KANSAS GEOLOGICAL SURVEY
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Fossils and Flint Hills
A Field Trip in Eastern Kansas for the
Association of Earth Science Editors
October 29, 2001

by

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On this field trip (see map, p. 10) we'll look at some of the rocks and fossils that crop out in eastern Kansas. The fossiliferous limestones and shales at our first stop were deposited during the Pennsylvanian, about 300 million years ago, when shallow seas covered the region. At our second stop, we'll be looking at younger limestones and shales, deposited during the Permian. We'll be travelling in three of the state's physiographic provinces, the Glaciated Region, Flint Hills, and Osage Cuestas (see factsheets).

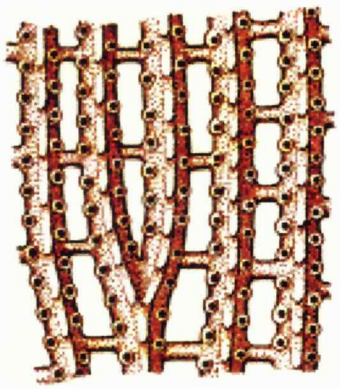
Stop 1—K-4 and U.S.-24 Interchange

The road cut at the junction of Kansas Highway 4 and U.S. Highway 24 is an easy place to see and collect invertebrate fossils. In Kansas, invertebrate fossils are much more common than vertebrate fossils. Even so, they represent only a tiny sampling of the animals that once inhabited this part of the earth, most of which lived and died leaving no visible trace. The fossils here give an idea of the variety of animals that lived in the Pennsylvanian seas, roughly 300 million years ago. Among the fossils found at this site are brachiopods, bryozoans, crinoids, gastropods (snails), bivalves (oysters, clams, scallops), and trilobites. The less familiar of these are described in more detail below.

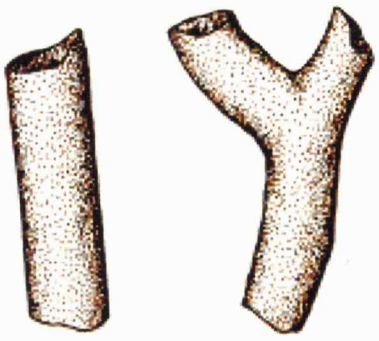
Two units here, the Holt Shale and Coal Creek Limestone Members of the Topeka Limestone, are particularly fossiliferous (fig. 1). The Holt Shale Member is a dark-gray, layered siltstone, about 2 feet thick. Fossils of brachiopods and bryozoans (see description below) are common in this member. The Coal Creek Limestone Member, which sits directly above the Holt Shale Member, is a light-gray or olive, silty limestone, about 4 feet thick.

In addition to the fossils at this site, you can see coal, exposed at the surface in the Calhoun Shale, the formation just below the Topeka Limestone. Pyritized wood is also found in the same vicinity as the coal, just above the coal layer in the Calhoun Shale.

Bryozoans are some of the most abundant fossils found in sedimentary rocks, and they are also widespread today, both in marine and freshwater environments. Bryozoans are small animals (just large enough to be seen with the naked eye) that live exclusively in colonies. Bryozoan colonies can resemble colonies of some corals. Like corals, most bryozoans secrete external skeletons made of calcium carbonate, but unlike corals, bryozoans generally don't build reefs. Each bryozoan colony starts out with a single individual, called a zooid. Each zooid is essentially cylindrical and has a ring of tentacles that it uses to feed, drawing tiny plants and animals towards its mouth. As the first zooid begins feeding, it buds to form additional zooids, each of which has its own feeding tentacles. The new zooids also bud, forming the colony. Large colonies may consist of hundreds of thousands or even millions of zooids. Fossil bryozoan colonies come in a variety of shapes. Some bryozoans built colonies that grew from the seafloor in branching structures; these fossils look like something like twigs. Other species erected netlike frameworks, while still other spread like a crust on shells, rocks, plants, and even other bryozoan colonies.



Fenestella, one bryozoan found in Kansas rocks, built netlike colonies.



Another bryozoan, *Rhombopora,* is characterized by upright, branching stems that resemble small twigs.

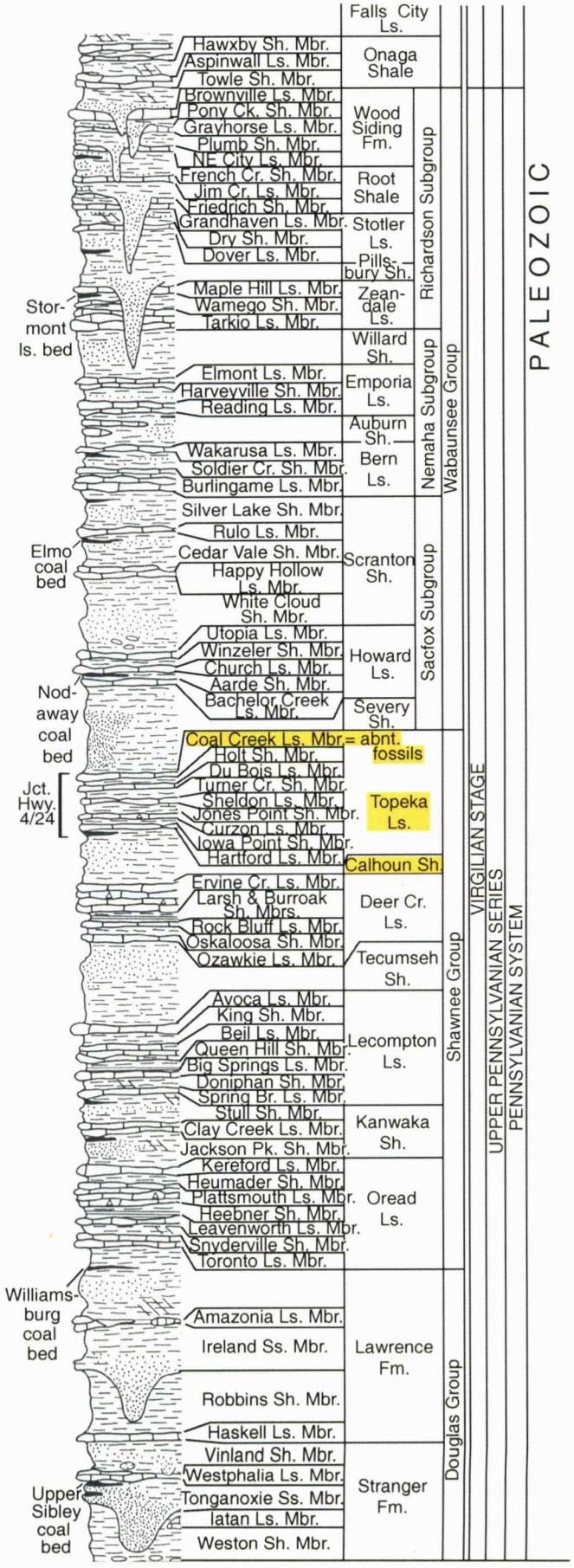


Fig. 1—Stratigraphic classification of Upper Pennsylvanian rocks in Kansas (from Zeller, 1968).

Brachiopods have a shell consisting of two parts called valves. Their fossils are common in the Pennsylvanian and Permian limestones of eastern Kansas. Brachiopods have an extensive fossil record. They first appear in rocks dating back to the early part of the Cambrian Period, about 545 million years ago, and were extremely abundant until the end of the Permian Period, about 250 million years ago, when they were decimated in the mass extinction that killed more than 90 percent of all living species and was the largest of all extinction events (larger than the major extinction at the end of the Cretaceous that killed off the dinosaurs). A distinctive feature of all brachiopods is that their valves are bilaterally symmetrical—that is, the right half is a mirror image of the left half. (Humans are also bilaterally symmetrical.) The bilateral symmetry of the individual valves differentiates brachiopods from clams and other bivalved mollusks, with which they are sometimes confused. Unlike brachiopods, clam valves are not bilaterally symmetrical; instead, the right and left valves are mirror images of each other. Brachiopod shells come in a variety of shapes and sizes (fig. 2). The outer surface of the valves may be marked by concentric wrinkles or radial ribs. Some brachiopods have prominent spines, but these are generally broken off and incorporated separately in the sediment.

Clams and other bivalves. Fossil clams are generally easy to recognize because they look a lot like the shells scattered along modern seashores. Clams and their relatives (oysters, scallops, mussels) are often called bivalves (or bivalved mollusks) because their shell is composed of two parts called valves. Like their living relatives, fossil bivalves come in many different shapes and sizes. Typically the right and left valves are symmetrical (in contrast to the bilateral symmetry of individual brachiopod valves), though some bivalves, such as oysters, have valves that are not symmetrical. In western Kansas, fossil clams found in younger rocks from the Cretaceous Period, are even more common. Some of these—the inoceramid clams from western Kansas—are huge, as much as 6 feet in diameter.

Crinoids were also common in the Pennsylvanian seas. Because they resemble plants, with feathery arms set atop a long stem, crinoids are sometimes called sea lilies. But they are definitely animals—relatives of starfish, sand dollars, and sea urchins. Crinoids appeared in the fossil record about 500 million years ago and still inhabit the world's oceans. Well-preserved fossils of entire crinoids have been found in the chalk of western Kansas (and are on display in museums around the country). Usually, what people find are pieces of the crinoid stem, which are shaped like little buttons and were used by Native Americans as beads. At this site, you might also find the crinoid calyx, the cuplike part that sat on top of the stem.

Trilobites are an extinct group of arthropods, relatives of insects, spiders, ticks, crabs, shrimp, lobsters, and numerous other organisms. They were exclusively marine organisms. Trilobites first appear in the fossil record in rocks deposited during the Lower Cambrian, about 540 million years ago. Although they were extremely abundant during their first 100 million years or so, by the Pennsylvanian and Permian Periods (when the surface rocks in eastern Kansas were deposited), trilobites were much less dominant. They became extinct, along with many other species, at the end of the Permian. The

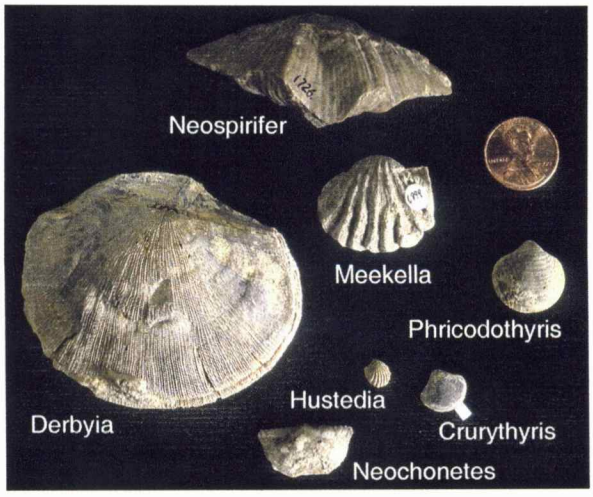


Fig. 2—Fossil brachiopods common in Kansas rocks.

Fig. 3—This tail, or pygidium, of the trilobite *Ameura* came from the Pennsylvanian Drum Limestone, near Independence, Kansas. Most Kansas trilobites belong to the genus *Ameura* or *Ditomopyge*.

bodies of trilobites, like insects, have three parts: the head (or cephalon), the thorax, and the tail (or pygidium). Leg-like appendages attached to all three parts, but these are rarely preserved. Because of this, and the fact that trilobites have no living counterpart, paleontologists are hesitant to speculate about how trilobites lived. Trilobite pygidia are sometimes found at this site.

Stop 2—Tallgrass Prairie National Preserve

The Tallgrass Prairie National Preserve is a 10,894-acre facility established in 1996 as a joint effort of the National Park Service and the National Park Trust (fig. 4). One of the ranch's original names was the Spring Hill Ranch, a reflection of the ranch's connection to the environment, though more recently it has been called the Z Bar Ranch. Today the ranch is part of the National Park Service system, but the purchase agreement included a provision for leasing of the pastures for livestock. So in the summer, these hills are still grazed by cattle, and this is still very much a working ranch.

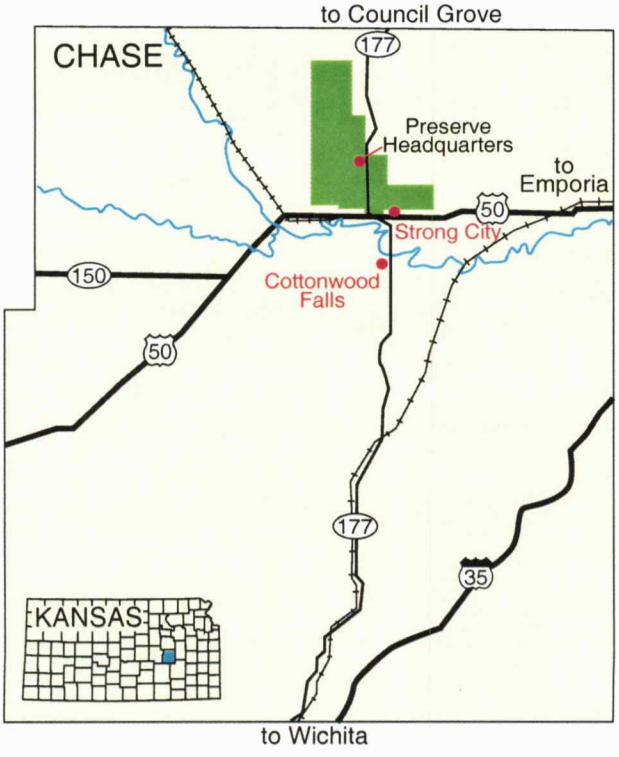


Fig. 4—Location of the Tallgrass Prairie National Preserve.

Geology

The preserve is entirely in the Flint Hills physiographic region, and the bedrock geology is Permian in age, mostly the alternating limestones and shales that are typical of the Flint Hills (fig. 5). Some of the highest hills on the ranch are capped by the Florence Limestone Member of the Barneston Limestone, a rubbly rock layer composed of limestone and chert. (Chert is known locally as flint, the rock that gave the hills their name.) The Threemile Limestone and Schroyer Limestone Members of the Wreford Limestone also crop out on the preserve; these units consist of limestones and some fairly thick layers of chert. Other units present include the Crouse Limestone, which was used in the construction of many of the property's rock fences and buildings; the Funston Limestone, named after a military camp at Fort Riley, about 50 miles north of here; and the Eiss Limestone Member of the Bader Limestone, a vuggy rock that is the source of water for some of the property's more persistent springs. Toward the bottom of the geologic section is the Cottonwood Limestone Member (Beattie Limestone), a rock unit named after Cottonwood Falls. The Cottonwood is a common building stone; the preserve's ranch house, the Chase County courthouse in Cottonwood Falls, and even the State Capitol in Topeka include Cottonwood limestone in their construction, and the rock is still quarried for building stone today.

Many of these limestones contain invertebrate fossils that are typical of Permian and Pennsylvanian rocks in this part of the world. The Cottonwood, for example, is typified by fusulinids—extinct, single-celled marine animals that are shaped like grains of wheat. Brachiopods, bryozoans, and crinoids are common in several of the other units, and even an occasional trilobite will turn up. In short, many of the same fossils that are found at the first stop are found here, though generally not in quite such profusion or as well preserved.

Plants

The flora of these pastures is also fairly typical of the Flint Hills. This is tallgrass prairie, characterized by grasses such as big bluestem, little bluestem, Indian grass, switch grass, and others. However, other grasses that are typical of midgrass or short grass prairie, such as buffalo grass, are also present here, as is prickly pear cactus. The big bluestem is

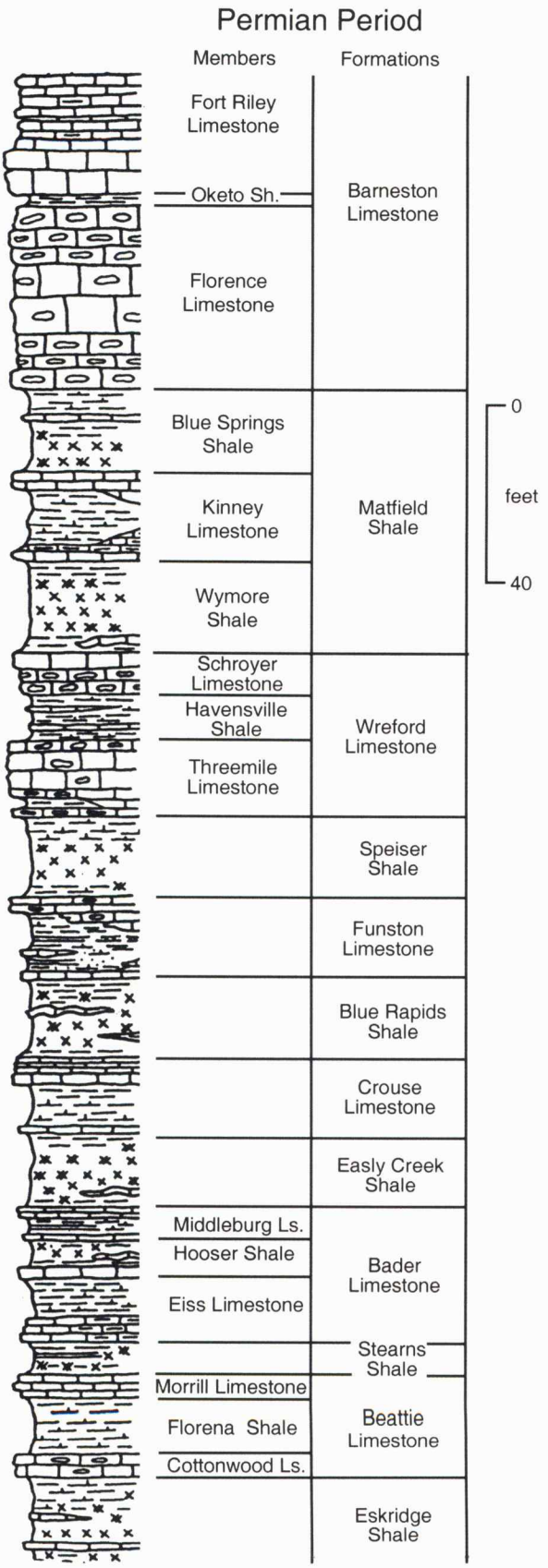


Fig. 5—Idealized section of the rocks at Tallgrass Prairie National Preserve.

probably the most noticeable grass. If left alone, it will grow six or seven feet in height. Its seed-head forms a typical tri-part shape that gives the grass another colloquial name—turkey foot. A number of flowering plants also characterize this prairie. In the spring, blue false indigo, wild alfalfa, lead plant, and various cone flowers give the pastures a purple tint. In the summer, butterfly milkweed, with its orange blossoms, is common (fig. 6). Around the springs and seeps of the ranch, watercress, cardinal flower, and bright yellow beggar-ticks are found. In the fall, the yellow of broomweed covers many of the hills, particularly in places where soils are thin or pastures have been overgrazed. The light blue flowers of pitcher sage were especially noticeable on the ranch this autumn. At the north end of the ranch, near Palmer Creek, and in the Fox Creek valley to the east of the ranch house, riparian vegetation is common, including oak, hackberry, sycamore, and other trees.

These pastures are burned every spring, usually in mid-March to early April (fig. 7). Burning helps control the brushy, less desirable vegetation that would otherwise grow up in the pastures. It also creates a black surface on the pastures that causes the ground to warm up more quickly, and thus encourages the growth of green grass for the cattle. Annual burning of these grasses is a relatively recent practice, generally associated with settlement by ranchers; however, these grasses were probably burned every few years even before Europeans arrived, either through lightning fires or those set by Native Americans.

Animals

These hills also provide a home to a variety of fauna. Twenty-three species of fish and 97

Fig. 6—Butterfly milkweed at the Tallgrass Prairie National Preserve (photo by Robert Sawin).

Fig. 7—Burnt pasture at the Tallgrass Prairie National Preserve (photo by Robert Sawin).

Fig. 8—Collared lizard at the Tallgrass Prairie National Preserve (photo by Robert Sawin).

invertebrate species have been collected on the preserve. Some of the watersheds are home to a rare and endangered minnow, the Topeka shiner, as well as more common fish and turtles. Twenty-eight species of amphibian and 53 species of reptiles have been found on the preserve. Eastern collared lizards, bright green and sometimes as long as 12 inches, are often seen on rocky outcrops (fig. 8). The preserve also hosts a variety of birds: 132 species live here or migrate through, including eastern meadowlark, upland sandpiper, nighthawks (known locally as bull bats), dickcissels, and various sparrows, raptors, and waterfowl. Great blue herons have a rookery on Fox Creek. The U.S. Geological Survey's biological resource division has been tracking greater prairie chickens, which have booming grounds (or leks) on the ranch. In addition, some large mammals are seen here fairly regularly, including whitetail deer, coyotes, and bobcats. Bison, antelope, and elk were found here once; they no longer roam the preserve, though the Park Service is making plans to introduce bison to one pasture.

People

Native Americans lived on or moved through these prairies for centuries before the arrival of European-Americans. They used the chert from some of these rock formations to make a variety of implements, particularly points. Near a spring on the north end of the ranch, for example, a number of flakes and partially formed points are found, made out of chert in the Threemile Limestone Member. In more recent times, this land bordered trails and hunting areas used by the Kansa and the Osage Indians. The Kansa, the tribe after whom the state of Kansas is named (Kansa means people of the south wind), were moved from northeastern Kansas to a reserve in Morris County, immediately north of here, in the 1800's. Eventually they were moved to northern Oklahoma, though the tribe still maintains ties to this area.

European settlement in this area began in the 1850's. Kansas became a territory in 1854, then a state in 1861. Chase County was established in 1859. Though there were claims on land that is now part of the preserve as early as the 1850's, the first clear homestead was established in 1860. The holdings that eventually became the Spring Hill Ranch were first developed in the 1870's, primarily by Stephen Jones, who later sold out to Barney Lantry. The ranch passed through several hands in the 1900's and was renamed the Z Bar in 1955.

The Ranch

Since the early days of European settlement, the ranch was used for raising livestock. Today, cattle are generally brought into the pastures in mid-April. These are 400- to 500-pound calves that are left on the pastures through part of the summer. Ranchers stock at the rate of about two acres per calf. Because of the high quality of Flint Hills grass, the cattle generally make substantial weight gains, as much as two to three pounds per day. The cattle are removed over the course of June and July, and are usually gone by the middle of August. By then, the dry summer weather has usually reduced the growth of the prairie grasses, and they have far less nutritional value than they do in the spring. The cattle are usually taken to feedlots, where they are fattened on grain rations (also known as finishing), before being shipped to slaughterhouses.

Buildings on the ranch consist of the ranch house and barn, both built of native limestone. North of the ranch house is the Fox Creek school, a one-room schoolhouse that is also made of native limestone. The rest of the property consists of a series of pastures that form the rough shape of an L. The bulk of the preserve pastures lie north-south on the west side of Kansas Highway 177, with a smaller area included on the east side of the highway. These pastures are divided by a number of fences. May of the original fences on the ranch were constructed of native limestone. A few quarries where this limestone was dug are still visible on the ranch, along with a few of the remaining rock fences, though all of them have been replaced with barbed-wire.

The landscape here has also been altered somewhat by the creation of a number of stock ponds, either fed by springs or from runoff during rainstorms, that are primarily used to water livestock. Numerous springs also flow on the preserve and at least three are diverted into concrete stock tanks and used to water livestock. Flow rates on these springs range from a trickle to as much as 100 gallons per minute. An inventory of spring locations on the ranch identified 237 springs, though probably 80 percent of these are wet-weather springs and disappear in the dry weather of summer. This spring water is of extremely high quality.

The Preserve

Efforts to create a national park in the tallgrass prairie of the Flint Hills began in the 1960's, and local opposition to such a facility formed fairly quickly. Many local residents were concerned about the condemnation of private property and the size of a national park (and its impact on tax roles and on local ranching); they believed that local landowners were already adequately protecting the land. In 1986, the ranch was purchased by Boatmen's National Bank in Kansas City; then in 1994 it was sold to the National Park Trust, a private organization that operates in support of the national park system.

In 1996 the ranch was established as the Tallgrass Prairie National Preserve and made part of the National Park Service system. Nancy Landon Kassebaum-Baker, a long-time Senator from Kansas and daughter of Kansas governor and Presidential candidate Alf Landon, was instrumental in the creation of the preserve. The enabling legislation for the property limits the Department of the Interior to ownership of no more than 180 acres, with the National Park Trust owning the remainder. The two organizations manage the property jointly. The arrangement was designed to assure locals that the federal government's role at the preserve would be limited.

Visitation to the preserve today is generally around 20,000 to 25,000 people per year. The bulk of those visitors come to the preserve in May through October. Visitors can tour the barn, ranch house, and other outbuildings, ride a bus onto the prairie, and hike a trail between the ranch house and the Fox Creek school. This facility is really in its infancy as a public park, and the Park Service is developing plans for the preserve, in close consultation with the local residents and interested organizations. Those plans will probably include a visitor's center near Strong City, hiking trails and perhaps overnight camping on the prairie, some areas of prairie restoration, and the aforementioned bison herd.

Acknowledgments

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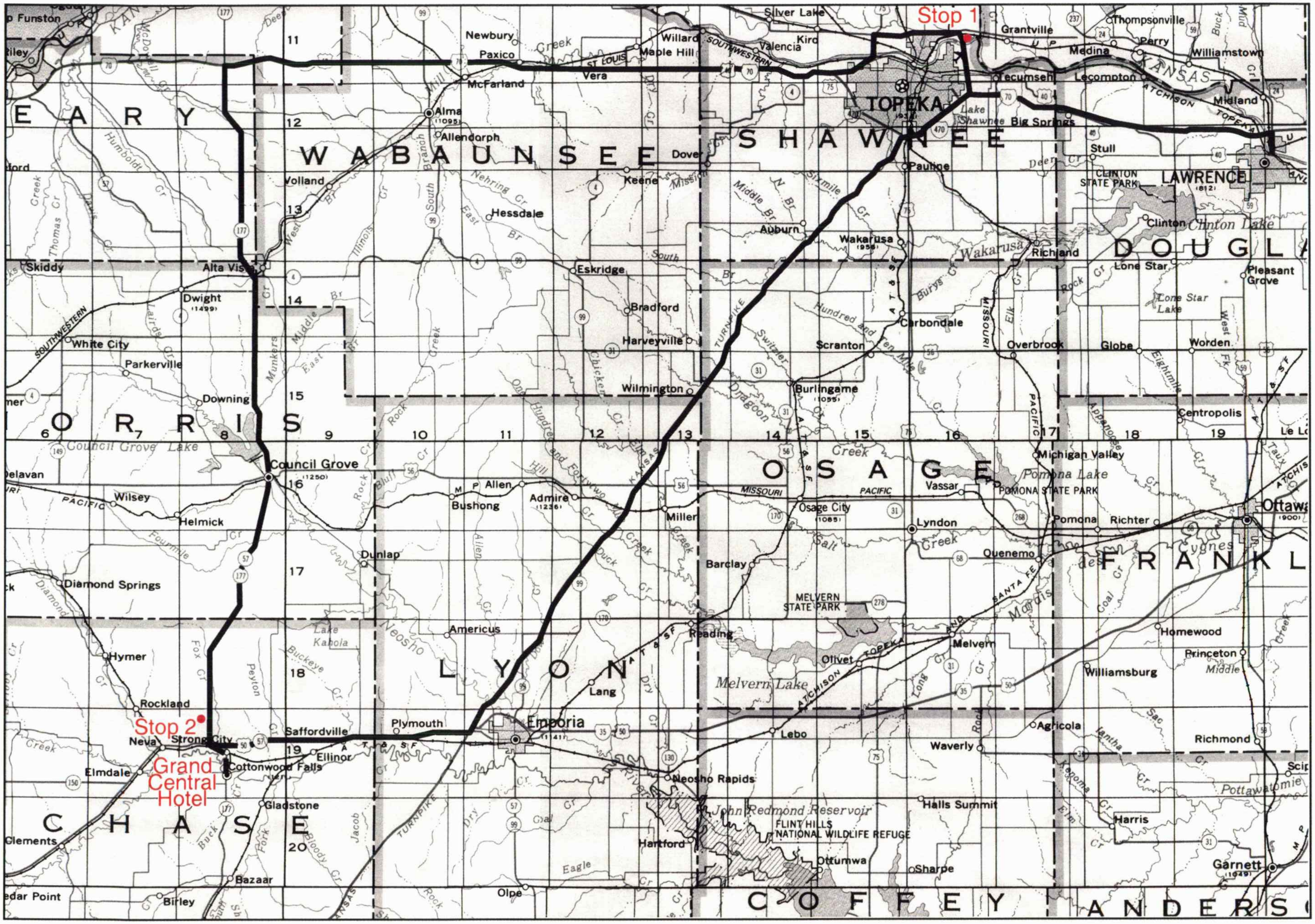
Stop 1
Stop 2
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TOPEKA
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Council Grove
Alta Vista
Strong City
Cottonwood Falls
Saffordville
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DOUGLAS
OSAGE
LYON
CHASE
COFFEY
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Ottawa
Silver Lake
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Volland
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Dover
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Richland
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John Redmond Reservoir
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Harris
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