

AESE FIELD TRIP
ROAD LOG
October 22, 1985

by

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Kansas Geological Survey
Open-file Report 85-20

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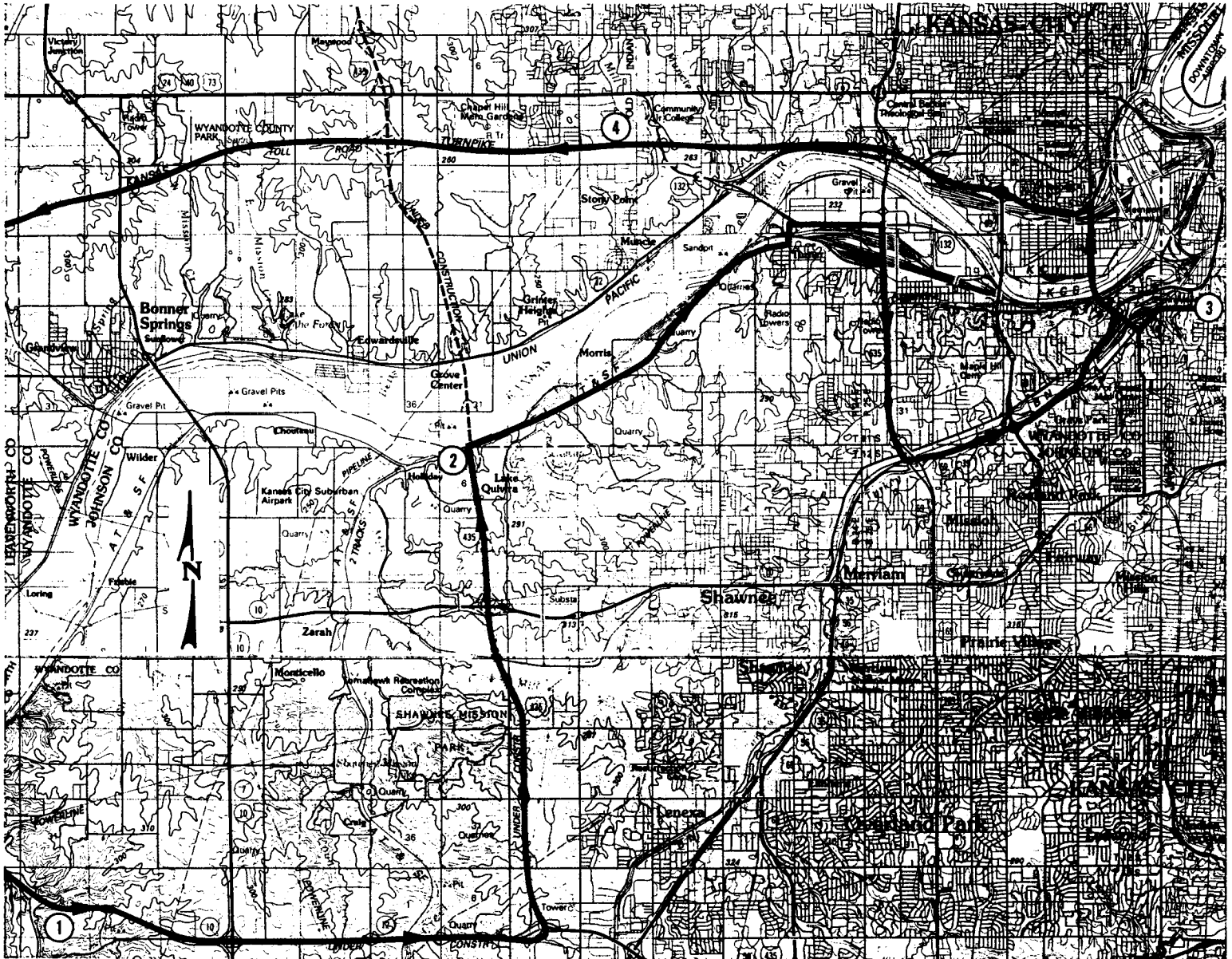
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OF
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AESE FIELD TRIP

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AREA MAP SHOWING FIELD-TRIP ROUTE AND LOCATION OF STOPS 1-4.

ROAD LOG

AESE FIELD TRIP, 22 October 1985

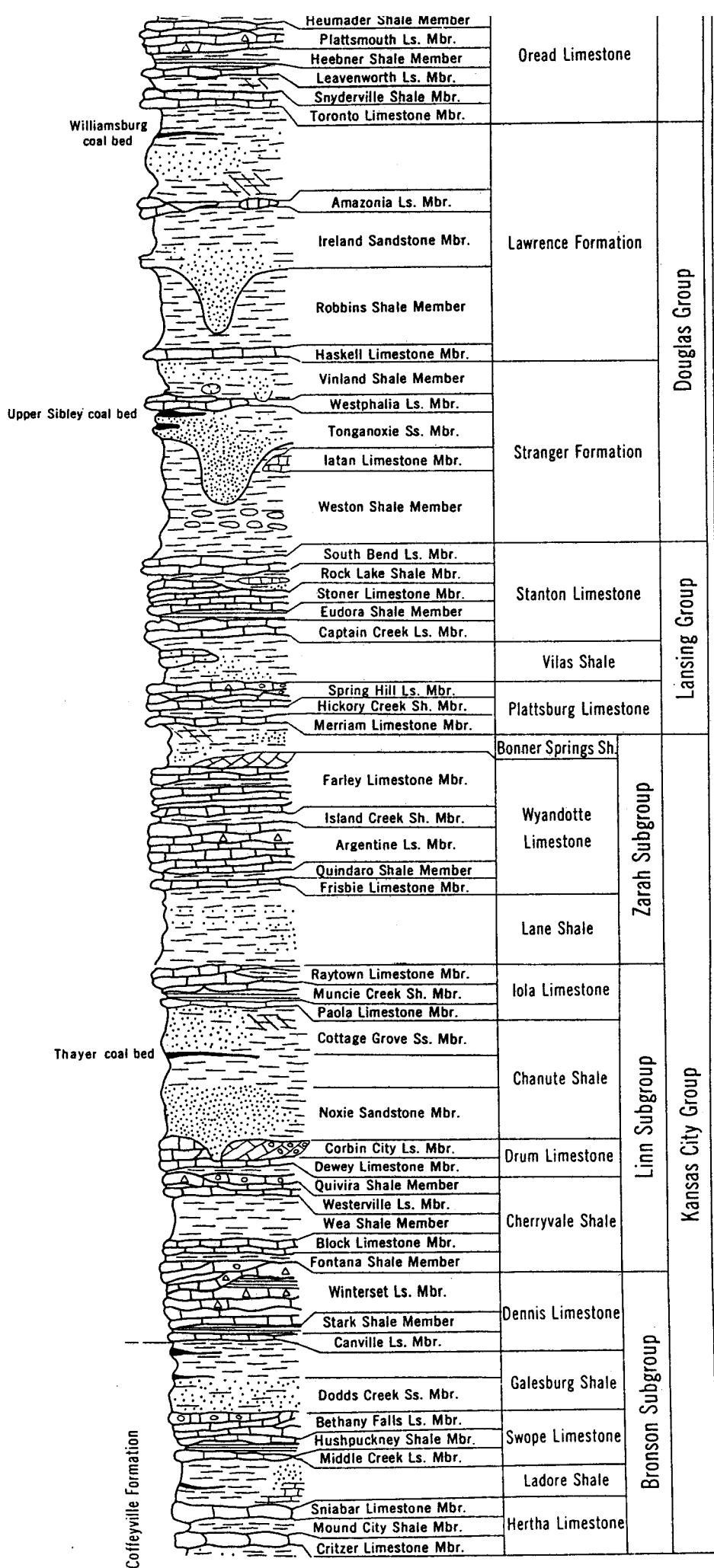
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Kansas Geological Survey

The following field trip between Lawrence and Kansas City focuses on Pennsylvanian formations, mostly limestones and shales, that were deposited about 300 m. y. ago. We also will see evidence of glacial, wind, and river deposition from the Pleistocene, about a million years ago. The following log is keyed to mileposts--small, green, numbered signs on the right-hand side of the roads we'll be on. Total elapsed mileage is shown in parenthesis below the milepost number.

- (0.0) Holiday Inn-Holidome. The starting point for the field trip, the Holidome (elevation 876 ft) is built on Pleistocene glacial till and alluvial sediments from the nearby Kansas River. The Kansas, or Kaw, marks the approximate southern boundary of glaciation into Kansas about a million years ago, although red quartzite boulders and other glacial debris can be found a few miles south of Lawrence.
- 0.0 Underpass of US-40. Here the road merges with K-10.
(0.5)
- 0.3 9th Street traffic light. This marks the edge of the Oread
(0.8) escarpment, (elevation 1,015 ft). The Oread Limestone, the resistant unit that forms the escarpment, is named after Mount Oread, the hill to the east that was the original site of the University of Kansas.
- 1.1 15th Street traffic light. The Toronto Limestone Member of the
(1.6) Oread Limestone is exposed in the northeast corner of the intersection.
- 1.3 The highway crests Daisy Hill. To the east are KU dormitories.
(1.8) Exposures of Leavenworth and Plattsmouth limestone members of the Oread Limestone are visible in the road cut.
- 1.4 To the west is Pioneer Cemetery, the burial place for victims of
(1.9) Quantrill's raid. More than 100 citizens were killed and much of Lawrence was burned by William Quantrill and his group of raiders from Missouri in 1863. Pioneer Cemetery is also the burial place of R. C. Moore, after whom the Kansas Geological Survey headquarters are named.
- 1.6 19th Street traffic light. Moore Hall, the tall, red brick building
(2.1) housing the Kansas Geological Survey, and Parker Hall, housing the Kansas branch of the U.S. Geological Survey's Division of Water Resources, are to the west.
- 2.0 23rd Street traffic light. The route turns east, or left, following
(2.5) K-10. US-59 continues south to Ottawa, Garnett, and on to Oklahoma. 23rd Street is known for the aesthetic qualities created by massing neon signs from fast-food franchises.

- 2.5
(3.0) Naismith Drive traffic light. This road is named after Dr. James Naismith, the inventor of basketball and one-time coach at KU. He also is the only basketball coach in KU's history with a career losing record. The drainage ditch at this intersection is occasionally the site of small flash floods, mostly the result of runoff from buildings and parking lots that have created impermeable surfaces on the KU campus.
- 3.3
(3.8) Massachusetts Street traffic light. This is Lawrence's main street; the Lawrence business district is 1.5 miles north. Lawrence is named after Amos Lawrence of Massachusetts, one of the original promoters of the New England Emigrant Aid Society, which helped settle Lawrence in 1854. Many of Lawrence's streets are named after states, but because a big share of the original settlers were from Massachusetts, it is appropriate that Massachusetts is the city's main street.
- 3.5
(4.5) Haskell Indian Junior College, south of the highway, serves representatives of 126 Indian tribes from 36 states.
- 6.7
(7.2) Here the highway drops down onto the Newman Terrace (elevation 815 ft), formed on the floodplains of the Kansas and Wakarusa rivers. This floodplain, measuring 5 miles from north to south, was created by the erosion of shales and soft sandstones in the Lawrence and Stranger formations. During a flood in 1951, the entire floodplain was under water. The Kaw River bottoms are generally sandy while the Wakarusa River bottoms are more gumbo, higher in clay. Until the past decade or so, these bottoms were known for the vegetable and melon crops they produced.
- 7.0
(7.5) Blue Mound (elevation 1,052 ft) is visible 2.3 miles to the south. This outlier is capped by the Oread Limestone and was once the site of the only ski slope in Kansas.
- 7.5
(8.0) The borrow pit south of the highway was created when sand and gravel were dug out to build up the road bed. Today it is the home of the KU water-skiing club.
- 8.5
(9.0) Oxbow lake, formed by the Wakarusa River, south of the highway. The few naturally occurring lakes in Kansas are of two types. One is formed in sinkholes caused by solution and collapse of evaporite beds in central and western Kansas. The second is oxbow lakes, such as this one, that occur in the floodplains of larger rivers, primarily in the central and eastern parts of the state. The small scarp between the lake and the highway marks the edge of the Newman Terrace.
- 9.1
(9.6) Wakarusa River, the largest right-hand tributary of the Kansas-Smoky Hill River drainage basin. The Wakarusa is dammed 12 miles upstream to form Clinton Reservoir and joins the Kaw River immediately east of Eudora.
- 9.2
(9.7) Orange glacial deposits are exposed north of the highway.



MISSOURIAN STAGE

UPPER PENNSYLVANIAN SERIES

SECTION SEEN DURING FIELD TRIP
 FIGURE AFTER THAT IN ZELLER'S
THE STRATIGRAPHIC SUCCESSION
IN KANSAS.

- 11.0 The town of Eudora, named after the daughter of a Shawnee Indian
(11.5) chief, is north of the highway.
- 12.9 Stoner Limestone Member of the Stanton Limestone is exposed north
(13.4) of the highway. The Stoner is generally 10-20 ft thick in eastern Kansas, thickening to 50 ft in southern Kansas.
- 13.1 Vilas Shale overlain by the Captain Creek Limestone Member of the
(13.6) Stanton formation. The Stanton is part of the Lansing Group, which is an oil reservoir in the deep subsurface in central and western Kansas and locally here in eastern Kansas. Oil geologists often lump the Lansing Group together with the slightly older Kansas City Group and speak of oil production from the "Lansing-Kansas City." The most common pay zones are porous limestones.
- 13.2 Captain Creek (elevation 785 ft). The Captain Creek Limestone
(13.7) Member, visible throughout the field trip, is named after this stream.
- 13.5 Captain Creek limestone. This is also the Douglas County/Johnson
(14.0) County line. Douglas County is named after Senator Stephen Douglas and Johnson County is named after the Rev. Thomas Johnson, who founded the Shawnee Methodist Mission in 1830 in present-day Kansas City. Johnson County and Wyandotte County, northeast of here, have a combined population of more than 400,000. Most of those people live in 14 towns and villages, ranging in size from Overland Park (population 81,784) to Mission Woods (population 213). The 400,000 people in these two counties account for nearly half of the population in metropolitan Kansas City and about one-fifth of the population of Kansas.
- 14.6 Sunflower Army Ammunition Plant to the south. This plant, first
(15.1) used in World War II to make weapons' propellant, closed at the war's end. It reopened during the Korean War, the Vietnam War, and again in 1984. It produces 8 million pounds of nitroguanidine per year and is the only such plant in the country.
- 15.6- Stoner Limestone Member of the Stanton Limestone.
16.0
- 16.1 Vilas Shale overlain by the Captain Creek limestone.
(16.6)
- 16.4 Eudora Shale Member overlain by the Stoner Limestone Member. Part
(16.9) of the Eudora is a gray-black shale that contains phosphate nodules and is somewhat radioactive, making it an important marker bed on geophysical logs taken in the Kansas subsurface. The radioactivity creates a strong kick on gamma-ray logs.
- 17.4 Captain Creek limestone.
(17.9)
- 18.0 The town of DeSoto, named after the discoverer of the Mississippi
(18.5) River, is 1 mile north. DeSoto is the home of Al "The Mad

Hungarian" Hrabosky, a relief pitcher for St. Louis Cardinals, Kansas City Royals, Atlanta Braves, and Denver Bears. In a recent issue of "The New Yorker," Roger Angell described Hrabosky as "the bearded, angry-looking performer . . . who habitually turned his back on the batter between pitches while he muttered imprecations and inspirational messages to himself, and then strode balefully toward the rubber like a Bolshevik entering the Union League Club."

18.7
(19.2)

Kill Creek (elevation 770 ft). Kill is an old Dutch word for creek.

18.9-
19.2

Captain Creek limestone, overlain by Eudora shale, overlain by the Stoner limestone, all members of the Stanton Limestone.

19.6-
20.0

Captain Creek limestone.

21.0-
21.2

The highway descends through members of the Wyandotte Limestone, which averages 60 ft in thickness in the area.

21.3
(21.8)

Camp Creek (elevation 780 ft).

21.7
(22.2)

Cedar Creek.

22.4
(22.9)

Iola Limestone overlain by Lane Shale in a roadcut along a county road to the north.

22.6-
23.0

Wyandotte Limestone.

23.0-
(23.2)

STOP 1. This roadcut is a classic example of the cyclic sedimentation that is common in Pennsylvanian deposition in eastern Kansas. These cycles were first described by R. C. Moore and other geologists in the 1930s. Moore theorized that each limestone and shale represented a time when a Pennsylvanian sea transgressed and then regressed.

Recent work has redefined this cycle to include four limestone and shale units that recur in order many times throughout the Pennsylvanian in the Midcontinent. This model, called a cyclothem, begins with a lower limestone, generally thin (from 1 to 10 ft thick) that was probably deposited as the sea deepened. Above that is a generally black, fissile shale, 5-10 feet thick. This shale is considered an offshore, marine shale and was probably deposited as the seas reached their maximum depth. Next came an upper limestone that is generally up to 20 ft thick and was deposited as the seas regressed. Then an upper shale was deposited in a nonmarine environment. This upper shale is brown to gray, in contrast to the lower dark-gray to black marine shale.

The roadcut here displays this cycle. The lowermost unit is the Argentine limestone, named after an area in Kansas City where a

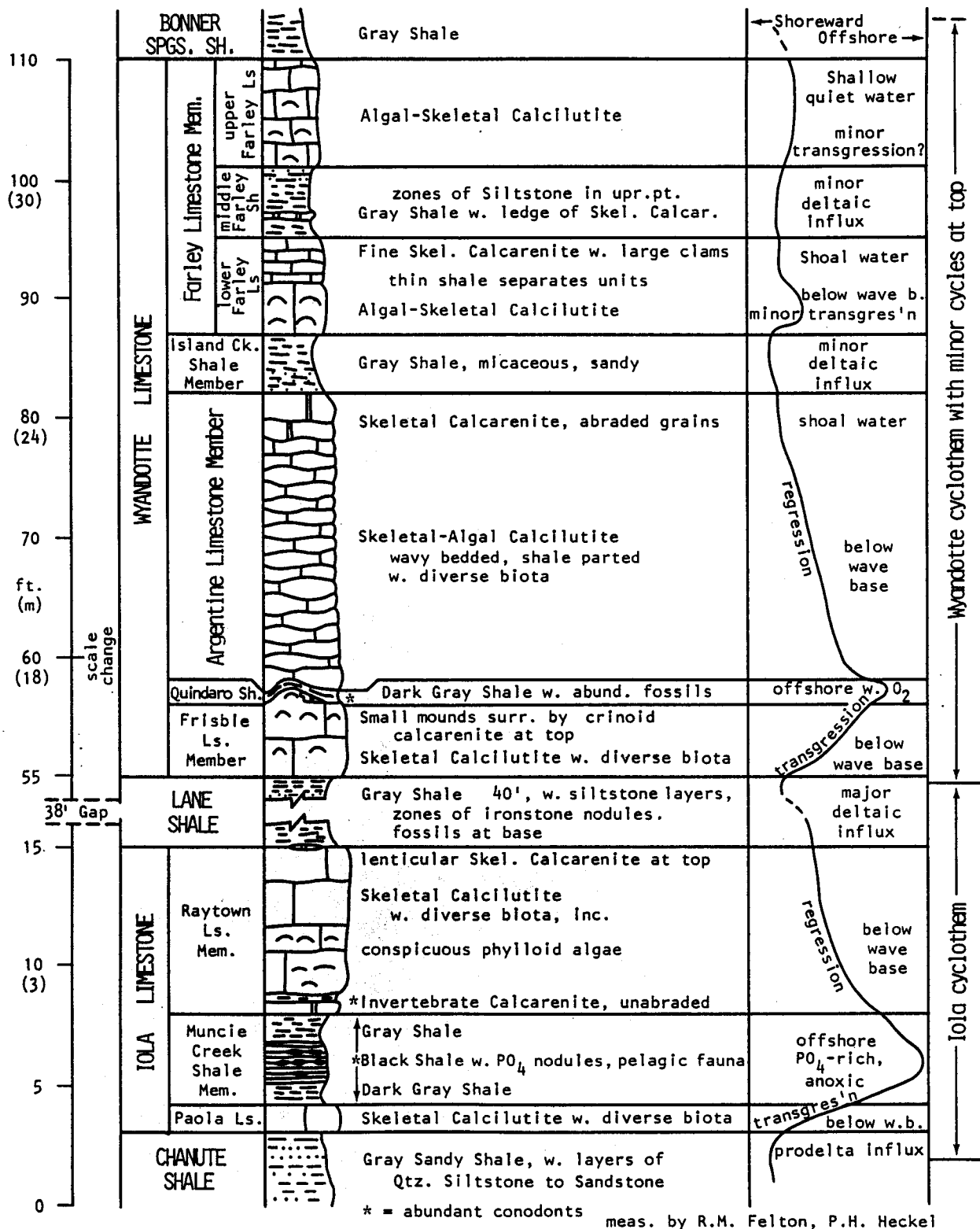
smelter was operated in the early 1900s. The Argentine is about 17 ft thick and contains abundant algae. Above the Argentine is a thin layer of the Island Creek shale, overlain by a thicker layer of the Farley limestone, a layer that is visible several places along the field trip. Above the Farley is the Bonner Springs Shale, which is greatly variable in thickness. The roadcut is capped by the Plattsburg Limestone. Immediately south of the road here is a quarry where the walls show the Bonner Springs pinching out and disappearing within a few hundred feet.

This roadcut is a good spot for collecting invertebrate fossils. Crinoids, brachiopods, and bryozoans are especially common. Some fusulinids can be found. Calcite nodules and small pieces of chert can be seen in places.

- 23.5
(24.0) Captain Creek limestone (elevation 1,000 ft).
- 23.8
(24.3) Stoner limestone.
- 23.9
(24.4) Captain Creek limestone.
- 24.3
(24.8) Plattsburg Limestone.
- 25.3
(25.8) K-7 Interchange. K-7 runs 10 miles north to Bonner Springs and 7 miles south to Olathe.
- 27.0
(27.5) The highway passes through the southern part of the Craig-Monticello Natural Gas Storage Area. Gas is stored here at an average depth of 582 ft in the "Squirrel sand" of the upper part of the Cherokee Group (Pennsylvanian). Sandstone bodies, such as the Squirrel, are called "shoestring sands" because of their configuration when plotted on a map; they are thought to be ancient sand-filled river channels. Shoestring sandstones are common sources of oil in eastern Kansas, but they are narrow and provide only small drilling targets, a characteristic that produced the name Squirrel sandstones, because drillers thought the sand body behaved "squirrelly."
- 27.1
(27.6) Stanton Limestone.
- 27.3
(27.8) Plattsburg Limestone to the north.
- 27.6
(28.1) Bonner Springs Shale.
- 27.8
(28.3) Mill Creek. The Wyandotte Limestone is exposed in the walls of the creek immediately south of the highway.

- 28.2 Plattsburg Limestone overlain by Vilas Shale.
(28.7)
- 28.4 Stanton Limestone.
(28.9)
- 28.5 Plattsburg Limestone overlain by Vilas Shale.
(29.0)
- 29.0 The asphalt plant and quarry north of the highway are in the
(29.5) Wyandotte Limestone.
- 29.1 Bonner Springs Shale overlain by Plattsburg Limestone.
(29.6)
- 29.4 Junction with I-435 headed north. The Plattsburg Limestone is
(29.9) exposed through this interchange, along with parts of the underlying
Bonner Springs Shale and overlying Vilas Shale. This interchange is
also in the midst of the Olathe Northeast oil field. Discovered in
1982, it produces from Squirrel sand of the upper Cherokee Group.
The pumpjacks in this field are small because the oil here is
shallow, only about 500 ft underground.
- 2.0- Stanton Limestone.
2.3
- 2.6 Underground limestone mine to the west.
(31.5)
- 2.8 Stoner limestone.
(31.7)
- 2.9 To the west are additional wells in the Olathe Northeast oil field.
(31.8)
- 3.7 Captain Creek limestone.
(32.6)
- 4.0- The highway descends through the Stoner, underlain by the Eudora
4.3 shale, underlain by the Captain Creek limestone, underlain by the
Vilas Shale.
- 4.5 The Vilas Shale, at the top of this roadcut, contains a white to
(33.4) buff sandstone and lies atop the Plattsburg Limestone.
- 4.7 Upper and lower limestones in the Farley Limestone Member of the
(33.6) Wyandotte Limestone, overlain by Bonner Springs Shale and Plattsburg
Limestone.
- 4.9 Wyandotte Limestone is exposed in the south wall of Little Mill
(33.8) Creek valley. The thick limestone unit is the Argentine limestone,
beneath the Lane Shale.

STOP 1: I-435 SW. EXIT RAMP AT HOLLIDAY RD.



SECTION SEEN AT STOP 2; FIGURE TAKEN FROM HECKEL'S RECENT INTERPRETATIONS OF LATE PALEOZOIC CYCLOTHEMS.

- 5.0 Little Mill Creek.
(33.9)
- 5.6 Bonner Springs Shale overlain by Plattsburg Limestone.
(34.5)
- 5.8 Plattsburg Limestone overlain by Vilas Shale, which again includes
(34.7) layers of sandstone.
- 6.0 K-12 Interchange and exposures of the sandy Vilas Shale overlain
(34.9) by the Captain Creek limestone.
- 6.4- Various exposures of Plattsburg Limestone.
7.7
- 7.9 Holiday Drive exit, leaving I-435. To the west, the Farley
(36.8) limestone is overlain by the Bonner Springs Shale and the Plattsburg Limestone. Here the Farley is composed of two limestone beds and a considerable amount of shale, in contrast to the thick sequence of limestone that the Farley displays at Stop 1.
- (37.5) **STOP 2** shows two complete cyclothem (the section is depicted in the accompanying illustration, taken from Phil Heckel's Recent Interpretations of Late Paleozoic Cyclothem). The road at the base of the hill runs atop the Drum Limestone, which crops out in the Kansas City area. The lowest visible unit is the Chanute Shale, overlain by the Paola limestone--a thin, barely visible limestone. Above that is the Muncie Creek shale, a dark-black, fissile shale that contains abundant marble-sized, rounded nodules that are rich in phosphate and found in several black marine shales in Kansas cyclothem. Above the Muncie Creek is a thicker limestone, the Raytown, overlain by a very thick shale, the Lane. The Chanute Shale, Paola limestone, Muncie Creek shale, the Raytown limestone, and the Lane Shale represent a complete cyclothem.

Above these layers is a second cyclothem, beginning with the thin Frisbie limestone. Above that is the Quindaro shale, a dark-black, thin shale. On the east side of the roadcut, about halfway up the exit ramp, is a reef or mound structure where the Quindaro is draped over the Frisbie. This mound was probably created by algal colonies that built up on the sea bottom and were surrounded by thickets of crinoids. Above the Quindaro is the Argentine limestone, overlain by the Island Creek shale, overlain by the Farley limestone. The last three units are the same ones seen at stop 1.

The Kansas River (740 ft) is visible northwest of this stop. A sand-dredging operation is generally visible on the river to the northwest. The Kansas River occasionally washes Pleistocene fossils out of the sandbars along its path in this area, including the remains of mastodons and mammoths. From here we proceed east on Holliday Drive, named for a small town a mile west of here that was named after Cyrus Holliday, founder of the Atchison, Topeka, and

Santa Fe Railroad, which runs along the south bank of the Kaw, adjacent to the roadway.

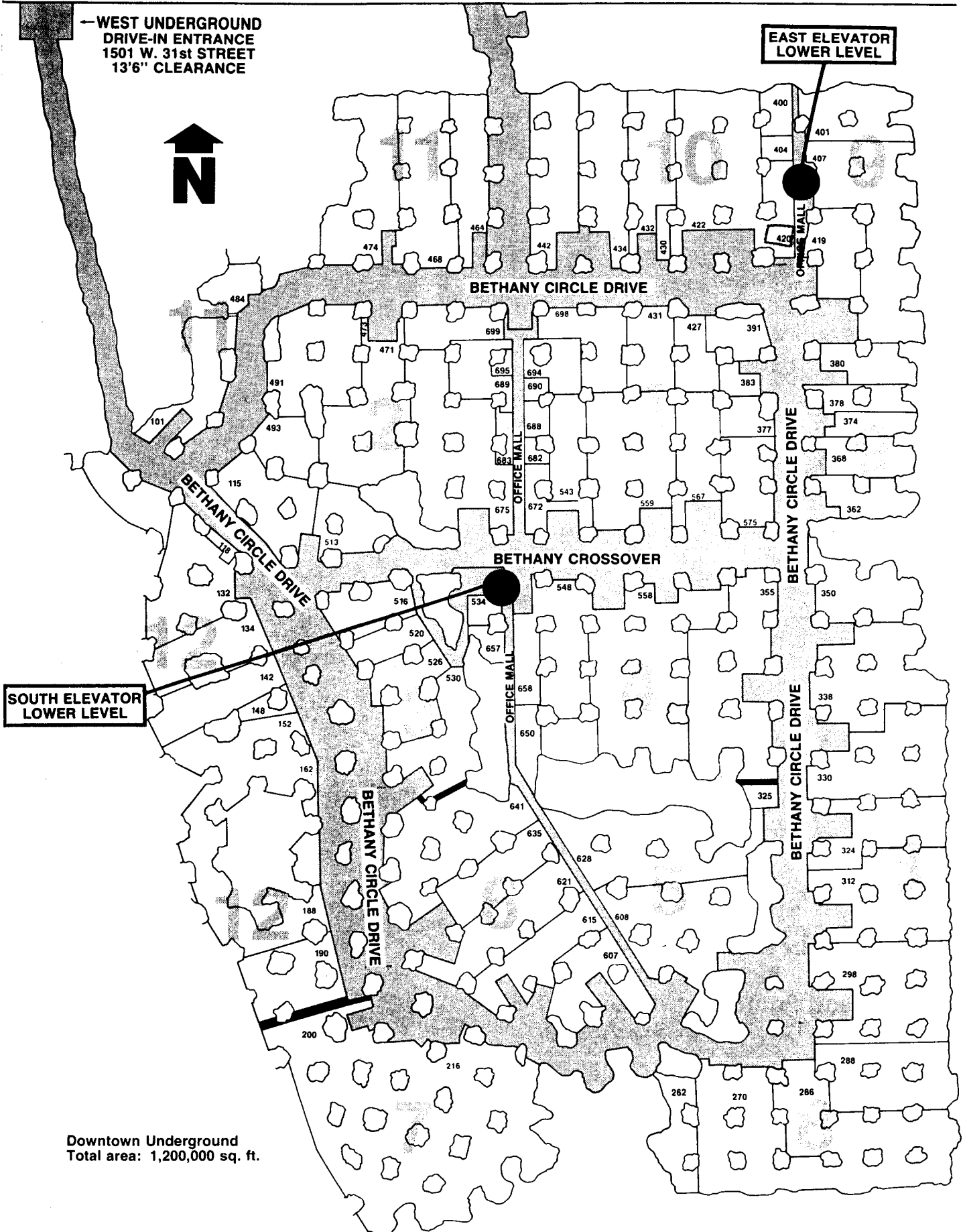
- (37.8) Chanute Shale overlain by the Iola Limestone, Lane Shale, and Wyandotte Limestone south of the road. Many of the formations here, such as the Chanute and the Iola, are named after towns in southeastern Kansas where they reach their maximum thickness. In Kansas, the Pennsylvanian crops out in north-south-trending bands across the eastern end of the state, something like stripes on a zebra.
- (38.0) Johnson County water district water-intake station. Parts of the county take their water supply from the Kansas River.
- (38.5) South of the road is the dam for Lake Quivira, which includes a housing development by the same name. Before he moved back to California, George Brett lived here.
- (39.6) Water-treatment plant.
- (39.9) The town of Morris.
- (40.7) Junction with Inland Drive. We bear left. The Bethany Falls Limestone Member of the Swope Limestone is partially obscured by vegetation south of the road. This is the same unit that we will see underground in Kansas City. The Bethany Falls limestone dips below the Kaw River valley to the east and to the west. It is brought to the surface here by a small anticlinal uplift. For the next 0.8 miles, the quarries and mines of Inland Storage are visible to the south. This is a large, underground storage area similar to the one we will see at Stop 3.
- (41.6) South of the road, partially obscured by vegetation, is a collapse feature in the Dennis Limestone.
- (41.9) Westerville Limestone Member of the Cherryvale Shale overlain by the Drum Limestone.
- (42.0) Drum Limestone.
- (43.2) Junction with 55th Street in Turner, a former town that is now part of Kansas City, Kansas. Turn left.
- (43.5) Traffic light. Turn right (east) onto Turner Drive and the floodplain of the Kansas River (elevation 762 ft).
- (44.5) Traffic light. Turn left (north) onto I-635 south.
- (45.8) To the east is an area of Kansas City, Kansas, known as Argentine. Its name came from the Latin word for silver (argentum), and it was once the site of two smelters that refined small amounts of silver. This area is also the type locality of the Argentine limestone.

- (47.4) Plattsburg Limestone on both sides of the highway. This area was once undermined, although these old mines were filled in during construction of the highway. About 0.5 miles east, an old limestone mine caved in during the late 1960s and destroyed several houses.
- (48.4) Argentine Limestone Member of the Wyandotte Limestone.
- (48.9) I-35 Interchange. We proceed north on I-35; again, the upper number in the following description is keyed to the mileposts, and the number in parenthesis represents total mileage.
- 231.8
(49.7) Johnson County/Wyandotte County line. Wyandotte County is named for the Wyandot Indians, who moved to this area from Ohio and organized Wyandotte City. Wyandotte City, Quindaro, and several neighboring towns were consolidated in 1886 to form Kansas City, Kansas.
- 232.6-
233.3 Drum Limestone.
- 233.5
(51.4) Turkey Creek. From its source to the point where it joins the Kansas River, Turkey Creek falls a vertical distance of nearly 350 ft over a 10-mile course. This is an average gradient of 35 ft per mile, comparable to the 40 ft per mile gradient of the Arkansas River as it flows through the central Colorado Rockies. Much of Turkey Creek's watershed is composed of impermeable surfaces--roofs, streets, parking lots--and heavy downpours can cause flash floods as violent as those in the mountains. One such storm in September 1977, sent Turkey Creek and Brush Creek, the next stream to the east, out of their banks, causing millions of dollars in damage and killing 25 people.
- 234.1
(52.0) North of the highway is the Cherryvale Shale, up through Drum Limestone, Chanute Shale, Iola Limestone, and Lane Shale. The hill is capped by Wyandotte Limestone.
- 234.4
(52.3) Cherryvale Shale and the overlying Drum Limestone.
- 234.6
(52.5) 7th Street Trafficway. We proceed south. This part of Kansas City is known as Rosedale and was a separate city until it was annexed by Kansas City in 1922. Rosedale was the site of the Geyser Mineral Bath-House during the late 1800s. Built on the south side of Turkey Creek, the bath-house was near a well that was drilled for gas and produced mineral water that was used for bathing and manufacturing soft drinks. Today this area is known locally for its barbeque joint, The Rosedale Barbeque (see the authors for more information on Kansas City barbeques).

Visible on Mount Marty, a high bluff to the southwest, is the Rosedale Arch. A half-scale replica of the Arc de Triomphe in Paris, it honors World War I veterans from the area. At the base of this bluff, leading out from this exit, is Rainbow Boulevard, named after the Army's 42nd Division of World War I. That division was

WEST UNDERGROUND
DRIVE-IN ENTRANCE
1501 W. 31st STREET
13'6" CLEARANCE

EAST ELEVATOR
LOWER LEVEL



SOUTH ELEVATOR
LOWER LEVEL

Downtown Underground
Total area: 1,200,000 sq. ft.

MAP OF DOWNTOWN UNDERGROUND (STOP 3).

composed of National Guard units from Kansas, Missouri, and more than 20 other states and was known as the Rainbow Division.

- (53.0) Traffic light. Proceed left on Southwest Boulevard.
- (53.5) Traffic light at 31st Street. This is also the Kansas/Missouri state line.
- (54.0) Downtown Underground. **STOP 3**. This underground storage area (configuration of the mine is shown in the accompanying diagram) was developed in the Bethany Falls limestone, a unit that is consistently 20-25 ft thick and that has been used extensively in construction around Kansas City. The Bethany Falls has little dip and is overlain by a thick, impermeable shale that keeps water out of the old mines. Thus, this mine provides cool, relatively dry space for storage.

Such mines are common in Kansas City, and they provide about 1/7th of the city's warehouse space. Mining in the 1900s has produced over 120 million square feet of mined-out space, more than 4.5 square miles. Because of Kansas City's central venue and its location in the middle of an agricultural area, much of that space is used to store food products.

- (55.5) Proceed on 31st Street to Southwest Boulevard and back to 7th Street Trafficway.
- (56.3) Kansas River. Between 1854 and 1866, 34 steamboats paddled up the Kaw River and one made it as far west as Fort Riley. However, shallow water and sandbars eventually halted steamboat traffic. As one Lawrence newspaper editor wrote, the Kaw is "a hard road to travel."
- (57.2) Traffic light at Kansas Avenue (elevation 750 ft). This is literally the low point in the field trip. The lowest point in Kansas is south of Coffeyville, at the Oklahoma border, where the elevation is slightly less than 700 ft. The high point is in Wallace County, near the Colorado border, where the elevation is 4,039 ft.

This is also the Armourdale area of Kansas City, Kansas, named after one of several meat-packing plants that operated in the Kaw River bottoms to the northeast. Many of these plants were heavily damaged during the 1951 flood. In the 1970s, meat packing moved into western Kansas, where irrigation was allowing farmers to grow corn and other crops suitable for feeding cattle. Giant feedlots soon appeared in western Kansas, followed by the meat-packing business, which has now generally left Kansas City.

- (57.7) Intersection with I-70. A mile to the north, on 7th Street, is the Sadecki Grocery, famous for its Polish sausage (see the authors for information on ethnic butcher shops in Kansas City) and for Ray Sadecki, a 20-game winner for the 1964 world-champion St. Louis Cardinals.

- 419.6-
420.4 Westerville Limestone Member of the Cherryvale Shale overlain by the Drum Limestone. Oolites are common near the top of the Westerville, which is sometimes called the "Kansas City oolite." The Westerville reaches a thickness of 20 ft around Kansas City but is replaced by a shale in Miami County, south of here. The Cherryvale Shale is named for a small town in Montgomery County, Kansas.
- 419.4
(60.3) Mattoon Creek.
- 419.0
(60.7) Interchange with I-635. Iola Limestone exposed north of the roadway.
- 418.7
(61.0) Argentine limestone north of the highway.
- 418.4
(61.3) North of the highway is a quarry in the Argentine limestone.
- 418.2
(61.7) Lane Shale overlain by the Argentine limestone.
- 417.5
(62.2) Loess on the north side of the highway. Loess is a finely ground rock flour that is common in northwestern Kansas and forms many of the bluffs along the Missouri River in northeastern Kansas. Loess in this area was deposited during the Pleistocene.
- 417.3
(62.4) Brenner Heights Creek.
- 416.9
(62.8) Loess on both sides of the road.
- 416.6
(63.1) Muncie Creek.
- 416.0
(63.7) Loess exposure.
- 415.3
(64.4) Argentine limestone north of the highway.
- 415.1
(64.6) **STOP 4.** On the south edge of the parking lot is an information booth for the state of Kansas. Inside are restrooms, water fountains, and information about tourist stops in Kansas. Along the north edge of the parking lot are two layers in the Farley limestone, the same unit seen at the top of the roadcut at Stop 2 and that was one unit at Stop 1. The layer of the Farley at the east end of the parking lot is oolitic, dotted with small spheres of calcium carbonate. The lower limestone also is crossbedded in places. The upper layer of the Farley is exposed at the west end of the parking lot. This limestone contains abundant remains of phylloid algae, a leaflike algae that thrived on the muddy seafloor

and today forms small chips of clear spar in the limestone. The Farley also contains clams and brachiopods.

- 414.5
(65.2) Crossbedded limestone in the Farley.
- 414.0
(65.7) Two miles south is the site where the first ferry operated across the Kansas River. Moses Grinter built the ferry in 1831, and in 1867 constructed a two-story brick farmhouse nearby. The house is today a state-owned museum.
- 412.7
(67.) Stanton Limestone. In the next 1.2 miles, I-70 intersects with I-435. In this stretch, I-70 drops down from the Stanton through the Vilas Shale, Plattsburg Limestone, Bonner Springs Shale, to the Farley limestone. The road then climbs back up through the section.
- 411.5
(69.2) South of I-70, the top of the Plattsburg Limestone is overlain by the Vilas Shale, the Captain Creek limestone, the Eudora shale, and the Stoner limestone. After this point, the numbering system changes to that of the Kansas Turnpike.
- 226.0
(69.8) East Mission Creek.
- 225.6-
225.8 Tonganoxie Sandstone Member of the Stranger Formation.
- 224.6
(71.2) West Mission Creek.
- 224.2
(71.6) Exit for K-7 to Leavenworth and Bonner Springs.
- 223.2
(72.6) Tonganoxie sandstone.
- 222.4-
222.9 The top of the Stanton Limestone down through the Vilas Shale, Plattsburg Limestone, and the Bonner Springs Shale.
- 221.8
(74.0) Wolf Creek. The name of the stream serves as a reminder that gray wolves were once common through most of Kansas. Last reported in Kansas in 1905, wolves preyed almost entirely on buffalo.
- 221.4
(74.4) Bonner Springs Shale overlain by Plattsburg Limestone.
- 221.0
(74.8) Stanton Limestone.
- 220.5
(75.3) The Tonganoxie Sandstone Member here is crossbedded, with thin, angling lines indicating that the sand was deposited by flowing water. The Tonganoxie occurs in a narrow band, never more than 20 miles across, to the southwest. This sandstone reaches a maximum thickness of 160 ft and seems to be the valley deposit of a large,

southward-flowing stream that cut down into older rocks during the Pennsylvanian.

- 215.9
(75.9) Stranger Creek. The name is a translation of an Indian word that means "wandering aimlessly about," an apt description of the meandering habit of this stream.
- 214.9
(76.9) Stoner limestone.
- 213.4
(77.4) South of the highway is an exposure of a thin coal bed in the Stranger Formation. These coals were once mined in this vicinity and other parts of northeastern Kansas, but today coal mining is limited to the southeastern corner of the state.
- 212.2
(78.6) Cow Creek, one of seven Cow creeks in Kansas.
- 212.0
(78.8) Stranger Formation overlain by reddish Pleistocene deposits.
- 211.6
(79.2). Sandstone in the Stranger Formation
- 210.7
(80.1) Nine-mile Creek.
- 209.0
(81.8) Lawrence Service Area.
- 208.2
(82.6) Kent Creek.
- 206.0
(84.8) Mud Creek.
- 205.8
(85.0) Douglas County/Leavenworth County line.
- 205.4
(85.4) A river channel abandoned by the Kansas River. The slightly higher ground east of this channel is underlain by the Newman Terrace, seen early in the field trip.
- 204.3
(86.5) To the north is another old river channel.
- 203.5
(87.3) East Lawrence Interchange.
- 203.0
(87.8) Kansas River. The Kaw looks wider and deeper than at other places along its course, primarily because it is impounded a little more than a mile downstream by Bowersock Dam, the only dam on the Kansas River and the only hydroelectric dam in the state. It has the capacity to produce just under two megawatts of electricity. With

its sandy bottom and connection to the Mississippi River via the Missouri, the Kaw is home to several species of fish that are rarely found elsewhere in Kansas, including sturgeon, lamprey, and eels.

201.9
(88.9) West Lawrence Interchange. The Holidome is 0.5 miles to the south.