarpment of Atoka sandstone. Sandstone is underlain by dark, fissile shale with siliceous concretions.

39.8 *Cross-roads at SE cor. sec. 24.*

40.0 CAUTION. *Access road south to Holiday Cove.*

40.8 TURN NORTH (LEFT) *just west of Cities Service station.*

41.4 TURN RIGHT *through gate, drive towards garage, turn, and park.* STOP 3. Wagoner city water intake and pumping station. This section has been studied by Dr. Huffman and his students and by Jack G. Blythe.



MAP 6. Wagoner County

Section measured by Jack G. Blythe of Oklahoma City University

NW ¼ sec. 20, T. 18 N., R. 19 E.

	Feet
Warner sandstone member of McAlester formation	10
Hartshorne formation (?). Covered	16
Atoka formation	
limestone, ferruginous, fossiliferous	1
shale, dark gray, with calcareous nodules	3
covered	3.5
sandstone, olive brown, friable	3.5
covered	9.6
shale, dark gray, with calcareous nodules	8.2
covered	6.0
sandstone, buff, cross-bedded, ferruginous	55.5
shale, gray, with calcareous nodules	5.0
covered	27.0
sandstone, buff	1.0
covered	3.7
sandstone, buff, cross-bedded	8.8
covered	1.9
sandstone	0.5
covered	5.4
sandstone	0.5
shale, dark gray, with thin limestone beds	19.2
limestone	0.4
siltstone, gray, calcareous, with *Taonurus*	3.0
shale, black, fissile	20.9
limestone, crystalline, buff to reddish, fossiliferous	1.0
shale, black, fissile	25.1
conglomerate, rounded chert pebbles	17.0

The base of the Atoka is here a chert pebble conglomerate, 8 miles north a sandstone pebble conglomerate, to the west and northwest a sandstone, and at places it is shale. Its character is governed by the locally-available materials on the unconformable surface. The unconformity and overlap at the base of the Atoka are second in importance only to those at the base of the Krebs in this region. Some geologists would make this break the base of the Pennsylvanian.

41.5 *Drive back through gate and return south on gravel road.*

42.1 TURN WEST (RIGHT) *at intersection at Cities Service station.*

44.5 *Cross K.O. & G. tracks.*

47.2 **CAUTION.** *Cross U.S. Highway 69.*

45.7 *Cross M.K. & T. tracks.*

46.0 *Cross-roads at SE cor. sec. 21.* Cross trace of northeast-trending fault.

47.0 *Road south at SE cor. sec. 20.*

48.0 TURN SOUTH (LEFT) *at cross-roads at SE cor. sec. 19.*

48.1 *Narrow bridge over branch of Billy Creek.*

48.8 *Cross Missouri Pacific tracks.*

49.0 SLOW. TURN RIGHT *onto narrow road at cross-roads at SE cor. sec. 30.*

49.2 *Turn right into pasture just beyond barn and follow across fields.*

49.6 STOP 4. In West Wagoner oil field. SE ¼ sec. 30, T. 18 N, R. 18 E. Hale limestone is here a cross-bedded calcarenite with some 20 feet exposed. Basal calcareous clay-ironstone of the Atoka in creek and on shoulder of hill to northwest. Dark shales with thin coal and fossiliferous clay-ironstone cap rock in creek bank. Siltstone at top of bank near cars. The structure is a Hale knob with thin Atoka section now exposed in the axis of a horst.

Drive back to gravel road.

50.0 TURN EAST (LEFT) *onto road.*

50.2 TURN SOUTH (RIGHT) *at cross-roads.*

50.4 Spaniard limestone exposed in road cut. Here and to the south and southeast the Spaniard is "Campophyllum limestone", so called because it carries abundant specimens of the solitary coral *Caninia torquia*. Hill ahead is Blue Mound, capped by Bluejacket sandstone, Doneley limestone and Rowe coal near base. Mound is outlier on downthrown side of fault.

51.2 TURN EAST (LEFT) *at SE cor. sec. 31.*

52.1 *Road south. Continue east across Missouri Pacific tracks.*

52.2 *Road north at SE cor. sec. 32.*

52.4 Hill to south is capped by Warner sandstone.

53.2 *Cross-roads at SE cor. sec. 33.*

53.4 *Cross M.K.&T. tracks.*

53.9 TURN SOUTH (RIGHT) *on U.S. Highway 69.*

54.6 *Overpass M.K.& T. tracks.* Spaniard limestone exposed in borrow pit east of south approach.

54.8 *Overpass Missouri Pacific tracks.*

55.0 SLOW. TURN SHARPLY RIGHT AND THEN BACK NORTH *at south end of approach to overpass.*

55.3 *Circle around and park near overpass.* STOP 5. In NE¼ sec. 9, T. 17 N., R. 18 E. Spaniard limestone well exposed in railroad cut. Limestone contains numerous specimens of *Caninia torquia* throughout this area. Thin coal is beneath the limestone, and underclay, shale, and sandstone of the lower part of the cyclothem are exposed well.

Return to highway.

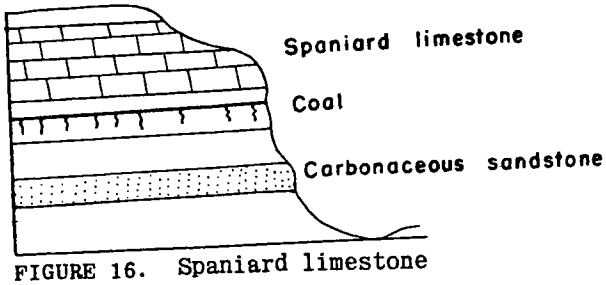


FIGURE 16. Spaniard limestone

55.5 GO SOUTH *on U.S. Highway 69. Merge with traffic from left. We will make a rest stop just south of this point. Please park off west side of highway and maintain order of caravan.*

56.1 *Cross Oklahoma Highway 51 one mile west of city of Wagoner.* Chert gravel of upland terrace. Mound to southwest is entirely shale.

57.2 *Cross-roads on south line of sec. 16.*

58.2 *Cross-roads at S¼ cor. sec. 21.* Old strip pits in Rowe coal 1 mile southeast.

58.6 Road cut in sandstone, clay-ironstone, crinoidal shale at Sam Creek horizon. Volcanic ash in terrace was once dug ½ mile west.

59.2 *Cross-roads at S¼ cor. sec. 28. Fort Gibson Dam is 14 miles southeast.* Strip pits in Rowe coal along Coal Creek ½ miles southwest.

60.6 Upland terrace deposits.

61.8 *Bridge over Verdigris River.* Spaniard limestone exposed at north pier and in north bank of river ½ mile upstream.

62.1 *Bridge over east end of Vann's Lake.* On alluvium.

62.6 TURN WEST (RIGHT) *on gravel road on south line of sec. 9.*

63.2 *Cross-roads at SE cor. sec. 8.*

64.2 *Cross-roads at SE cor. sec. 7. Vann's Lake School on northwest.* Isolated hill to north is capped by Bluejacket sandstone.

65.2 *Cross-roads at SE cor. sec. 12.* Excellent exposure of Sam Creek limestone 1½ miles north and 300 yards east of south pier of Vann's Ferry Bridge.

65.5 Steep west-facing escarpment is fault-line scarp.

66.2 *Cross-roads at SE cor. sec. 11.*

67.2 *Narrow bridge. Road north at SE cor. sec. 10.*

67.8 Base of Bluejacket sandstone in east-facing escarpment.

69.1 Old strip pits in coal believed to be Weir-Pittsburg.

69.2 *Cross-roads.* Coal five inches thick in bank on northwest corner.

69.5 *Stop sign. Enter town of PORTER and continue straight ahead.*

69.7 *Road north at S¼ cor. sec. 8.*

69.9 Old strip pit on south.

70.2 TURN NORTH (RIGHT) *at SE cor. sec. 7.*

71.2 *Cross-roads at SE cor. sec. 6.* Active strip pit to east.

72.2 TURN WEST (LEFT) *at offset on township line, NE cor. sec. 6.*

72.7 TURN NORTH (RIGHT) *at SE cor. sec. 36.*

73.2 CAUTION. *Rough, narrow bridge.*

73.6 TURN WEST (LEFT) *at SE cor. sec. 25.* On Bluejacket sandstone.

74.5 Inola limestone in tributary gulleys on south.

74.7 *Sharp curve right across narrow bridge.*

75.5 Steep slope is fault line scarp. Dips are in drag zone along fault.

75.8 TURN NORTH (RIGHT) *at SE cor. sec. 27. Two rough crossings ahead.*

76.8 *Road west at SE cor. sec. 22.* Ripple marks on top beds of Bluejacket.

77.8 CAUTION. TURN WEST (LEFT) *on Oklahoma Highway 51. SE cor. sec. 15.*

77.8 *Bridge.*

79.9 *Curve westward onto pavement. Road east is line of new route of Highway 51.*

80.1 *Road north at east $\frac{1}{4}$ cor. of sec. 17.*

80.6 Fault-line scarp with Taft sandstone.

81.1 *Cross-roads at SE cor. sec. 18.*

NOTE: At next log point there is an opportunity to leave the caravan. The remainder of the trip is over twelve miles of rough roads with two stops. Those who wish to leave keep right with Highway 51 to Broken Arrow and Tulsa.

81.3 *Continue west, leaving Highway 51, which curves northwestward.*

81.4 *Cross M.K. & T. tracks.*

81.5 STOP SIGN. TURN SOUTH (LEFT) *onto main street of town of COWETA. On Oklahoma Highway 72.*

82.0 *Turn west (right) with Highway 72.*

82.2 *Turn south (left) with Highway 72.* Road ahead leads onto Chelsea sandstone escarpment.

82.5 *Bridge over Coweta Creek.*

82.9 *Bridge over Coweta Creek.*

83.2 *Road west at SE cor. sec. 24.* Thick terrace deposits to west.

84.1 *Bridge over Arkansas River.*

84.3 TURN WEST (RIGHT) *on south line of sec. 25.* On alluvium.

85.1 TURN SOUTH (LEFT) *at SE cor. sec. 26.*

86.0 *Sharp turn across narrow bridge over Concharty Creek.*

86.8 STOP 6. Tiawah limestone is exposed near old house and well. The Tiawah at this place is quite different from the occurrences to the north. It is a thin, impure, ferruginous bed. The Tebo coal is five feet below the base of the limestone. The following section was measured by Jimmy Tom Lontos in 1952.

Chelsea sandstone (in escarpment to west)	48.6 feet
Shale, covered	14.2
Tiawah limestone, dark gray, carbonaceous, fossiliferous	2.6
Shale, gray to black, weathered	5.0
Tebo coal	0.5
Underclay	0.8
Shale, dark gray, sandy, micaceous	3.5
Sandstone	

This is the last certainly identified crop of Tiawah to the south.

87.4 TURN WEST (RIGHT) *at cross-roads at SE cor. sec. 2.*

88.0 Base of Chelsea sandstone.

88.9 *Road south at SE cor. sec. 3.*

90.2 Base of Chelsea sandstone on west side of outlier.

90.3 SLOW. *Narrow bridge over branch of Concharty Creek.* **GO INTO LOW GEAR TO CROSS MIDLAND VALLEY TRACKS** *on steep slope.* Base of Chelsea sandstone on east side of outlier.

90.7 Base of Chelsea sandstone on west side of outlier.

91.3 **CAUTION. STOP,** *then cross U.S. Highway 64. Village of STONE BLUFF.*

91.9 *Narrow bridge.*

92.0 TURN NORTH (RIGHT) *at SE cor. sec. 6.*

92.1 TURN WEST (LEFT) *with road.*

92.5 In the hill west of the road is an old strip pit and drift in Croweburg coal. The Verdigris limestone is exposed above the coal.

92.9 In ditch on north side of the road the lowest resistant ledge is a compact sandy limestone believed to be the Breezy Hill limestone. About ten feet above it is another sandy limestone identified as the Blackjack Creek (Lower Fort Scott) limestone. Pass through section of thick sandstone beds with intervening shales on way up side of mountain.

93.2 STOP 7. On top of Concharty Mountain, in sec. 7, T. 16 N., R. 15 E. We are in the edge of an oil field which covers a large part of the mountain. The oil is from several pays.

The section measured here is in part by Herbert Ware, in part by Lontos

Sandstone, buff, cross-bedded Shale Sandstone, buff Shale Sandstone, buff Shale Sandstone, light buff Shale	120.0
Sandstone, white, medium-grained	5.5
Shale, greenish	6.2
Limestone, gray, compact (Blackjack Creek)	0.8
Shale, dark, which phosphatic nodules	6.8
Limestone, buff, silty (Breezy Hill limestone)	0.7
Sandstone, buff, thin-bedded, micaceous	1.1
Shale, dark, largely covered	13.8
Shale, sandy, weathers buff	14.8
Sandstone, thin-bedded, buff to gray	1.1
Limestone, gray, compact in lower part, argillaceous in upper part, highly fossiliferous (Verdigris limestone)	2.7
Shale, black fissile	1.3
Clay-ironstone	0.3
Shale, black, fissile, with phosphatic nodules	5.8
Coal (Croweburg coal)	1.4
Underclay	1.5
Shale, gray	70.0
Coal	1.5
Underclay	1.0
Sandstone, thin-bedded, light buff, with shale beds	25.0
Shale, gray, silty	10.0
Chelsea sandstone	

The sandstones in the upper part of Concharty Mountain are similar to those of the Wewoka and from this point south this section is called Wewoka. To the north, it is called Labette.

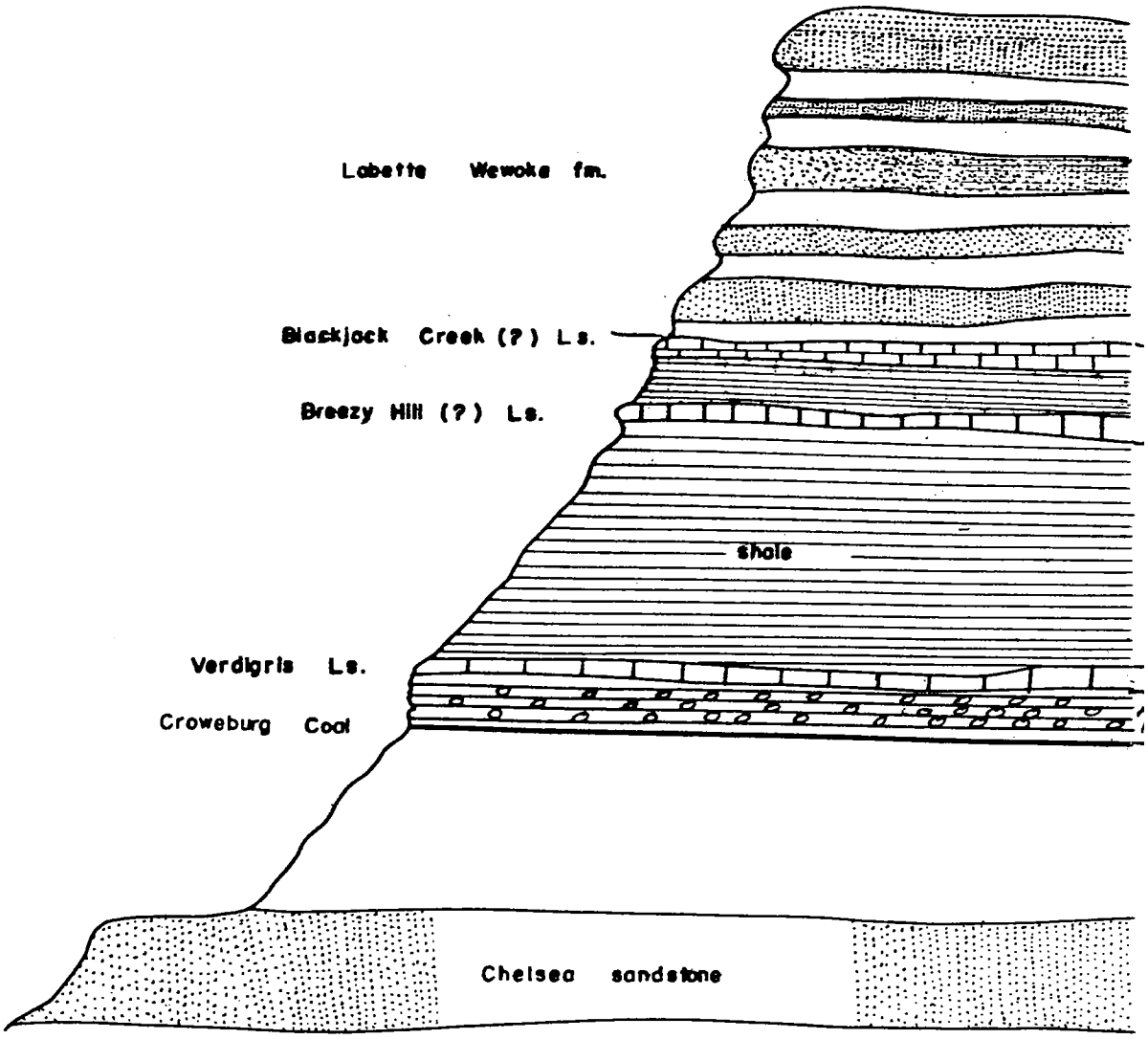


FIGURE 17. Section on Concharty Mountain

The Oklahoma City Geological Society and the Oklahoma Geological Survey wish to tell that we are glad you came and hope that you enjoyed the trip. You are invited to attend next year's trip, which is planned for the Arbuckle Mountains under the leadership of Dr. William E. Ham. Dr. Ham will have essentially completed his geologic study of the mountains and his preparation of his maps and reports at that time. His general geologic map of the mountains is in press and will be available in the Fall of 1954.

There is no good way off Concharty Mountain except back the way we came. Turn left on Highway 64 for Tulsa, right for Haskell, Muskogee, and Okmulgee.

HOPE TO SEE ALL OF YOU AGAIN NEXT YEAR

146.0 TALALA. *Wait for caravan to pass before proceeding.*

146.4 *Cross-roads on south line of section 27. Caravan goes east here.*

147.4 *Cross-roads at SE cor. sec. 33.* Dawson coal strip pits 1½ miles west.

148.4 *Road west at SE cor. sec. 4.*

149.4 *Road east near SE cor. sec. 9.*

150.4 *Cross-roads near SE cor. sec. 16. Highway 169A goes east to Will Rogers birthplace.*

150.6 *Bridge over Fourmile Creek.*

151.4 *Cross-roads on south line of sec. 21.*

151.8 *Cross-roads and railroad station in village of OOLOGAH.*

152.7 *Curve southwestward with highway.*

152.9 *Bridge over Fourmile Creek.*

153.9 *Angle left, south onto Oklahoma Highway 88 at intersection near SE cor. sec. 32. Leave U.S. Highway 169.* On Oologah limestone.

154.9 *Road west at SE cor. sec. 5-22N-15E.*

155.9 *Turn east with highway at SE cor. sec. 8.*

156.9 *Road south at SE cor. sec. 9.*

157.6 Base of Oologah limestone in east-facing escarpment.

157.9 *Turn south with Highway 88. Road east.*

158.5 *Curve east with Highway 88.*

158.9 *Bridge over Verdigris River.* Blackjack Creek and Breezy Hill limestones in west bank.

159.5 *Highway curves to southeast.* Outlier on northeast is Claremore Mound, scene of battle between Cherokee and Osage Indians. Mound is capped by Oologah limestone, slopes are Labette shale, road is on Blackjack Creek limestone (Lower Fort Scott).

160.7 *Sageeyah School and Sageeyah Baptist Church.*

161.3 *Cross-roads at SE cor. sec. 24.*

163.3 *Cross-roads at township corner. SE cor. sec. 36-22N-15E.*

164.3 *Turn east with Highway 88. Roads west and south. SE cor. sec. 1.*

165.3 *Highway turns south into edge of Claremore.*

165.4 Will Rogers Memorial on left, Oklahoma Military Academy on right.

166.1 *Cross Frisco tracks.* STOP. *Cross U.S. Highway 66. Proceed one block east to Will Rogers Hotel, headquarters of the field trip for Friday night.* Dinner is at 7:00 in the hotel.