

KANSAS GEOLOGICAL SURVEY
OPEN-FILE REPORT 92-30

Red Hills Field Trip
Staff Field Trip 6-7 October, 1992

by

Jim McCauley
Rex Buchanan

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KANSAS GEOLOGICAL SURVEY
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The following two-day field trip begins west of Medicine Lodge, runs through the Red Hills, and ends at Little Basin in western Clark County. The route will go through Permian redbeds, Cretaceous sandstones and shales, and the more recent Ogallala Formation. We will also see several recent and historic examples of subsidence.

DAY 1
 GYP HILLS TRAIL

0.0 This trail follows the Gyp Hills Scenic Drive, beginning on County Road N5 408, about 3.3 miles west of the junction between U.S. Highway 160 and U.S. 281 North in Medicine Lodge. This trail winds south from U.S. 160, eventually turning west, then north and leading back to U.S. 160 about 10 miles west of here. The elevation here is 1,510 feet.

(0.5)

0.5 T-road to the east.

(0.2)

0.7 Walnut Creek.

(0.7)

1.4 The elevation here is 1,650 feet. The T-road to the east angles back to U.S. 160 just a mile west of Medicine Lodge. The oil wells in this area are in the Medicine Lodge North oil and gas field, which was discovered in 1954 and produces oil from Mississippian rocks at a depth of 4,500 feet.

(1.0)

2.4 **STOP 1.** Elevation 1,700 feet. Here the road climbs up through exposures of the Flower-pot Shale, containing veins of selenite that weather out and litter the hillsides like broken glass. This shale underlies the gypsum beds of the Blaine Formation, which caps the buttes and mesas in this area (a table showing the units encountered on this trip is attached at the end of the road log. The table is from Bruce Latta's 1948 *Geology and Ground-Water Resources of Kiowa County*, Survey Bulletin 65; in a few cases, the stratigraphic nomenclature is out of date). Gypsum was first quarried in these hills in the late 1800s and was originally used in the production of Keene's cement, a high-grade plaster used in the construction of expensive buildings. Quarrying and underground mining moved later to an area southwest of Sun City, where it continues today. The gypsum is processed at a large plant on the west edge of Medicine

Lodge and is used to make wall board for home construction and various types of plasters.

(0.7)

3.1 **STOP 2** . Entrance to the Maria Ranch. The elevation here is 1,800 feet, 300 feet above Medicine Lodge about six miles to the northeast. The elevation makes this an excellent location for radio towers.

(1.2)

4.3 Creek crossing, elevation 1,610 feet.

(1.0)

5.3 An oil-well lease road leads to the west.

(0.2)

5.5 Oil-well lease road to the east.

(0.1)

5.6 A windmill is east of the road.

(0.4)

6.0 A T-road runs to the west. The road log follows the road to the west, following the Gyp Hill Scenic Drive.

(0.5)

6.5 The elevation is 1,700 feet.

(0.4)

6.9 T-road to the north, which leads two miles to Flowerpot Mound. Several trees once grew from the summit of this hill; from a distance they suggested a potted plant growing from an inverted terra cotta flowerpot. The mound, in turn, has lent its name to the Flower-pot Shale, which is exposed on its slopes. The mound lies between East and West Cedar creeks, which flow more than 200 feet below the hill's summit. Flowerpot Mound is a butte capped by an outlier of gypsum in the Blaine Formation. The steep slopes of this and other buttes in the area deter cattle from reaching the summit, thus preserving small islands of virgin prairie that are not grazed.

(0.5)

7.4 Turn to the south.

(0.2)

7.6 Turn west.

(0.8)

8.4 An oil-well lease road leads north to the Brooks-Younger gas field.

(0.8)

9.2 East Cedar Creek, elevation 1,730 feet. This is the headwater region of East Cedar Creek, which joins West Cedar Creek 4.5 miles to the northeast, forming, you guessed it, Cedar Creek.

(1.0)

10.2 Turn south.

(0.1)

10.3 The elevation is 1,900 feet.

(0.7)

11.0 Turn west.

(0.2)

11.2 West Cedar Creek, elevation 1,850 feet.

(0.7)

11.9 T-intersection. Turn north.

(0.3)

12.2 Turn west at an old school house. The elevation is 1,910 feet.

(1.1)

12.9 Cattle guard. Turn north.

(0.2)

13.5 Creek crossing. This un-named creek flows south into Big Sandy Creek.

(0.3)

13.8 Oil tanks. These tanks provide storage for oil that is pumped to the surface by wells in this area. The oil in the tanks is generally collected by trucks and transported to a central location for refining. These tanks are also used in many locations to separate oil from the salt water that is often pumped to the surface with the oil. Kansas wells produce an average of 10 barrels of salt water for every barrel of oil, and the salt water must be separated and disposed of, usually by pumping it into a deep underground rock formation where it cannot endanger groundwater. Because salt water has not always been disposed of properly, it represents a major environmental challenge in the state.

(0.2)

14.0 Cattle guard.

(0.5)

14.5 Cattle guard.

(0.5)

15.0 Oil tank and cattle guard, elevation 1,980 feet. This upland area includes alluvial sand and gravel that was deposited early in the Pleistocene or late Tertiary. These deposits cover some of the higher drainage divides in the Red Hills and occur in the undissected plains north of the Red Hills. These alluvial plains once extended across today's Red Hills, bearing debris washed eastward out of the Rocky Mountains. Erosion has since removed much of this alluvium and carved out numerous valleys and canyons in the underlying redbeds that today characterize the Red Hills.

(0.4)

15.3 Cattle guard

(0.1)

15.4 Junction with the road to Deerhead. The road to the right leads north and continues on the Red Hills Scenic Drive. Take the road to the left, which leads to Deerhead and follows the drainage divide between the Medicine Lodge River to the north and the Salt Fork of the Arkansas River to the south.

(0.2)

15.6 Red cedars, which are actually junipers, thrive in the Red Hills. A portion of the Red Hills is known as the Cedar Hills, giving its name to the Cedar Hills Sandstone, a red sandstone that crops out east of here near Medicine Lodge. Some ranchers consider red cedars a nuisance and detrimental to the range. They attempt to eradicate them, as in the pasture north of here.

(0.3)

15.9 Cattle guard. The grayish-green bush that thrives in the sandy draws is sand sage (*artemisia filifolia*), a cousin of the big sagebrush that thrives in the Great Basin and the dry valleys of the Rocky Mountains.

(0.6)

16.5 Y-intersection. Take the road to the right, leading northwest.

(0.6)

17.1 Cattle guard. Much of the route of this field trip is along public roads, through pastures that are not fenced along the road. Cattle

regularly wander onto the roads. Kansas has an open-range law, which states that it's the driver's responsibility to avoid hitting cattle, not the responsibility of ranchers to fence them off the road. Much of this route is through open range. Drive carefully.

(0.2)

17.3 Cattle guard.

(0.2)

17.5 Elevation 2000 feet.

(0.5)

18.0 The road turns left (west) at a cattle guard.

(0.6)

18.6 This upland area is mantled by alluvial sands and gravels that are usually mapped as the Meade Formation. These hills are 200 feet higher than the prominent gypsum-capped hills we climbed just southeast of Medicine Lodge. The alluvium underlying this area is thick enough to act as an aquifer providing water for the nearby windmill and stock tank.

(1.0)

19.6 Cattle guard.

(0.6)

20.2 Cattle guard and T-road north. Continue straight (west).

(0.7)

20.9 Turn left (south).

(0.2)

21.1 Turn right (west). For the next mile the road passes through a small area of sand hills. Loose sand fills the roadway in places for the mile, so drivers should maintain their speed to avoid getting stuck.

(1.0)

22.1 T-road. This crossroads is Deerhead (elevation 1,950 feet). The road south leads to an equally populous place known as Aetna. Turn right (north) and proceed back toward U.S. 160.

(2.0)

24.1

Elevation 2,030 feet.

(0.8)

24.9 Roadcut in the Meade Formation showing cross-bedded sandstone and conglomerates.

(0.2)

25.1 Stop sign, junction with U.S. 160. Medicine Lodge is 19 miles east and Coldwater is 24 miles west. Go 1.2 miles west on U.S. 160, then turn north.

SUN CITY-BELVIDERE-WILMORE

0.0 This route begins at U.S. Highway 160, 19.2 miles west of its junction with U.S. 281 in Medicine Lodge and 21.8 miles east of its junction with U.S. 183 in Coldwater. It passes through the northern part of the Red Hills and through an area where Cretaceous rocks crop out in Kiowa County, including some rugged badlands areas. The buff-colored gravels exposed at this intersection are in the Meade Formation. These alluvial gravels are Quaternary in age and cover upland areas and interstream divides.

(0.5)

0.5 The oil tanks and oil well east of the highway are part of the Donald oil field. Oil here is produced from Mississippian rocks that are 4,200 feet deep. Mississippian rocks crop out in extreme southeastern Kansas in Cherokee County.

(1.2)

1.7 Red beds in the Whitehorse Formation.

(0.6)

2.3 About 0.8 miles east of this point, a natural bridge once spanned a tributary of Bear Creek. This natural bridge collapsed in 1963 (although stories persist that the bridge was actually dynamited by the owner, who grew tired of tourists coming onto his property). This was once a popular attraction in the Red Hills. An early description was written in 1896 by Prof. F. W. Cragin, who wrote many of the early descriptions of the geology and paleontology of the Red Hills:

This bridge spans the canon of the creek, here about fifty-five feet from wall to wall. The height of the bridge above the bed of the creek is at the highest point forty-seven feet, at lowest thirty-one, and at middle thirty eight. The width of the bridge at the middle is thirty-five feet. The upper surface of the bridge declines toward the down-stream side, but not so much that a wagon drawn by a steady team could not be driven across it. The thickness of the arch is therefore greater on the up-stream side, where it measures twenty-six feet, than on the down stream. The relief of the vicinity seems to indicate that at a geologically recent time Bear creek here flowed to the east of its present course, and that its waters, becoming partially diverted by an incipient cave, enlarged the latter, and finally were wholly stolen by it, the cave at length collapsing, save at the portion now constituting the natural bridge.

(1.8)

4.1 The hills east of the road are capped by the Medicine Lodge Gypsum Member of the Blaine Formation and the road drops through massive gypsum into Bear Creek valley.

(0.3)

4.4 Bear Creek, elevation 1,700 feet. Bear Creek flows into the Medicine Lodge River three miles to the northeast.

(0.1)

4.5 Cattle guard.

(0.1)

4.6 Bridge.

(0.8)

5.4 Cattle guard, elevation 1,830 feet.

(0.2)

5.6 Cattle guard.

(0.2)

5.8 T-road to the west. This road leads one mile west to one of two gypsum mines in Kansas. The other mine, located near Blue Rapids in Marshall County, takes gypsum out of the Easley Creek shale, while the Barber County mine takes gypsum from the Medicine Lodge Gypsum Member of the Blaine Formation. Both gypsum units were deposited during the Permian, but the Easley Creek was deposited several million years before the Medicine Lodge. This mine, operated by Gold Bond Building Products, is one of the ten largest gypsum mines in the U.S. Gypsum from the mine is hauled to Medicine Lodge for processing. This is **STOP 3**, a brief tour of the mining operation.

(0.4)

6.2 Here the road makes a sharp curve around a box canyon. The road then makes the descent to the Medicine Lodge River, cutting through the gypsum in the Blaine Formation and the underlying Flower-pot Shale.

(0.8)

7.0 Clawson Williams Walker Memorial Bridge spans the Medicine Lodge River, elevation 1,660 feet. Turkey Creek flows into the Medicine Lodge a short distance upstream. The drainage basin of the Medicine Lodge River extends north to Haviland on U.S. Highway 54 in Kiowa County. The Medicine Lodge drains the entire southeast quarter of Kiowa County, southwestern Pratt County, the far northeast corner of Comanche County,

and much of Barber County. The Medicine Lodge River drains the south edge of the High Plains in Kiowa and Pratt counties. Runoff in the river's source area south of Greensburg in Kiowa County falls 700 feet in elevation over a linear distance of 25 miles by the time it reaches this point. It falls more than 400 more feet by the time it enters Oklahoma just east of Kiowa. The Medicine Lodge River flows into the Salt Fork of the Arkansas River just above the Great Salt Plains in Oklahoma.

(0.6)

7.6 Railroad crossing and stop sign. Sun City. Turn west.

(0.1)

7.7 Railroad crossing. Just west of the railroad crossing, turn north and cross the railroad again.

(0.4)

8.1 T-road west. Turn west. At this corner is a sign indicating that Belvidere is 11 miles away. The Sun City gypsum mine is visible to the south in the hills beyond the Medicine Lodge River.

(0.3)

8.4 Turkey Creek.

(0.1)

8.5 Curve. The road turns, following the railroad tracks to the northwest. The road that leads straight west winds its way into the hills of northeast Comanche County and passes near a badlands called Hell's Half Acre, where cedar-studded canyons have been cut into white Cheyenne sandstone of Cretaceous age. Also near this point, a railroad spur named Gypsum branches from the main set of tracks and leads south two miles to the Sun City gypsum mine, providing a rail connection between the mine and the gypsum plant on the west edge of Medicine Lodge.

(0.4)

8.9 Redbeds are exposed in a road cut east of the road and in the Flowerpot Shale.

(0.5)

9.4 Northeast of the road are gravel pits. The Medicine Lodge River flows a short distance southwest of the road. This road and the railroad both follow the Medicine Lodge River through this part of the Red Hills because this path offers a much easier grade than routes that cut through the rough country to the north and south. This railroad is a branch of the Atchison, Topeka, and Santa Fe that runs west from Attica in Harper County, to Medicine Lodge, and then northwest through the Medicine Lodge River valley through Sun City to Belvidere, where it turns southwest

and passes through Wilmore, Coldwater, Protection, and Ashland before ending at Englewood near the Oklahoma border. This is one of the few rail lines that penetrates the Red Hills. The nearest line to the south is 50 miles away in Oklahoma and follows a similar northwest path up the Cimarron River valley.

(0.4)

9.8 Farm house north of the road. In the hills farther to the north is the Sun City oil field, discovered in 1941. It produces oil from Pennsylvanian rocks that crop out in southeastern Kansas from Fort Scott southwest to near Coffeyville.

(0.6)

10.4 T-road south.

(0.2)

10.8 A lease road runs east and then north to the Turkey Creek East gas field. This field produced oil at one time but the oil wells have since been abandoned and plugged.

(0.3)

11.1 Creek crossing.

(0.3)

11.4 Creek crossing.

(1.0)

12.4 T-road north.

(0.2)

12.6 The Glick compressor station of the Kansas Gas Supply Corporation is north of the road. The Glick oil and gas field is a large field northwest of here that covers part of northeast Comanche and southeast Kiowa counties.

(0.1)

12.7 Creek crossing.

(0.1)

12.8 Abandoned farm house north of the road.

(1.1)

13.9 T-road north. The road north leads 5.5 miles to the town of Croft in Pratt County. This crossroad is located near the point where the Medicine Lodge Gypsum Member outcrop meets the bed of the Medicine Lodge River. To the northwest along this road the gypsum is in the subsurface,

below the river valley. Gypsum was mined near this area in the late 1800s, and at that time the locale was known as Kling.

(0.2-0.4)

14.1-14.3 **STOP 4** . The rock units in this road cut do not have the horizontal bedding usually seen in Kansas rocks. Instead, they have a disturbed appearance that is probably the result of dissolution of the Medicine Lodge gypsum, which lies very close to the surface here. Gypsum is soluble in water; when it is dissolved by groundwater, cavities are left behind. When these cavities collapse, they cause wavy or disturbed beds in the rocks above.

(0.0)

14.3 Creek crossing. This is also the Barber/Kiowa county line. Kiowa County is named for the Plains Indian tribe that ventured south into Kansas. They were represented at the Medicine Lodge peace conference of 1867 by Satanta. There is a town named for Satanta in Haskell County, and a town named Kiowa in Barber County. Geologists have given the name Kiowa Formation to a shale and sandstone sequence that is exposed in Kiowa County.

(0.2)

14.5 Creek crossing and pond north of the road.

(0.8)

15.3 Red beds are exposed in the road cut on the north side of the road. These beds are most likely in the Dog Creek Formation, named for exposures along Dog Creek near U.S. 160 southeast of Sun City.

(0.1)

15.4 Creek crossing.

(0.5)

15.9 Soldier Creek. This creek has its source 12 miles north near Wellsford.

(1.8)

17.7 Anchor D ranch. Just north of the ranch is a railroad crossing, and north of the crossing this road makes a T with a blacktop road. Turn west. The road to the north goes 11 miles to U.S. 54.

(0.7)

18.4 Medicine Lodge River, elevation 1,800 feet. Just to the north, the Medicine Lodge River is joined by Spring Creek. Like many of the south-flowing tributaries of the Medicine Lodge River that drain the edge of the High Plains to the north, Spring Creek is fed by numerous springs--hence

its name. These springs emerge near the contact between the alluvial sediments of the High Plains and the much older, underlying rocks of the Red Hills. The sediments of the High Plains are sand and gravels that provide abundant pore space for groundwater to accumulate and move through. The Cretaceous and Permian rocks that underlie the High Plains aquifer are fine sandstones, siltstones, and shales that do not allow as easy movement of groundwater. As a result, where these two rock types meet, groundwater tends to move along that contact; where that contact intersects the ground's surface, as it does along the edge of the High Plains to the north, springs emerge, draining groundwater from the High Plains sediments and giving rise to streams.

(0.7)

19.1 T-road south. Take this road about 0.6 miles to a scenic box canyon formed in the Cheyenne Sandstone. By fencing off the open end, the canyon can be used as a corral for horses or cattle. About two miles farther are several sandstone hoodoos formed in the Cheyenne Sandstone. After this short detour, we will return to the blacktop road.

(0.2)

19.3 Belvidere. A geologic map of the Belvidere area by Bruce Lata is attached. This town gets its name from an Italian word meaning "beautiful view." Belvidere is home to the Medicine River General Store and Turnbull's Trail's End Junk Shoppe. A road leads northwest out of Belvidere and crosses the Medicine Lodge River and then forks. The left fork follows Thompson Creek to U.S. 54 east of Brenham. The right fork leads north to U.S. 54 near Haviland.

(0.2)

19.5 Creek crossing. To the north is Ty Della Memorial Park. A half-mile southwest of here is Champion Draw, which lent its name to the "Champion shell bed," a layer that is almost entirely composed of shells and is called a coquina. The Champion shell bed, named by F.W. Cragin in 1895, is usually a foot thick or less and occurs near the base of the Kiowa Formation. Shells from 30 different species of invertebrate animals have been found in this bed.

(0.7)

20.2 Creek crossing. Visible at times through the trees that line the Medicine Lodge River to the north are two prominent outcrops of white sandstone. The western outcrop is Osage Rock; the eastern is Cheyenne rock, the site of a battle between the Osage and Cheyenne Indians. These rocks are formed from Cheyenne Sandstone, which is named for the rock. This sandstone, deposited during the Cretaceous, lies atop the Permian red beds that crop out throughout the Red Hills. The contact between these two units is an unconformity, or a gap in the geologic record, leaving no

trace of two geologic periods, the Triassic and Jurassic, which occurred between the Permian and the Cretaceous. Evidence of roughly 100 million years of geologic history is thus missing in this area, either because those periods were times of erosion, rather than deposition, in this area, or because the rocks that were deposited here during the Triassic and Jurassic were since eroded away.

The Cheyenne Sandstone is widespread within the subsurface of western Kansas but crops out only here in the Red Hills of south-central Kansas. A layer of quartz and chert pebbles is often found at the base of the Cheyenne here in Kiowa County. These pebbles, naturally cemented together to form a rock geologists call a basal conglomerate, probably represent a flood or increase in the flow of water during the Cheyenne's deposition. That increased water flow could carry rocks that were larger and heavier than the fine-grained sand that makes up most of the Cheyenne. Basal conglomerates are common features of unconformities, marking the beginning of a period of deposition.

(0.8)

21.0 Farm house north of the road.

(0.2)

21.2 Transition between gravel and pavement.

(0.1)

21.3 The road leading west from this point follows the Medicine Lodge River valley. Iron Mountain, four miles west of here, gets its name from ironstone ledges in the Dakota Formation that crop out on its slopes. This marks one of the few known outcrops of the Dakota in the Red Hills area. Elsewhere in central and northern Kansas, the Dakota is found conformably above the Kiowa. The road ahead and the railroad follow Otter Creek to the southwest.

(0.4)

21.7 The rounded hills south of the road are formed on the soft gray shales of the Kiowa Formation, which overlies the Cheyenne Sandstone. The Kiowa is made up of shales and sandstone; in central Kansas, the Kiowa looks much like sandstones and shales from the Dakota Formation, which lies immediately above the Kiowa.

(0.5)

22.2 This area is known as Mephistopheles' Quarter Acre. It is composed of resistant pillars of Cheyenne Sandstone that geologists call hoodoos. The overlying gray shales of the Kiowa Formation crop out south of the road.

(0.3)

22.4 **STOP 5.** Shale and thin shell beds in the Kiowa Formation are south of the road and railroad. The lower fossil layer is stained red by iron oxide, and many of the fossils have decomposed. A better-cemented layer of fossils is found near the tops of hills here. Fossils of vertebrates, such as fish, have also been found in the Kiowa.

(0.5)

22.9 Otter Creek flows a short distance west of the road.

(0.5)

23.4 Just east of the road, the railroad cuts through a hill, exposing the Kiowa Formation. This place is named Blue Cut for the bluish-gray color of the exposed shale. Part of the Kiowa Formation was once named the "Blue Cut Shale."

(0.1)

23.5 A lease road leads northwest from this point to wells in the rambling Glick oil and gas field. Glick was the original name of Belvidere, named for George Washington Glick from Atchison, who served as the first Democratic governor of Kansas from 1883 to 1885. The surrounding township still bears his name.

(0.6)

24.1 Shale of the Kiowa Formation is exposed on both sides of the road. This formation is named for exposures here in Kiowa County where it reaches its greatest thickness of 160 feet. This formation crops out to the west in Clark County and in adjacent parts of Comanche and Barber counties. It also crops out from Rice to Clay counties, where it is the oldest Cretaceous rock lying directly on older and older Permian rocks as one moves northeastward. In addition to fossils from the Champion shell bed, the Kiowa contains fossil plants in several horizons.

(0.1)

24.2 A number of small landslides are visible in the hills, formed on the shales of the Kiowa Formation, west of the road. Geologists call this erosion "slumps," and they are common on steep slopes formed on weak shale formations such as the Kiowa. Slumps are environmental hazards, especially in urban areas where buildings and retaining walls are built on shale hillsides where a slope failure can have catastrophic results.

(0.2)

24.4 Turn west.

(0.3)

24.7 Turn south.

(1.0)

25.7 T-road. This is the Kiowa/Comanche county line. Turn west and proceed along the county line, with Kiowa County to the north and Comanche County to the south.

(0.2)

25.9 The elevation here is 2,100 feet.

(2.5)

28.4 Turn south on T-road, elevation 2,160 feet.

(1.0)

29.4 Barn and windmill west of the road.

(0.5)

29.9 T-road. Turn west.

(0.7)

30.6 Turn south.

(0.3)

30.9 Natural gas compressor station on the east side of the road.

(1.2)

32.1 Curve west.

(0.2)

32.3 Mule Creek, elevation 2,010 feet. Mule Creek has its source 15 miles northwest in southwestern Kiowa County. It flows southeast, emptying into the Salt Fork of the Arkansas River near Aetna in southwestern Barber County.

(0.2)

32.5 Turn south and enter Wilmore.

(0.3)

32.8 Railroad crossing. Turn west just beyond the railroad tracks. The grain elevator in Wilmore is decorated with a mural depicting a scene in southwestern Kansas by well-known muralist and crop-artist Stan Herd. Stan is originally from nearby Protection but now makes his home near Lawrence. He painted a large mural in the Kansas State History Museum. His field art uses the land as a canvas, various crops as his paints, and a tractor and implements as his brushes.

(0.3)

33.1 T-road north.

(0.2)

33.3 Curve. Sand and gravels in the Meade Formation are exposed in this road cut.

(0.3)

33.6 Caliche deposits in the Meade Formation are exposed in the road ditch.

(0.4)

34.0 Oil tanks west of the road collect oil from the surrounding Wilmore oil and gas field, discovered in 1966.

(0.2)

34.2 An oil well and tanks are east of the road.

(0.9)

35.1 T-road west.

(0.1)

35.2 Abandoned farm house east of the road.

(0.4)

35.6 T-road west, elevation 2,150 feet.

(0.5)

36.1 T-road west.

(1.0)

37.1 Stop sign and intersection with U.S. 160. Coldwater and U.S. 183 are six miles west. Medicine Lodge is 35 miles east on U.S. 160. From here proceed west on U.S. 160 to Coldwater and Ashland. This route is described in the U.S. 160 chapter of *Roadside Kansas*.

DAY 2

0.0 From the luxurious Red Hills Motel in Ashland, proceed west on U.S. 160 (Fourth Street) 1.5 miles to a radio tower on top of a hill. Just past the radio tower turn right (north) on the gravel road to begin this road log. The elevation here is 2,080 feet.

(1.7)

1.7 West branch Bear Creek.

(0.3)

2.0 T-road to the east.

(1.0)

3.0 Cattle guard.

(0.5)

3.5 East Branch Bear Creek. This branch joins the west branch forming Bear Creek on the east edge of Ashland at an elevation of 1,940 feet.

(1.4)

4.9 Bridge.

(1.3)

6.2 Cattle guard

(0.6)

6.8 Bridge. In the next mile the road climbs 200 feet, from 2,200 to 2,400 in elevation, passing through Permian redbeds of the Whitehorse Formation and poorly exposed gray shades of the Cretaceous Kiowa Formation to a prominent ridge capped by the Tertiary Ogallala Formation.

(1.0)

7.8 East of the road is a pit in the Ogallala Formation.

(0.3)

8.1 Cattle guard.

(0.5)

8.6 East of the road just before a curve to the left is an abandoned stone house made of iron-cemented sandstone that is common in the Dakota Formation in central and northern Kansas. The Dakota normally overlies the Kiowa Shale, although it is generally missing in the Red Hills area. It is

exposed at the head of some of valleys in southern Kiowa County above the town of Belvidere. The large amount of ironstone used in this house and the nearby wall suggests that the Dakota may be present at the heads of some of the nearby canyons here in Clark County as well. The elevation here is 2,460, more than 500 feet above Bear Creek in Ashland.

(1.1)

9.7 Resistant mortar beds in the Ogallala Formation are exposed rimming the canyon to the west.

(0.9)

10.6 Cattle Guard and curve to the right (north) passing over a gently rolling upland that is considered part of the High Plains and is underlain by the Ogallala Formation and even younger alluvial sands and gravels of the Meade Formation.

(1.1)

11.7 The topographic map shows a spring a short distance east of the road in the bed of Hackberry Creek.

(1.0)

12.7 The upper reach of Hackberry Creek. This creek flows into Bluff Creek about five miles east and 350 feet lower in elevation. We will pass this junction at mile 29.2 later on in this road log.

(1.5)

14.2 Turn to the left (west). Elevation 2,500.

(0.7)

14.9 Turn to the right (north).

(1.0)

15.9 Turn right (east).

(0.5)

16.4 Cattle guard.

(0.5)

16.9 Cattle guard.

(0.3)

17.2 Cattle guard.

(0.5)

17.7 Cattle guard.

(1.6)

19.3 Cattle guard. The road leaves open range and enters Clark County State Lake and Wildlife Area, administered by the Kansas Department of Wildlife and Parks. Clark County Lake is in a deep canyon created by rapidly eroding Bluff Creek as it cuts into the soft red beds and Kiowa Shale that underlie this area. The lake level is almost exactly 200 feet below this west entrance and the bed of Bluff Creek is 250 feet below this point. This canyon appears to be a fairly recent feature of the landscape. Maps show that the upper reaches of Bluff Creek flow east-northeast. Three miles north of here, Bluff Creek turns abruptly more than 90 degrees and flows directly south. The upper part of Bluff Creek lines up with the uppermost course of Rattlesnake Creek and may at one time have been part of Rattlesnake Creek and flowed on toward the northeast, eventually flowing into the Arkansas River. Sometime in the not too distant geologic past the upper part of Bluff Creek was captured (in a process known as stream piracy) by its headwardly eroded lower portion, which carved the deep canyon below us. As a result, Rattlesnake Creek was beheaded, losing its head to Bluff Creek, in a pretty violent episode in earth history. In time, Bluff Creek and its tributaries north of here may erode even farther headward and someday capture the Arkansas River, which is only eight miles north of the Bluff Creek watershed at this time.

(0.9)

20.2 STOP 1. After entering the Park, the road descends through the Ogallala rim rock into the underlying Kiowa Shale and Permian redbeds (Whitehorse Formation). Two prominent unconformities separate these three different rock types.

(0.1)

20.3 Bluff Creek. This creek heads in southern Ford County 15 miles northwest of here and flows into the Cimarron River 12 miles south of Protection near the Oklahoma border. In its course it drops a total of 900 feet from 2,600 in southern Ford County to 1,700 feet in southern Comanche County.

(0.4)

20.7 Rest rooms at the east shore of Clark County State Lake. After leaving the lake, the road climbs back through the same formations seen on the west side and curves to the north.

(1.3)

22.0 Junction with Kansas Highway 94. This highway leads west down to picnic areas and a boat ramp at lake level. Continue straight (north) on K-94.

(0.7)

22.7 Curve to the right (east).

(1.1)

23.8 Stop sign. Turn right (south) on gravel road. K-94 continues north 8.5 miles to Kingsdown on U.S. 54.

(0.3)

24.1 Cattle guard.

(0.2)

24.3 Cattle guard.

(0.5)

24.8 Cattle guard.

(0.8)

25.6 Ogallala mortar beds rim the canyons on both sides of the road.

(1.2)

26.8 Cattle guard.

(0.2)

27.0 Ogallala mortar beds. Elevation 2,400 feet.

(0.4)

27.4 Ogallala Formation.

(1.0)

28.4 Day Creek Dolomite. This unit is named for a locale in Northern Oklahoma and it separates the Big Basin Formation above from the Whitehorse Formation below and is commonly a bench former. Dolomite is carbonate rock similar to calcite. Whereas calcite is calcium carbonate (CaCO_3), dolomite is calcium magnesium carbonate, $\text{CaMg}(\text{CO}_3)_2$. Dolomite does not fizz as vigorously as calcite when tested with dilute hydrochloric acid.

(0.4)

28.8 Cattle guard.

(0.2)

29.0 Cattle guard.

(0.2)

29.2 Bluff Creek. The mouth of Hackberry Creek is just upstream of the bridge. Elevation 2120. The red sandstone cliffs are in the Whitehorse Formation.

(1.2)

30.4 **STOP 2.** A thick road cut exposes Kiowa Shale. In this cut much gray shale can be found laced with beds and veins of selenite. Layers of aragonite containing cone-in-cone structure can also be found. Aragonite is a polymorph of calcite. It has the same chemical formula (CaCO_3) but a different crystal structure and as a result much different physical properties. Mother of pearl and pearls are composed of aragonite. On the northwest side of the road near the top of the cut one of the shell beds that characterize the Kiowa in this area can be found.

(0.7)

31.1 Cattle guard.

(1.5)

32.6 Cattle guard. The white grain elevator on the north horizon is at Kingsdown 22 miles away.

(0.4)

33.0 The small draw east of the road is the head of Dugout Creek.

(0.6)

33.6 The crest of Mount Nebo, elevation 2,440 feet.

(0.4)

34.0 Gravel pit south of the road in the Ogallala Formation.

(0.8)

34.8 Cattle guard.

(0.2)

35.0 Mortar beds in the Ogallala Formation cap this prominent ridge and surrounding uplands. To the south is a broad lowland area containing Ashland and Englewood that has been termed the Ashland-Englewood Basin by some geologists. They theorize that dissolution of underlying evaporites (salt and gypsum) may have created a large area of subsidence through which the Cimarron River now flows. Recent collapses such as Big and Little basins and modern sinkholes suggest that this subsidence area is expanding northward.

(0.6)

35.6 The Permian Day Creek Dolomite separates the gray Kiowa shales (Cretaceous) above from red beds in the Whitehorse Formation (Permian) below.

(0.5)

36.1 Cattle guard. This is the southern limit of a large area of open range in northern Clark County.

(1.4)

37.5 East of the road is Mount Casino, elevation 2,130. A monument here commemorates the World War II battle of Monte Cassino, an historic monastery in Italy that was held by the Germans because of its strategic location. In a highly debated move because of its historical significance, Monte Cassino was destroyed by Allied bombing in 1944.

(0.8)

38.3 Casino Creek.

(0.1)

38.4 Casino Creek.

(0.3)

38.7 Casino Creek.

(0.1)

38.8 Casino Creek.

(0.2)

39.0 Casino Creek.

(0.4)

39.4 East Branch Bear Creek.

(0.6)

40.0 Stop sign. Junction U.S. 160 (East Fourth Street) and North Dodge Street. The log of U.S. 160 in *Roadside Kansas* describes the road west to Big Basin for STOP 3 and STOP 4 .

ROUTE FROM BIG BASIN TO GREENSBURG TO WICHITA

0.0-4.0 Junction U.S. 160 and U.S. 283 north of Big Basin. U.S. 160 turns west at this point leading to Meade 19 miles distant. We will proceed north on U.S. 283. West of the road for the next four miles are tributaries of East Indian Creek that have carved small canyons into the High Plains exposing the Ogallala Formation.

8.8 The center of large High Plains depression. A number of explanations have been proposed for these features, including wind erosion, differential compaction, and subsidence from solution of soluble rocks below.

11.6 Minneola and the U.S. 283 -U.S. 54 junction. Turn right and proceed east on U.S. 54. Mileage from here east will be keyed to the mileposts along U.S. 54. This junction is 65.7 and the elevation is 2,550 feet. Minneola sounds like an Indian name; in fact, "minne" (as in Minneapolis) is Sioux for water. However, Minneola is derived from the first names of two women, Minnie Davis and Ola Watson.

65.7 Turn right (east) on U.S. 54.

68.5 Bluff Creek. This creek has its source a few miles to the north in Ford County. It takes a zig-zag course in Clark County, possibly due to stream piracy. It is dammed to form Clark County State Lake. This stream drops 330 feet between here and the lake.

70.1 Clark County/Ford County line.

72.8 Bloom. This town was originally called Bloomsburg and was named for a town in Pennsylvania.

73.5 Road side park. An historical marker here tells of the Fort Dodge-Fort Supply Military Trail.

75.2 Elevation 2,600 feet. This point is on the divide between the Arkansas River drainage to the north and the Cimarron River drainage to the south. Runoff on either side of the road goes its separate way, eventually meeting in Keystone Lake just west of Tulsa, Oklahoma.

75.6 This small unnamed draw flows south into Bluff Creek.

81.0 Kingsdown and junction with K-94, which leads south to Clark County State Lake. This town can probably trace its name to some of the English upperclass who found adventure on the Kansas frontier in the late

1800s and applied English place names like Victoria, Runnymede, and Studley. The name Kingsdown Formation has been applied by some geologists to the windblown silt of Pleistocene Age that mantles the surface in this area.

81.4 North of the highway is Sodville Cemetery, a reminder that many of the early homes on the Great Plains were made of sod.

85.2 This unnamed creek is a tributary of Rattlesnake Creek, two miles to the south.

88.0 Bucklin and the K-34 junction. Dodge City is 26 miles to the northwest.

89.7 Rattlesnake Creek. This creek has its source in southern Ford County. Part of its upper reaches have been captured by Bluff Creek. Rattlesnake flows northeast across the Great Bend Prairie and through the salt marshes in Quivira National Wildlife Refuge before flowing into the Arkansas River near the town of Alden. Lessened streamflows in Rattlesnake Creek in recent years have led to concerns about water supply for the Wildlife Refuge.

92.5 Ford County/Kiowa County line.

97.2 Mullinville.

99.0 U.S. 154 heads west from here, leading 36 miles to Dodge City.

100.2 South Branch Rattlesnake Creek.

100.7 Mullinville Compressor Station operated by Northern Natural Gas.

101.7 The elevator north of the highway is a station named Joy.

103.0 Sandhills north of the road.

106.0 Junction U.S. 183. Kinsley is 25 miles north. Coldwater is 23 miles south.

106.9 West edge of Greensburg. Greensburg was named for D. R. Green who operated a stage line near present day U.S. 54 that was known as the "Cannonball."

107.4 Turn right following signs to the World's Largest Hand-dug Well. This well was dug in 1887 and 1888; it is 32 feet in diameter and 109 feet deep. It supplied the households and businesses of Greensburg with water

until 1932 when additional water supply wells were drilled. Bruce Latta, in his 1948 KGS Bulletin on the *Geology and Ground Water Resources of Kiowa County*, points out that " 'the world's largest hand-dug well ' . . . may be the largest dug well in Kansas, but it is not the largest in the world. St. Patrick's well at Orvieto, Italy, is a dug well 42 feet in diameter and 200 feet deep."

109.6 East Fork Rattlesnake Creek.

112.2 Brenham.

117.8 Havaland.

122.0 Wellsford.

122.9 Kiowa County/Pratt County line.

129.0 Cullison.

138.3 Pratt.

143.3 South Fork Ninnescah River.

148.2 Cairo.

149.0 Coon Creek.

150.5 Roadside park.

153.2 Pratt county /Kingman County line.

155.0 Cunningham.

158.3 South Fork Ninnescah River.

163.0 South Fork Ninnescah River.

164.7 South Fork Ninnescah River.

172.5 Kingman.

173.8-174.4 Permian Red beds in the Nippewalla Group are exposed north of the road.

182.3 Saroots Creek.

189.8 Kingman County/Sedgwick County line.

192.6 North Fork Ninnescah River.

194.4 Spring Creek.

195.1 Sand Creek.

196.8 K-163. Garden Plain is just south of the road.

198.0 Clear Creek.

202.7 Goddard.

209.1 Cowskin Creek and the west edge of Wichita.

212.1 Wichita Valley center Floodway.

212.2 I-235 Interchange. Take I-235 north or south to connect with Kansas Turnpike and return to Lawrence.

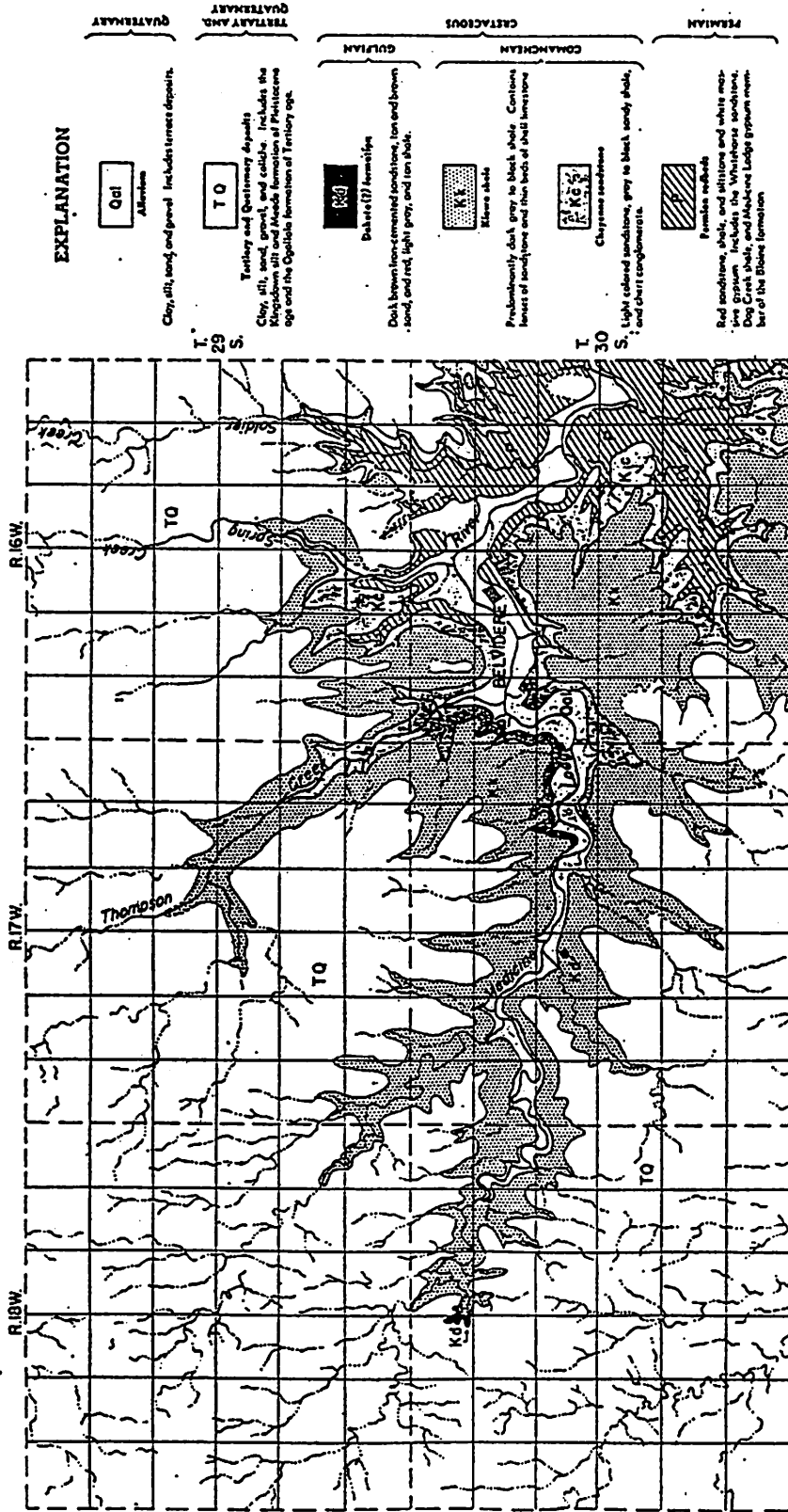


Fig. 3. Geologic map of the Belvidere area, Kansas.

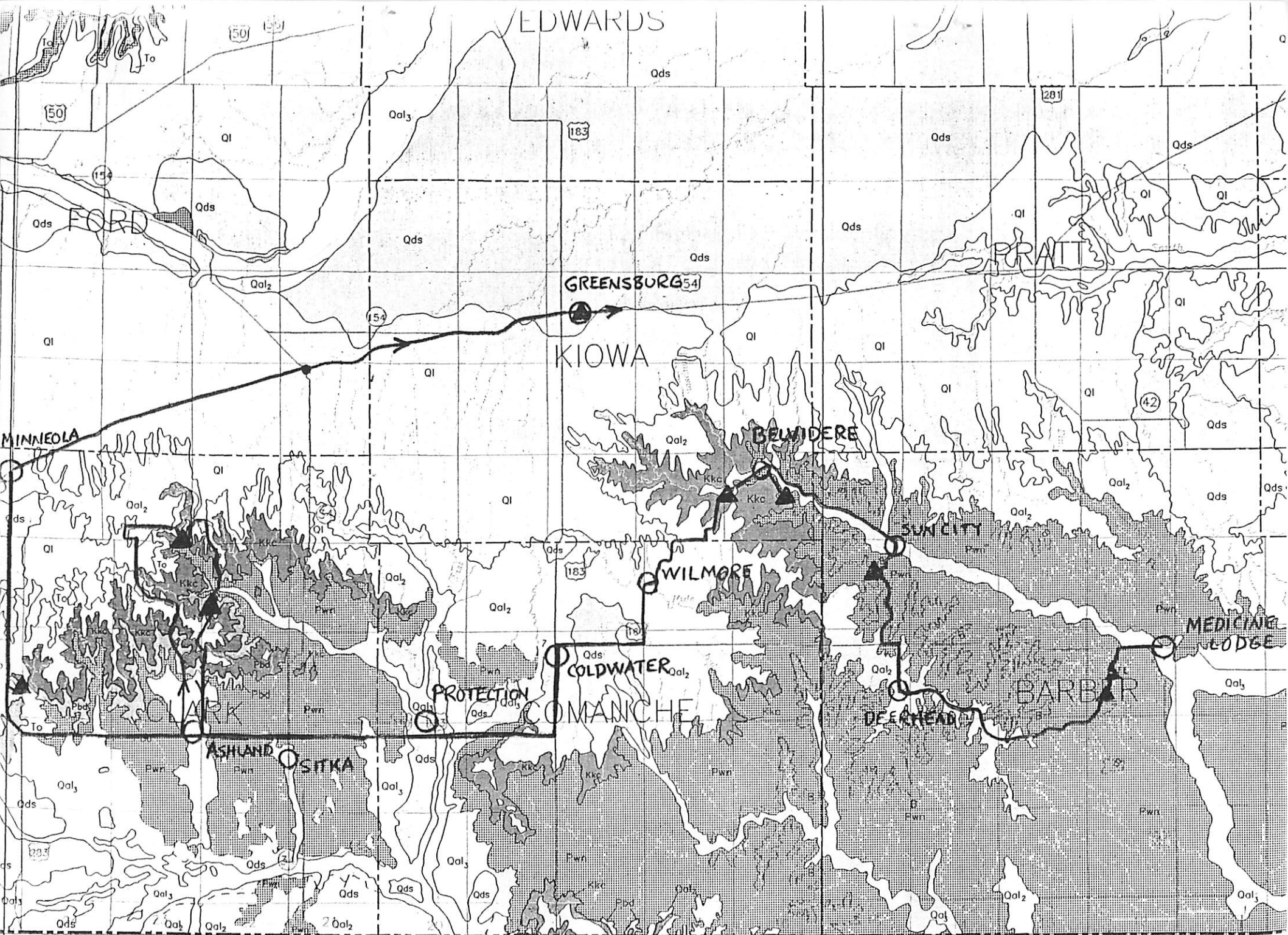
TABLE 1.—Generalized section of the geologic formations of Kiowa County, Kansas

SYSTEM	Series	Subdivision	Thickness (feet)	Physical character	Water supply
Quaternary	Recent and Pleistocene	Alluvium	0-40±	Very coarse gravel, sand, and silt comprising stream deposits in Medicine Lodge Valley and the valleys of smaller streams.	Yields moderate amounts of water to wells in the larger stream valleys. (Well 73 in Soldier Creek Valley is reported to yield 180 gallons a minute.) Waters are very hard—three samples had from 318 to 1,782 parts per million of hardness.
		unconformable on older formations			
		Terrace deposits	0-20 (?)	Sandy silt containing small amounts of sand and gravel occur as terrace deposits along Medicine Lodge Valley. These deposits together with certain slope-wash deposits probably are equivalent to the Gerlane formation. Coarse terrace gravels are believed to occur beneath dune sand in the northern part of the county.	Are believed to occur everywhere above the water table; therefore they probably would not yield water to wells.
		unconformable on older formations			
		Dune sand	0-60+	Fine- to medium-grained wind-blown sand. Covers approximately the northern third of Kiowa County.	Occurs above the water table; therefore it yields no water to wells. Serves as an important catchment area for recharge from local precipitation, however.
	Kingsdown silt	0-100+	Light-tan to brown silt and sandy silt containing some clay and stringers, nodules, and thin beds of lime carbonate; contains loess of Pleistocene and Recent age in upper part, and minor amounts of sand and gravel in lower part. Underlies the surface in the upland area and in the Mule Creek drainage area.	Is above the water table everywhere in this area; hence does not supply water to wells.	
Tertiary	Pleistocene	unconformable on older formations			
		Meade formation	300+	Interbedded lenses of clay, silt, sand, and gravel that are lithologically similar to materials of the Ogallala formation, and are both consolidated and unconsolidated. Contains nodules, stringers, and irregular beds of caliche and locally volcanic ash.	Sand and gravel beds of the Meade and Ogallala formations are the most important sources of water in Kiowa County, and yield large supplies. Most of the domestic, stock, and industrial wells and all of the irrigation and public supply wells derive water from these deposits, and they also supply water to numerous springs in the southern part of the county. The water, although hard, is satisfactory for most purposes.
Tertiary	Pliocene	unconformable on older formations			
		Ogallala formation	85+	Consolidated and unconsolidated, calcareous silt, sand, and gravel. Caliche occurs as cementing material, pipy concretions, nodules, or beds.	
		unconformable on older formations			

TABLE 1.—Generalized section of the geologic formations of Kiowa County, Kansas—Continued

SYSTEM	Series	Subdivision	Thickness (feet)	Physical character	Water supply	
Cretaceous	Gulfian*	Dakota formation	90+	Light-gray, blue-gray, yellow, yellow-tan, red, and mottled red and gray shale, sandy shale, and clay and tan to white and dark-brown, fine- to coarse-grained sandstone that is in part cemented with iron. Contains nodules, concretions, and thin beds of ironstone.	No wells are known to obtain water from the Dakota formation in this area, as adequate supplies of water of good quality are obtained from deposits above the Dakota.	
		local disconformity (?)				
	Comanchean*	Kiowa shale	300	Dark gray to black thinly laminated shale in lower part and gray, tan, brown, and red clay and clay shale in upper part. Contains thin beds of shell limestone and light- to dark-gray and white fine-grained sandstone. Large lense of yellow-tan to buff cross-bedded fine-grained sandstone occurs locally at top of formation. Also contains crystals of gypsum. Is exposed over a wide area in the southeastern part of the county.	Most of the materials of the Kiowa shale are relatively impermeable and will not yield water to wells. The large sandstone lense at the top of the formation supplies moderate amounts of water to one well (91) and several springs. The water is similar in quality to that from the Meade and Ogallala formations.	
		Cheyenne sandstone	20-94	Light-colored fine- to coarse-grained friable cross-bedded sandstone and lenses of gray to black sandy carbonaceous shale. Contains lenses of pebble conglomerate at or near base, and also contains crystals of selenite, pyrite, nodules of iron, and remains of plants. Exposed in the southeastern part of the county.	Supplies water to a few stock and domestic wells in the south-central and south-eastern parts of the county. Water in the Cheyenne sandstone is highly mineralized and locally is unfit for ordinary purposes.	
	Guadalupian*	Whitehorse sandstone	60+	Red poorly bedded fine-grained friable sandstone and siltstone containing minor amounts of shale. Crops out in the southeastern part of Kiowa County and in two small areas in the southwestern part.	Supplies small quantities of very hard water to a few wells (74, 81, and 82) in southeastern Kiowa County.	
Permian	Leonardian*	Nippewalla group	Dog Creek shale	50±	Red shale containing thin beds of light-gray and mottled red and light-gray fine-grained sandstone. Contains thin bed of light-gray shaly dolomite in lower part. Exposed in narrow bands along the sides of Medicine Lodge Valley in the southeastern part of Kiowa County.	Relatively impermeable; not known to yield water to wells in Kiowa County.
			Blaine formation (Medicine Lodge gypsum member)	22±	White massive gypsum; weathers to light gray. Other members of the Blaine formation are missing in this area.	Not known to yield water to wells.
			Flowerpot shale	200-	Dark red-brown to reddish-purple shale containing many thin and a few thick beds of sandstone. Contains gypsum in veins and as cementing material. Not exposed in Kiowa Co.	Supplies highly mineralized water to one well (55) in this area, but is not an important water-bearer.

* The classification here shown, which is used by the State Geological Survey of Kansas, differs somewhat from that employed by the Federal Geological Survey.



▲ = STOP

EXPLANATION OF AREAL GEOLOGY
SEDIMENTARY ROCKS

Cenozoic


(Formal names of stratigraphic units not included, except in Pliocene Series)

QUATERNARY SYSTEM

Holocene and Pleistocene Series
 Post-Kansan Deposits



 Alluvium  Dune Sand

Below floodplains and in stream terraces

 Loess


Thin except locally in northeastern Kansas and along some stream valleys elsewhere

Kansan and Older Deposits

 Alluvium  Drift


Non-glacial in stream terraces and in fillings of old valleys

Till; lacustrine and fluvial deposits of old valleys

 Glacial Boundary


Southern limit of glaciation (approximate)

TERTIARY SYSTEM

 Alluvium

Largely chert gravel (Some gravel of Pleistocene age included)


Miocene Series


 Ogallala Formation


Locally includes Rexroad, Laverne, and Delmore Formations


Mesozoic


CRETACEOUS SYSTEM


 Pierre Shale

 Niobrara Chalk

 Carlile Shale


 Greenhorn Limestone and Graneros Shale

 Dakota Formation

 Kiowa Shale and Cheyenne Sandstone

Cheyenne Sandstone not identified in outcrops north of T. 29 S. and west of R. 21 W.

TRIASSIC SYSTEM

 Dockum Group

Identified in outcrops in one small area in Morton County

Paleozoic


PERMIAN SYSTEM

Guadalupian Series

 Pbd

Big Basin Formation, Day Creek Dolomite, and Whitehorse Formation

Leonardian Series

 Pw

Nippewalla Group


Dog Creek Formation, Blaine Formation (base B), Flower Pot Shale (base FL), Cedar Hills Sandstone, Salt Plain Formation, Harper Sandstone with Kingman Sandstone Member (base K), and Stone Corral Formation

 Ps

Sumner Group


Ninnescah Shale (base N) and Wellington Formation with Carlton Limestone Member (base CR)

Wolfcampian Series

 Pc

Chase Group

Nolans Limestone, Odell Shale, Winfield Limestone (base WF), Doyle Shale, Barneston Limestone (base BA) with Fort Riley Limestone Member (base FR), Matfield Shale, and Wreford Limestone

 Pcg

Council Grove Group

Speiser Shale, Funston Limestone, Blue Rapids Shale, Crouse Limestone (base CS), Easley Creek Shale, Bader Limestone (base BE), Stearns Shale, Beattie Limestone, Eskridge Shale, and Neva Limestone