KANSAS GEOLOGICAL SURVEY
OPEN-FILE REPORT 88-53

THE DAKOTA FORMATION (CRETACEOUS) IN CENTRAL KANSAS

American Association for the Advancement of Science
Southwestern and Rocky Mountain Division
Field Trip Guidebook, 64th Annual Meeting, Wichita, Kansas

By

Larry H. Skelton

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KANSAS GEOLOGICAL SURVEY
1930 Constant Avenue
University of Kansas
Lawrence, Kansas 66047-3726

AMERICAN ASSOCIATION for the ADVANCEMENT of SCIENCE

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FIELD TRIP GUIDEBOOK

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by Lawrence H. Skelton
Kansas Geological Survey

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64th Annual Meeting Wichita, Kansas

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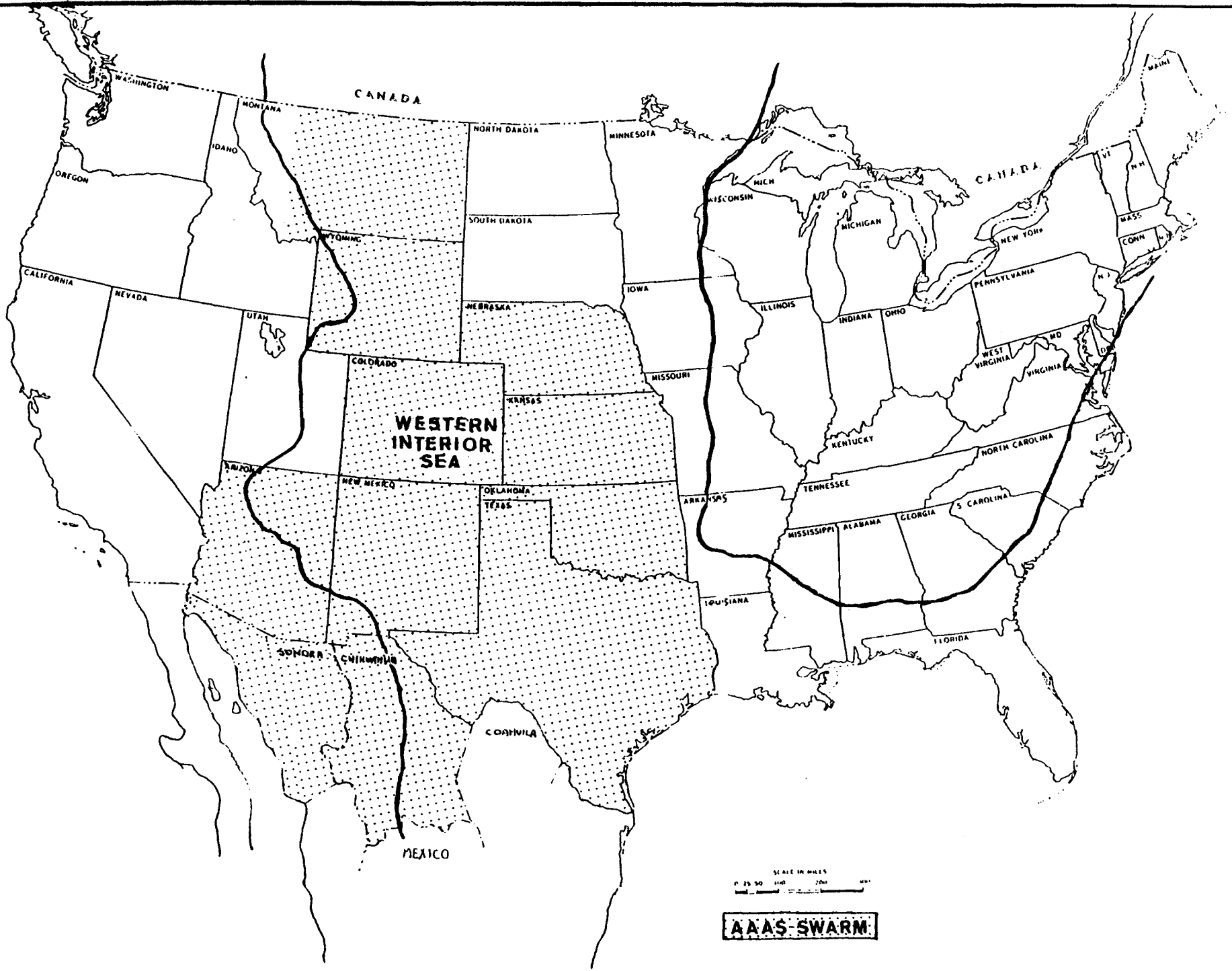
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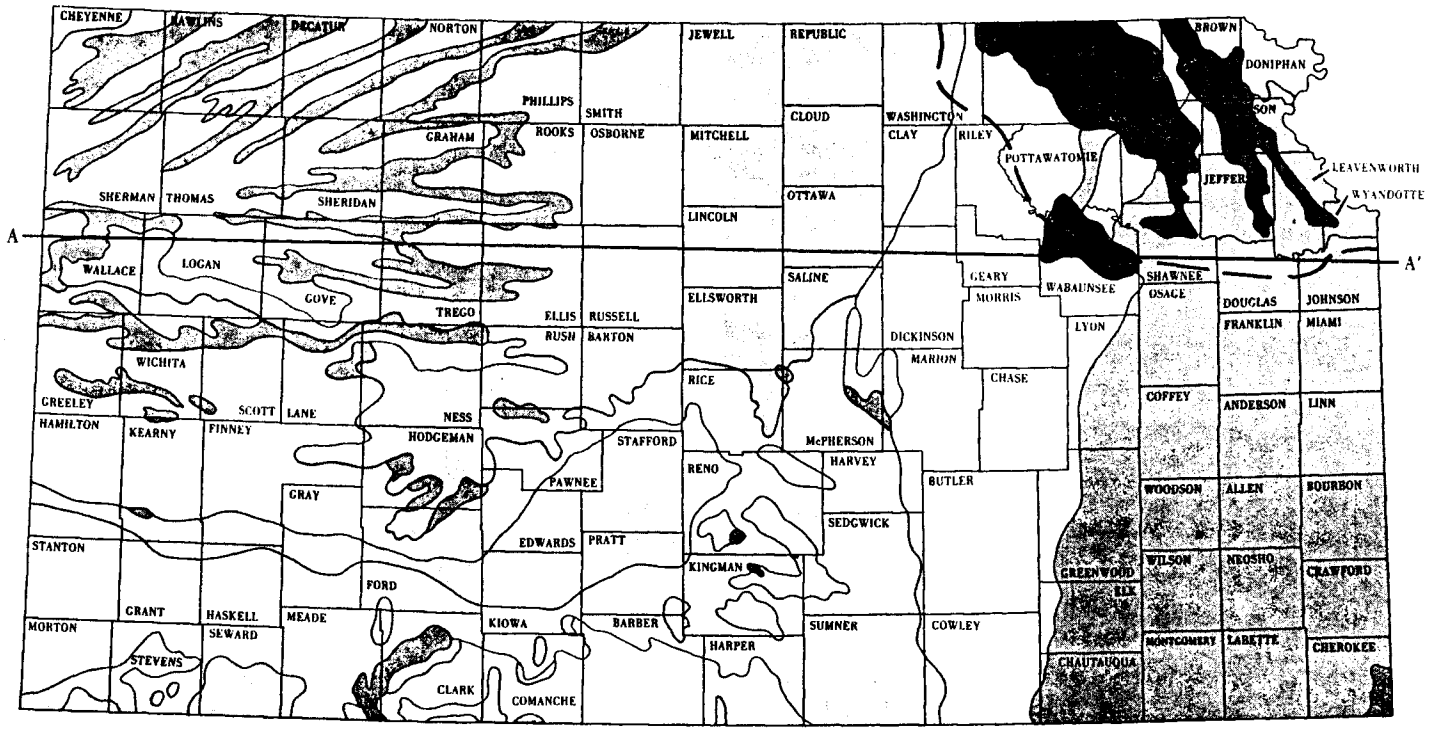
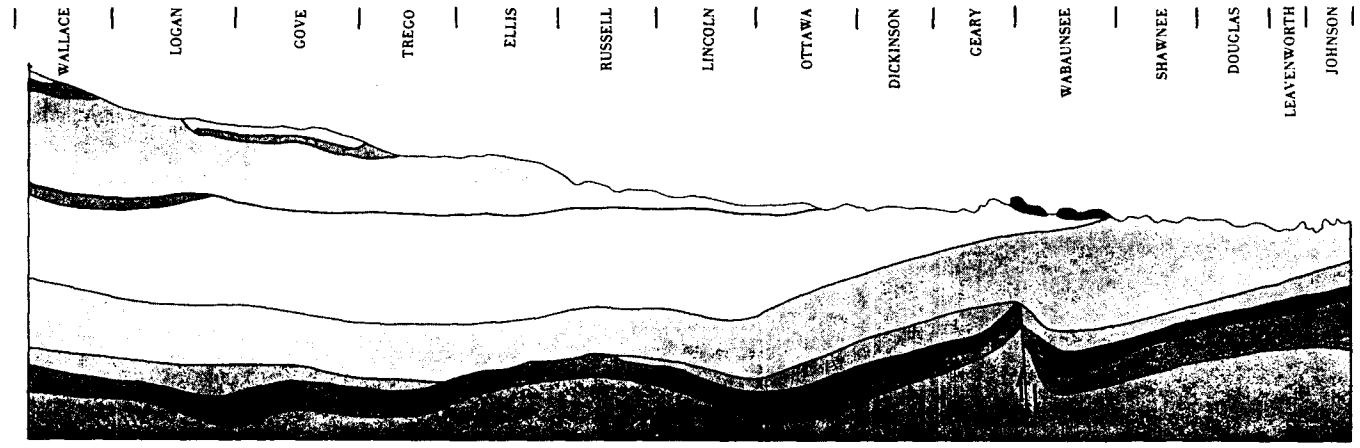
Generalized Geologic Map of Kansas

EXPLANATION

- QUATERNARY SYSTEM — Loess and river valley deposits
- Sand dunes
- Glacial drift deposits
- Limit of Kansan Glacier
- TERTIARY SYSTEM
- CRETACEOUS SYSTEM
- JURASSIC SYSTEM
- PERMIAN SYSTEM
- PENNSYLVANIAN SYSTEM
- MISSISSIPPIAN SYSTEM
- SILURIAN-DEVONIAN SYSTEMS
- CAMBRIAN-ORDOVICIAN SYSTEMS
- PRECAMBRIAN SYSTEM
- A—A′ Line of cross section





Geologic cross section below I-70

0 50 100 mi

0 50 100 km

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE - SOUTHWEST AND ROCKY MOUNTAIN REGION - WICHITA, KANSAS MEETING 30 MARCH - 2 APRIL 1988.

Geological Field Trip - The Dakota Formation, Saturday 2 April, 1988.

The Dakota Formation of the Lower Cretaceous series of rocks in Kansas crops out from the Kansas-Nebraska border in Washington County to northeastern Rice County. Outliers of the Dakota Formation extend southwestward from Rice-McPherson Counties to the Colorado border in Stanton County (Figure 1). The Dakota appears to be of continental origin and forms a transitional boundary with the overlying Graneros Shale (Hattin, 1965, p. 67) and the underlying Kiowa Shale both of which are marine.

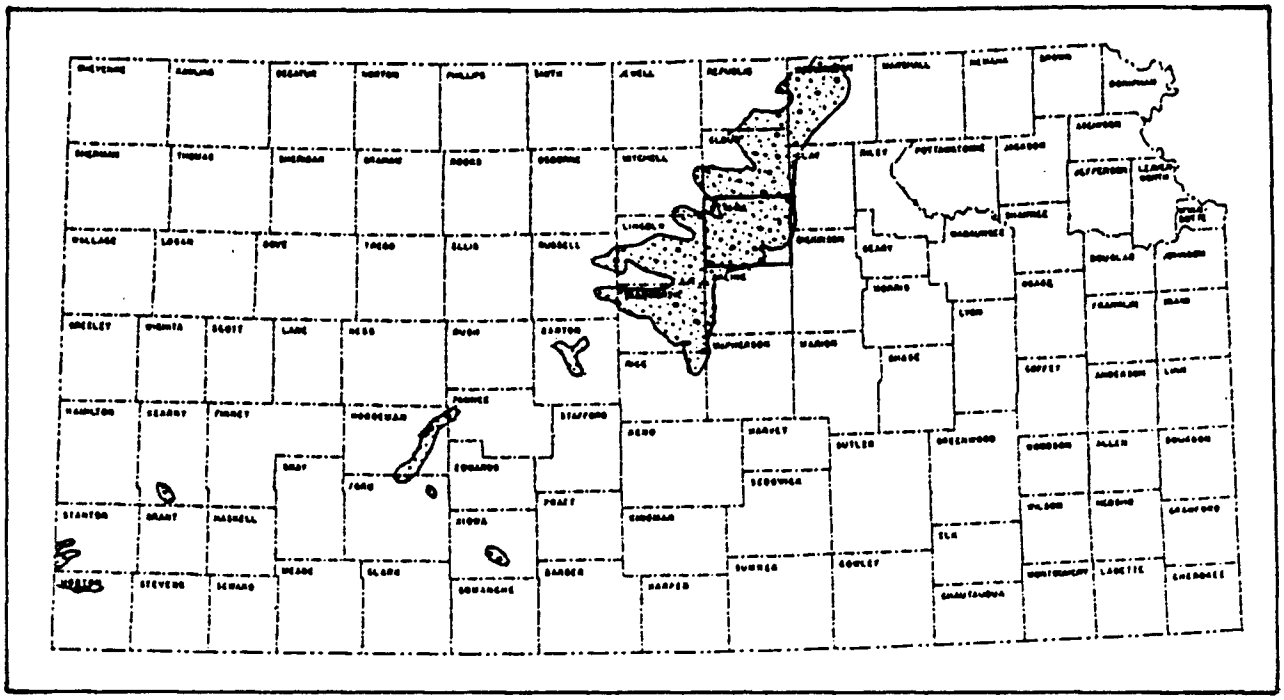


FIGURE 1.—Index map showing outcrop areas of Dakota Formation, Kansas.

The Dakota Formation in Kansas is comprised of the Jannsen Clay Member and Terra Cotta Clay Member. The Terra Cotta comprises approximately the lower two-thirds of the formation and consists of massive clay, silt and irregularly distributed sandstone. The upper third, the Jannsen Member, includes beds of lignite, gray to dark gray massive clay, silt, and some shale (Plummer and Romary, 1947, p. 40-41). The clays in both members are kaolinitic in composition whereas the clay in both the Graneros and Kiowa formations is predominantly illitic with some montmorillonite. O'Conner (1968, p. 55) noted the Dakota to be from 200 to 300 feet thick. Plummer and Romary (1947, p. 41) estimated that three-quarters of the Dakota's total thickness is clay. Swineford (1947, p. 62) notes that the contact between the two members is drawn at the top of a bed containing a concentration of concretionary pellets of limonite, siderite or hematite. She also observed that iron oxide is the most abundant cementing agent in Dakota sandstone and forms a case hardened crust where exposed on the surface (1947, p. 72). The crusts form hilltops throughout the area but do not represent very particular stratigraphic horizon. Rather, they are different sandstones within the formation.

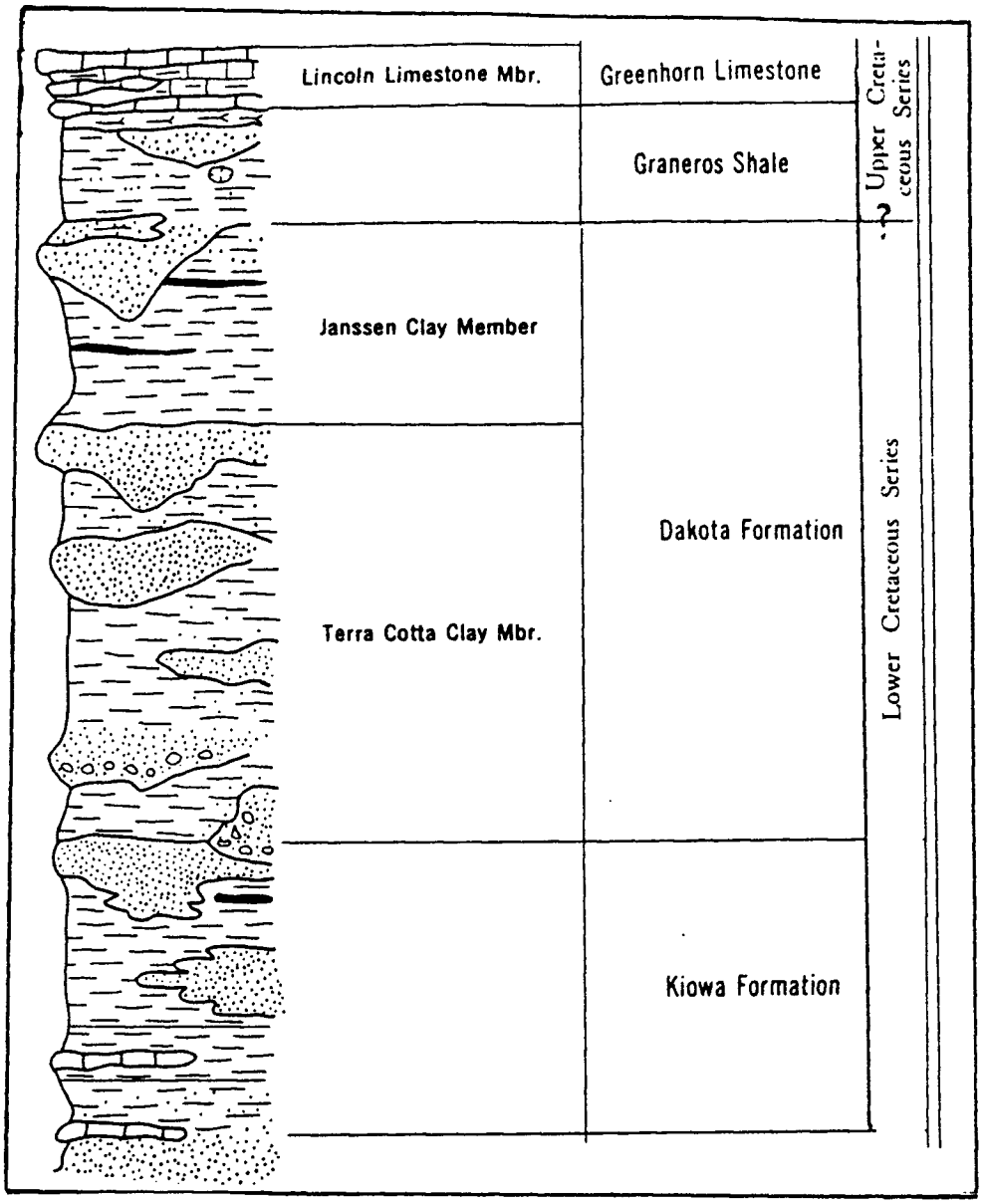


Figure 2. Stratigraphic relations of the Dakota in the outcrop area.

This field trip includes areas of lower Cretaceous strata in portions of Saline, Ellsworth and Lincoln Counties, Kansas. Outcrops of the Kiowa and Dakota Formations will be visited as well as one section displaying the Dakota Formation-Graneros Shale contact.

ULATIVE
ILEAGE

.0 Depart from the Holiday Plaza Inn in Wichita and travel north on Interstate Highway I 135 for approximately 70 miles.

9.0 Park City exit - Highway 254 intersection. Visible to the west (left) and northwest is a topographically lower area which is a Wisconsin stage terrace of the Little Arkansas River. Park City, on the right, was once named Cosmosa after the Cosmos.

16.0 Passing over the middle of the Goodrich Oil Field which was discovered by Continental Oil in December 1928. The discovery well was in Mississippian limestone and

had initial production rated at 4139 BOPD. Later discoveries were made in the Lansing-Kansas City Group (Pennsylvanian-Missourian), Hunton (Silurian-Devonian) and Viola and Arbuckle (Ordovician). By the end of 1986, the Goodrich had produced approximately 6.5 million barrels of oil.

37.3 Sedgwick-Harvey County line. Harvey County is named for the fifth governor of Kansas, James Madison Harvey; Sedgwick County for Major General John Sedgwick, a career soldier killed at the Battle of the Wilderness in May 1864. Continue to Newton, the county seat, which railroad investors from Newton, Massachussets honored by naming it for their hometown.

40.5 The "Equus Beds" a Tertiary (Pliocene/Miocene) valley fill, probably part of the Ogallala Formation which forms much of the High Plains aquifer, are about two miles west of here. The name was taken from fossil horse bones found there. The "Equus Beds" provide more than half the domestic water supply for Wichita.

48.4 McPherson County line - McPherson was named by returning Civil War veterans for their late commander, General James Birdseye McPherson of Ohio, Commander of the Army of the Tennessee who was killed on July 22, 1864 during the Battle of Atlanta. There is a statue of him in the courthouse square at McPherson, reportedly the only life-size bronze equestrian statue in Kansas.

51.4 Johnson Oil Field. Shell Oil drilled the # 1 Johnson discovery well in February 1932, in the "Mississippi Lime". IP was 13.5 million cubic feet of gas and 300 to 600 barrels of oil per day. During early development, some wells had 2000 BPD IP. Accumulative production thru 1986 exceeds 5 million barrels of oil and over a billion cubic feet of gas. The Johnson is one field on a 40 mile trend of the Voshell Anticline.

55.7 I 135 - U. S. Highway 56 interchange. McPherson, Kansas is 2.5 miles west. About 4.5 miles east is the Ritz-Canton Oil Field, a 1928 discovery which has since produced in excess of 71 million barrels of oil and 6½ billion cubic feet of gas. The Ritz-Canton extends about 9 miles northwest southwest and is about two miles wide. Producing zones include Lansing-Kansas City, Mississippian, Hunton, Maquoketa, Viola and Simpson.

60.2 Cross over Dry Turkey Creek. The rougher topography visible ahead is the upper watershed of drainage north to the Smoky Hill River in the area. Immediately to our rear, drainage is southward to the Little Arkansas River.

61.2 Exit to New Gottland.

68.7 By-Pass U. S. Highway 81 exit to Lindsborg.

72.7 McPherson-Saline County Line.

73.0 Smoky Hill River Crossing. The Smoky Hill River flows from Cheyenne County, Colorado to Junction City, Kansas, where it joins with the Republican River near Fort Riley, forming the Kansas, or Kaw, River.

73.4 Leave Highway I 135 and turn west on Highway 4 toward Lindsborg. The ridge of hills straight ahead are the Smoky Hill Buttes, and are topographically over 300 feet higher than the elevation at the Interstate exit (1305 feet). Proceed west for about 4½ miles to Coronado Heights.

STOP 1 - Coronado Heights SE Sec. 36, T 16S, R 4W and W/2 SW Sec. 31, T 16S, R 3W. Saline County. This ridge which has an elevation of about 1610 feet is capped by a "case-hardened" Dakota sandstone. Iron Oxide cement is abundant here along with numerous small limonitic or hematitic concretions. Cross-bedding is apparent. This exposure is typical of the sandstone layers observed as caps are not necessarily at the same stratigraphic position in the formation. Coronado Heights owes its name to the idea that the Spanish explorer, Francisco Coronado is thought to have passed through here and used this point as an observation site during his 1541 expedition through Kansas.

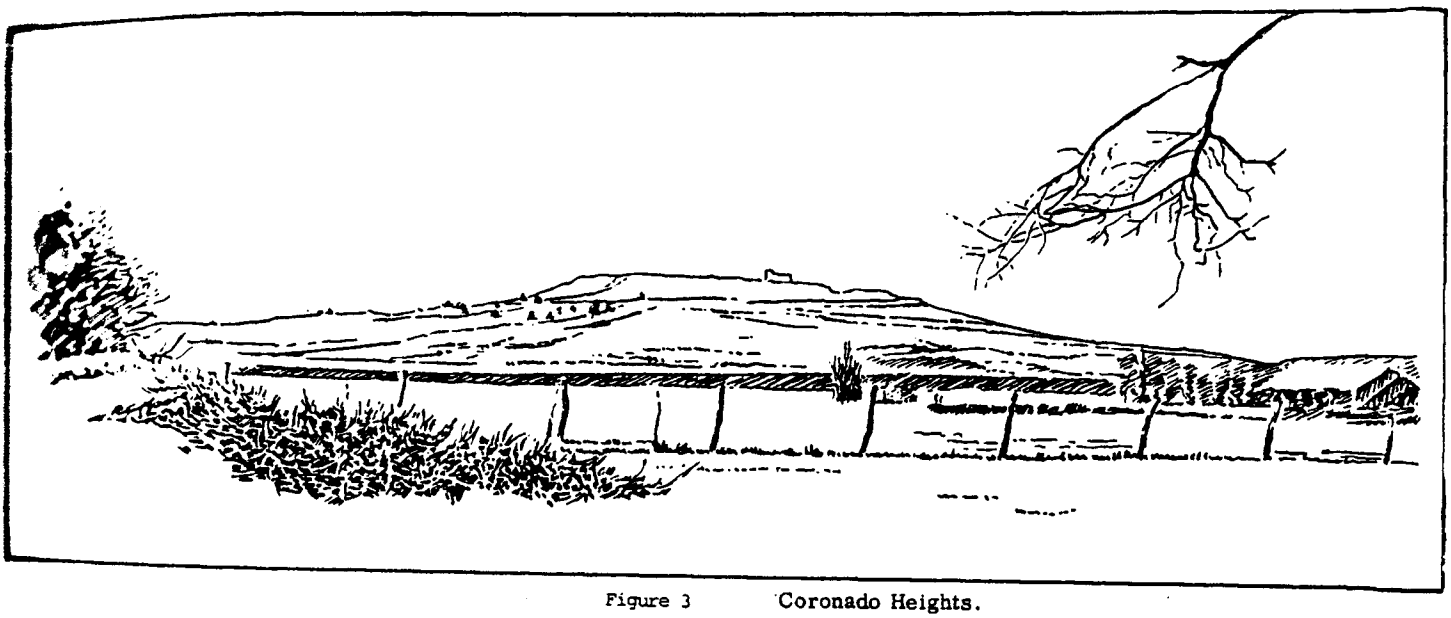


Figure 3 Coronado Heights.

Leave Coronado Heights, travel one mile east and turn south on paved road toward Lindsborg. Travel 3 miles south to intersection with Highway K-4 and turn west. While going south, we pass over the Lindsborg Oil Field, a 1938 discovery by the Carter Oil Company. At the time, the Lindsborg Field was close to the northern boundary of oil production in Kansas (Ver Wiebe, 1939, p. 49). Since discovery, about 15 million barrels of oil have been produced from the Maquoketa, Viola and Simpson. Proceed west on State Highway 4 for 8½ miles, to STOP 2, ½ - 3/4 mile past the intersection of State Highway 4 and 175.

STOP 2 - CSL SW Sec. 14, T 17S, R 6W, McPherson County, Kansas. This exposure is Kiowa Shale. A channel fill; possibly Dakota or more likely the Longford member of the Kiowa, as described by Franks (1959), is visible toward the west end of this cut.

Proceed west for ½ mile to the intersection of State Highways K 4 and K 141; turn north on K 141 and travel 10 miles to the turnoff to Mushroom Rocks State Park. Turn left and go west 2.5 miles to the park.

05.5 STOP 3 - Approximately C SL, Sec. 19, 15S, R 6W, Ellsworth County. Mushroom Rocks State Park. Weathered Dakota sandstone displaying strongly developed cross-bedding. Some of the boulders sit atop clay pedestals. They are caused by differential weathering and selective cementation; in the example here, calcium carbonate. There are other examples of spheroidal weathering in the Kansas' Dakota Formation, notably at Rock City south of Minneapolis in Ottawa County. Swineford (1947) reports cements of iron oxide, calcite, dolomite and silica in Dakota sandstone in addition to ankerite, celestite, and barite which occurs in Kiowa Formation sandstones. Some small areas of asphalt cement have been found in the Kiowa sandstone in one area of McPherson County. She reported (1947, p. 72) that the most abundant cementing material in Dakota sandstone is iron oxide.

After lunch, continue west for approximately ½ mile to STOP 4.

06.0 STOP 4 - NE NE, Sec. 25, T 15S, R 7W, Ellsworth County. Clay pit. Terra Cotta Clay Member of Dakota Formation. This clay pit, formerly worked by the Acme Brick Company, shows the mottled coloring which typifies the Terra Cotta Clay Member. The type area, near the Terra Cotta railroad siding is approximately 5 miles northeast of here and was formerly exposed in a series of pits excavated by the W.P.A. during the 1930's. The Terra Cotta Clay is estimated to comprise approximately two-thirds of the thickness of the Dakota Formation (Plummer and Romary, 1947, p. 39) and is 35 to 40 feet thick in this area. It is kaolinitic in composition. Fossil leaves found at many exposures are reportedly present at this location. From here, travel approximately 1 mile north to State Highway K 140 and turn west for 17 3/4 miles. At about 9 miles is Ellsworth, the county seat, named for Lt. Allen Ellsworth, who established a military post named after himself here in 1864. The fort was moved to near Kanopolis two years later and renamed Fort Harker. The town of Ellsworth was once a rip-snorting cowtown in the best western tradition. Both Wyatt Earp and James Butler (Wild Bill) Hickok were marshals at Ellsworth. Enroute, note the hill-tops capped by Dakota sandstone.

24.7 Black Wolf turnoff. Black Wolf is thought to be named for an Indian. Turn south at the village of Black Wolf. From the village, cross the Smoky Hill River and travel south ½ mile, turn west for ½ mile, then south for approximately one mile to STOP 5.

27.0 STOP 5 - W/2 Sec. 19, T 15S, R 9W, Ellsworth County. Lignite deposite - Dakota Formation-(Jannsen Member)-Graneros Shale contact. Lignite was mined prior to 1872 at a location about 7 miles northwest of here and has been found in seams as thick as 36 inches elsewhere in Ellsworth County. The included map (Schoewe, 1952), shows the distribution of the Dakota Formation and the location of lignite mines in Ellsworth County. At this stop, about a foot of lignite rests on a 3-inch layer of kaolinite which overlies a lignitic clay and siltstone bed. A gray siltstone 7 to 8 feet above the lignite is the top of the Dakota at this point (Schoewe, 1952, p. 118). Retrace route north back to K 140. Turn left onto K 140 and travel northwest for about 6½ miles to the town of Wilson. Wilson is known as "the Czech capital of Kansas" since it was a center of Czechoslovakian immigration and still boasts an annual Czech festival. Originally, the town was named Attica but that was changed to Bosland (Bos=cow) since it was a cattle terminal. Later, the name was changed to Wilson for an Isaac Wilson from Iowa (Rydjord, 1972, p. 83). At Wilson, turn north on Highway K 232 and travel 7.6 miles north to STOP 6, the final point of interest on this trip.

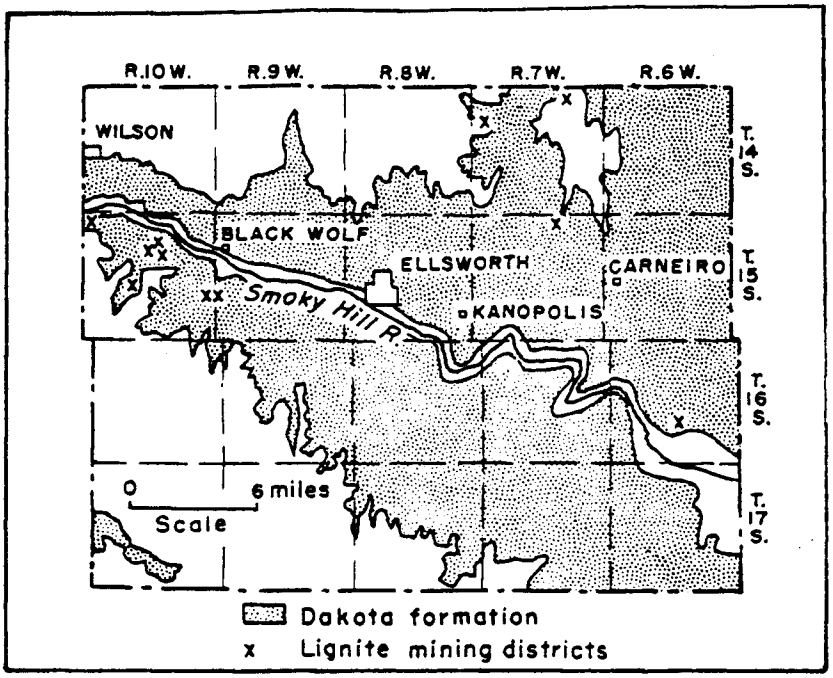


FIG. 4.—Map of Ellsworth County, Kansas, showing distribution of the Dakota formation and the location of lignite mining districts.

33.2 STOP 6 - SE Sec. 19 T 13S, R 1W, Lincoln County. Dakota Formation - fluvial continental facies. The accompanying illustration and explanation of this spectacular exposure are from Hattin, Guidebook Upper Cretaceous Stratigraphy and Depositional Environments of Western Kansas, Guidebook Series, Kansas Geological Survey, 1978.

This stop completes this field trip. Attendees may proceed on their own. For those interested in dinner (supper, here in western Kansas), there is a first rate restaurant, the Brookville Hotel, in the town of Brookville. To get there, go east on I 70 for 32½ miles from the Wilson, Kansas entrance. The Brookville Hotel serves home style dinners featuring fried chicken. The restaurant is an old hotel which formerly was a stagecoach stop when it was built in the 1870's. Many historically known people signed the guest register. Note the buildings made of Dakota sandstone. Well worth the visit!

From 3 to 6 miles east past the Wilson entrance to I 70, the highway passes over the Wilson Channel. The Saline River once meandered southward and joined the Smoky Hill River and the Wilson Channel represents that now filled watercourse.

Ten miles farther east is an exit to Kanopolis which is the site of the oldest continuously operated salt mine in Kansas. The mine was opened in 1914 and presently extracts salt from a 10 foot thick section within the Hutchinson Salt Member of the Wellington Formation (Permian-Cimmarronian) at a depth of 850 feet.

To return to Wichita, continue east on I 70 to the intersection of I 135 near Salina. Travel south on I 135 for 87 miles to "the Peerless Princess of the Plains", Wichita.

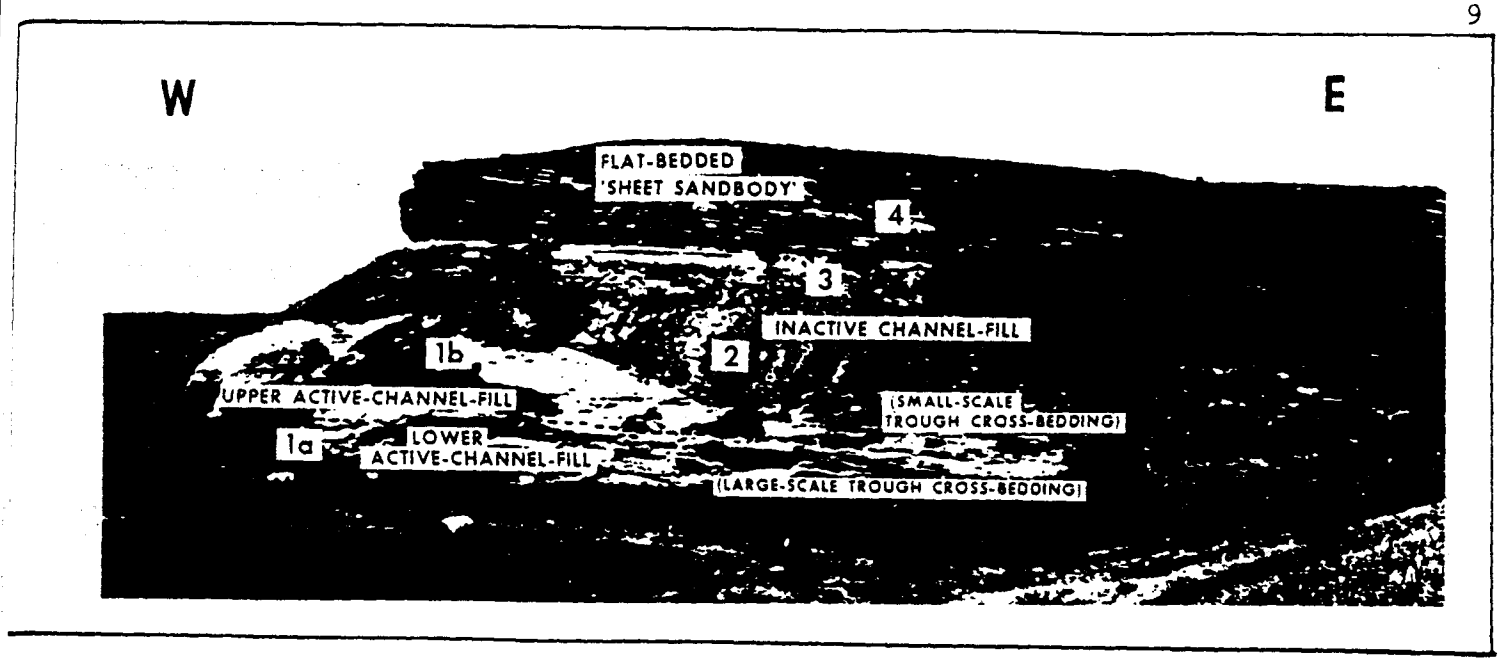


FIGURE 5A. Spectacular 100-ft (30-m)-thick section of upper part of Dakota Formation exposed at STOP 6. Units 1a and 1b represent active channel-fill of Rocktown channel sandstone body; unit 1a is characterized by large (1-3 ft (0.3-0.9-m) high and 5-15 ft (1.5-4.6-m) across) trough features and medium- to fine-grained sand with mudstone clasts and limonitized wood and plant debris; unit 1b is characterized by relatively small-scale (0.5-1.5-ft (0.15-0.46-m)-thick) trough crossbed sets and fine- to very fine grained sand. About 15 ft (4.6 m) of unit 1a is exposed; unit 1b is as much as 25 ft (7.6 m) thick. Sandstone body of unit 1 is truncated by carbonaceous silty claystone and shale (interlaminated with siltstone and clayey sandstone) of unit 2, which represents inactive fill of an abandoned channel; plant debris and root mottling is common. Unit 2 is as much as 25 ft (7.6 m) thick. Unit 3 is a root-mottled, carbonaceous sandy siltstone (as much as 16 ft (4.9 m) thick) of somewhat indeterminate origin but possibly related to units 8-12 (figure 14) exposed in nearby cut. Unit 4 is same as unit 14 in nearby cut (figure 14); as much as 31 ft (9.5 m) of flat-bedded sandstone is exposed here. The very fine grained sandstone contains abundant iron-stained plant debris, sparse burrows, and *Teredolithus* borings in wood; ripple-bedding and small-scale trough crossbed sets are abundant, especially in upper part of exposure.

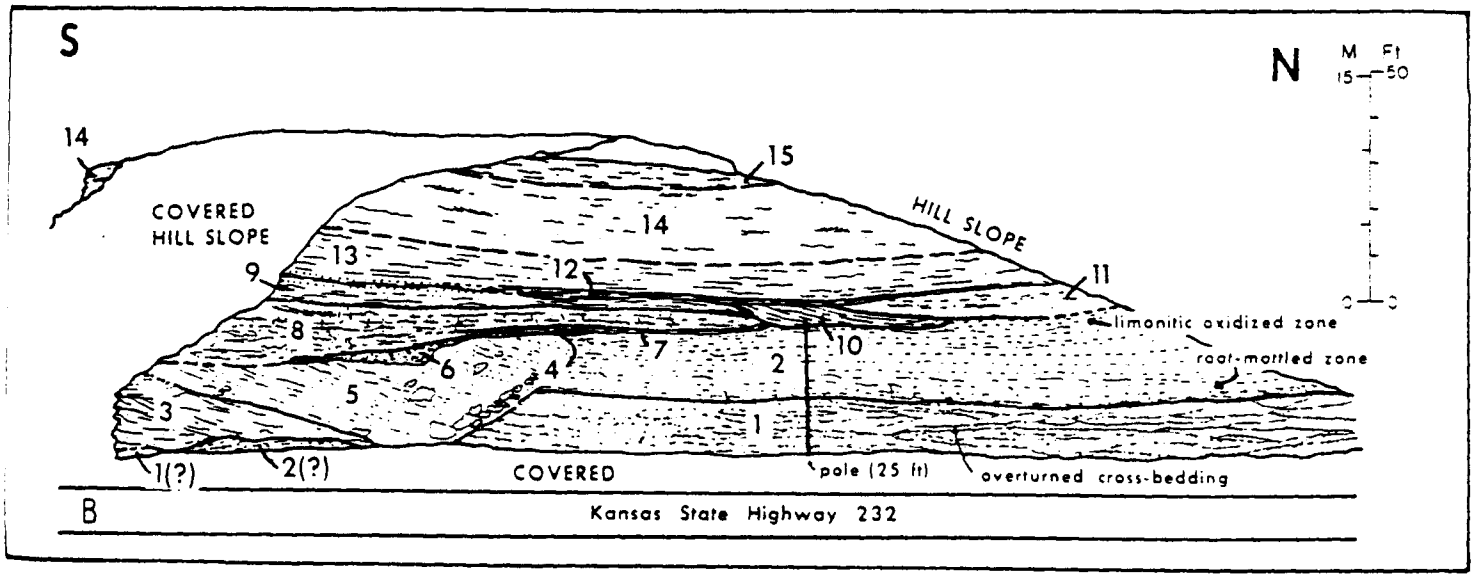


FIGURE 5B -Photograph and lithologic sketch of Dakota strata exposed at STOP 6. This exposure illustrates complex relationships of lithologic units in nonmarine fluvial channel and floodplain facies and marginal-marine deltaic facies in the upper part of the Dakota Formation. In general, unit 1 represents active-channel; units 2-6 represent complex floodplain and partly abandoned channel-filling processes; units 7-12 probably represent complex mixed-fluvial to marginal-marine deposition in deltaic environment; and units 13-15 may represent marginal-marine sand deposition across a deltaic surface during the initial phase of Graneros transgression. Elsewhere, Graneros Shale commonly overlies units such as 14 and 15 but has been stripped off here. Discordant surface labeled 4 is a spectacular feature of this exposure and may represent faulting of unit 5 against units 1 and 2 prior to deposition of unit 6. This surface may, however, be an erosional scarp of some sort, as indicated by numerous large exotic siltstone blocks in close proximity to discordant surface in shale of unit 5.

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Illustration Credits

Cover and Figure 3 by R. C. Moore in Moore, R. C., and Merriam, D. F., 1959, Kansas Geol. Soc., Annu. Field Conf., No 23, p. 38.

Figure 1 from Franks, P. C., et al, 1959, Kansas Geological Survey Bull. 134, part 6, p. 225.

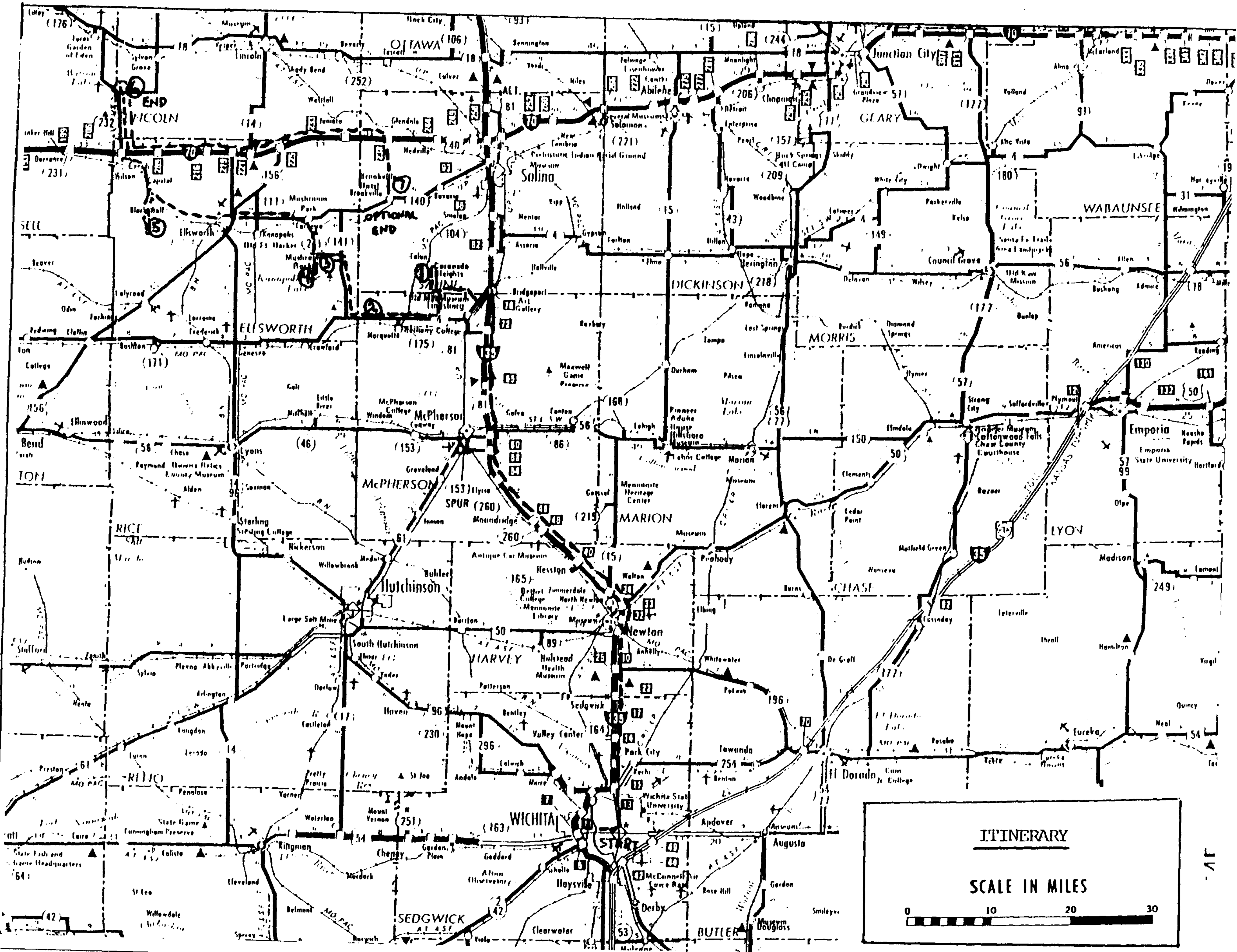
Figure 2 from Zeller, D. N., 1966, Kansas Geological Survey Bull. 189, plate 1.

Figure 4 from Schoewe, W. H., 1952, Kansas Geological Survey Bull. 96, part 2, p. 112.

Figures 5A and 5B from Hattin, et al, 1978, Kansas Geological Survey Guidebook Series 3, p. 65 and 63.

Colored Geological Map published by Kansas Geological Survey.

Western Interior Sea/AAAS area map modified from Hattin, D. E., 1986, Interregional model for deposition of Upper Cretaceous pelagic rhythmites, U. S. western interior: Paleoceanography, vol. 1, no. 4, p. 484.



ITINERARY
SCALE IN MILES
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OPTIONAL END
LINCOLN
ELLSWORTH
OTTAWA
SALINE
Salina
DICKINSON
Abilene
GEARY
Junction City
MORRIS
Council Grove
WABAUNSEE
LYON
Emporia
CHASE
Cottonwood Falls
MARION
Marion
McPHERSON
McPherson
RICE
Lyons
Sterling
RENO
Hutchinson
South Hutchinson
HARVEY
Newton
SEDGWICK
WICHITA
BUTLER
El Dorado
Augusta
Derby
Kingman
Ellsworth
Lindsborg
Hillsboro
Hesston
Halstead
Valley Center
Park City
Towanda
Andover
Eureka
Madison
Moundridge
Kanopolis
Mushroom Rock
Wilson
Yates Center
Nickerson
Buhler
Haven
Cheney
Goddard
Clearwater
Haysville
Mulvane
Douglass
Wichita State University
McConnell Air Force Base