

Figure 1. Overview satellite image of northeastern Kansas and northwestern Missouri. Landsat Thematic Mapper image, band 5 (mid-infrared), September 28, 1994. In this image, active vegetation appears relatively dark; bare ground and industrial areas are light; water bodies are black. Asterisk indicates location of Fort Leavenworth bottomland and Weston Bend of the Missouri River. KCI= Kansas City International Airport.

# MISSOURI RIVER AT FORT LEAVENWORTH, KANSAS, AND WESTON, MISSOURI: LEWIS AND CLARK'S EXPEDITION AND TWO HUNDRED YEARS OF CHANGE

by  
**James S. Aber**

## **Introduction**

The Missouri River marks the boundary between what are now northeastern Kansas and northwestern Missouri. This section includes one of the key geographic focal points in the exploration and settlement of the United States, namely the junction of the Kansas and Missouri rivers, known as "Kawsmouth," which is now the location of the Kansas City metropolitan region. Since prehistoric times, this vicinity has served native Americans, colonial Europeans, and finally the United States as a transportation and development center (Fig. 1). The initial geographic emphasis for colonial development was based on river travel connecting the eastern woodland with the western prairie of the mid-continent region. The potential resources from both environments were enhanced by mild temperate climate, which taken together favored human occupation and exploitation. Pursuit of fur trading was a key goal for colonial powers. President Jefferson sought similar economic benefits for the United States when he arranged the Louisiana Purchase and commissioned the Lewis and Clark voyage of discovery.

The Lewis and Clark journey (1803-06) was the first great expedition to chart and discover the western lands of the United States. It was also the last great pre-industrial journey in the United States. The travel was accomplished entirely with human, animal, and natural power to move the *Corps of Discovery* and their baggage across the continent and back.

---

James S. Aber has been a member of the ESU faculty since 1980, before which he was on the faculty at Chadron State College, Nebraska. His primary teaching and research topics include the ice ages, structural and tectonic geology, and remote sensing. During the past few years, he has developed a strong interest in wetland habitats and global climate change. He is a native of Kansas City, Missouri.

Lewis and Clark visited the area that would become Fort Leavenworth, Kansas, and Weston, Missouri, in early July 1804. This vicinity already had experienced a century of exploration and a short-lived settlement by the French, and so has the longest historical record within the Kansas City metropolitan region.

Soon after Lewis and Clark's successful return, new modes of steam-powered transportation forever changed the American landscape and culture. Riverboat travel remained the primary mode of transportation until well into the mid-1800s, when railroads reached the region. The broad river valley bottomlands were suitable sites for large railroad yards, and Kansas City, Missouri and Kansas became major railroad centers by the late 19th and early 20th centuries. In the mid- and late-20th century, construction of the interstate highway system reinforced older river and railroad transportation patterns. River management by the U.S. Army Corps of Engineers brought the lower Missouri River under control during the 20th century. Meanwhile, river travel (freight barges) have dwindled in importance in recent decades. However, the lower Missouri River remains critically important for economic and natural reasons, as demonstrated recently by the Great Flood of 1993 when the bottomland at Fort Leavenworth was completely inundated.

### **Historical overview**

European exploration of the lower Missouri River began in the early 18th century with expeditions by the Frenchman de Bourgmont. As France expanded its New World empire, it established a series of forts along the Mississippi and Missouri rivers. The most westerly of these was Fort de Cavagnial. It was a French military and trading post established on the western side of the Missouri River, a few miles above its confluence with the Kansas River, near modern Fort Leavenworth, Kansas. During the mid-1700s, Fort de Cavagnial was the economic and military center of a vast territory in which fur trading was lucrative for both the French and native American people.<sup>1</sup>

Construction of Fort de Cavagnial began in the spring of 1744 based on plans drawn up by the Governor of Louisiana, François-Pierre Rigaud, Baron de Cavagnial, Marquis de Vaudreuil, and later approved by King

Louis XV. The site was chosen by a military engineer, La Gautrais, who had extensive experience in French fortifications of Louisiana. He had previously engaged in a detailed survey of the Missouri River from the Mississippi to near the Platte, and thus knew the region quite well. According to the best historical information:<sup>2</sup>

*[The fort] was located on rising ground overlooking the village of the Kansa Indians on Salt Creek, opposite Kickapoo Island in present Leavenworth County, Kansas, just north of the Fort Leavenworth boundary.*

The fort was established with three goals in mind: 1) to control Canadian *voyageurs* in their fur trade with Indians, 2) to discover mines and minerals (gold and silver), and 3) to determine a route to and establish trade with Spanish America at Santa Fe.<sup>3</sup> Above all, the function of the fort was to facilitate and regulate fur trade with the Indians. Fur trading was the primary interest of European powers in exploiting the interior of North America. Next to silver and gold, high-quality furs were among the most valuable items in the European marketplace. Within this international context, the Kansa Indians were a prolific source of fur and were reliable customers and allies of the French.

During its first decade of existence, Fort de Cavagnial was a substantial French outpost engaged in active trade and cultural interchange with the Kansa Indians. However, in its second decade various factors led to decline in maintenance of the fort. In 1763, France gave up its American empire in the Treaty of Paris. Spain acquired all lands west of the Mississippi, and England took over the territories east of the Mississippi. Louisiana and Fort de Cavagnial thereby passed into Spanish hands, and Fort de Cavagnial was abandoned in the spring of 1764. The Spanish did not establish any permanent presence along the Missouri River, and Louisiana eventually passed back into French hands.

In 1803 President Jefferson was able to realize his long-held ambition to expand the United States westward with the acquisition of Louisiana from France. This was undoubtedly the single most important addition of territory in the history of the United States. It transformed the

U.S. from a relatively small country within a large continent into a country with *manifest destiny* to expand across the continent. Jefferson was also the prime motivator of the Lewis and Clark Expedition.<sup>4</sup>

*He conceived it, nurtured it through an unsettled infancy, and followed its further development with accelerating enthusiasm and unremitting care. His planning and organizational genius, supported by his broad base of technical knowledge ... augured almost certain success.*

Lewis and Clark passed through the Kansas City-Atchison region in late June and early July, 1804. They spent three days at Kawsmouth and then visited the site of Fort de Cavagnial on July 2, 1804. They camped opposite the old Kansa Indian village just above Kickapoo Island. They had at their disposal a French-speaking guide and previous maps. They crossed the river and located the former fort on rising ground, which was clearly depicted by remains of chimneys, the fort outline, and a spring.<sup>5</sup> Alas, the whereabouts of Fort de Cavagnial were subsequently lost, and the fort's remains have not been located today, in spite of much searching.<sup>6</sup> Lewis and Clark also sampled the water from limestone springs on the eastern side of the Missouri valley, at the site of Weston which later became an important stop for wagon trains.

Following the Lewis and Clark expedition, control of the region was established firmly by Fort Leavenworth, the oldest U.S. military fort west of the Mississippi. It was founded in 1827 on the western side of the Missouri River, a few miles upstream from Kawsmouth. The function of Fort Leavenworth was to protect wagon trains and to maintain peace among the Indians. River steamers brought people, animals and equipment to open the prairie frontier for development. The fort became a major jumping off point for settlers embarking on both the Santa Fe Trail and Oregon-California Trail leading westward across the Great Plains.

A short distance upriver and across the valley from Fort Leavenworth is Weston, Missouri. Founded in 1837, Weston became a thriving riverport town with a population of 5000 by the mid-19th century.<sup>7</sup>

However, a flood caused the Missouri River to shift away from Weston in the late 1800s.

When Lewis and Clark visited the Fort Leavenworth-Weston area, the landscape was a vast prairie maintained by periodic natural and intentional wildfires. It was here that they first saw beaver, which was so crucial to the fur trade.<sup>8</sup> The Missouri River was a tangled, shallow river with numerous sand bars and snags, subject to frequent flooding and shifting channels. Today hardwood forest covers upland portions of the valley bluffs, and a bottomland forest grows on the Missouri River floodplain.<sup>9</sup> The river is confined by levees into a single deep channel that rarely floods or changes course.

### **Historical maps**

Lewis and Jefferson had access to a variety of maps of the continental interior and Pacific coast to help with their initial planning for the expedition of discovery. These maps were the results of several previous explorations by the French, British, and Spanish during the 18th century. Lewis carried maps by Arrowsmith, Mackenzie, Cook, and Vancouver.<sup>10</sup> In addition, Lewis obtained a copy of a map by James Mackay, a Scottish trader who had extensive experience in the Canadian Prairie region. In 1795 Mackay led an expedition up the Missouri River from Saint Louis and produced a map that he turned over to Spanish authorities. Mackay visited Camp Dubois (near St. Louis) in January 1804 and met with Clark. It is not certain what they discussed, but Clark likely revised the preliminary map he was working on at the time.<sup>11</sup> In fact, Clark assumed the role of chief cartographer for the Corps of Discovery and eventually produced a map of the route which was one of the main accomplishments of the Lewis and Clark expedition.

From the maps available to Lewis and Clark, it is apparent that continental geography was relatively well known for the lower Missouri region from the Mississippi to the Mandan and Hidatsa Indian villages in modern North Dakota. The Corps of Discovery had little to discover along the lower Missouri in terms of basic river geography. Hence, the greater emphasis was placed on establishing favorable diplomatic relations with Indian nations along the way<sup>12</sup> and collecting new plants

and wildlife.<sup>13</sup> The lower Missouri passage was also a time of testing the men, their equipment, and their techniques in preparation for more arduous travels in subsequent years.

Among the earliest relatively detailed maps of the lower Missouri region is a British map of Louisiana (Fig. 2). Issued as a result of the French and Indian War, this map depicts the state of geographical knowledge of the Mississippi and lower Missouri basin in the middle 18th century. It represents the known geography at the time of Fort de Cavagnal. The Missouri River is shown along with most of its larger tributaries. Several Indian villages are noted, and the region north and east of the Missouri River is labeled *Extensive Meadows full of Buffaloes*. Although Fort de Cavagnal is not indicated specifically, its approximate location can be established in relation to other features shown on the map.



Figure 2. Portion of British map: *Louisiana as formerly claimed by France, now containing part of British America to the east & Spanish America to the west of the Mississippi* (1765). Asterisk indicates approximate position of Fort de Cavagnal. The Kansas River is identified here as *Padoucas R.* The 40° latitude is the border between Kansas and Nebraska today. Published in the *London Magazine*, June 1765; original map in the author's private collection.

Another early map of note was prepared by du Lac in 1802 (Fig. 3). This French map predates the Louis and Clark journey by only a few years and summarizes geographical knowledge of the lower Missouri region at the beginning of the 19th century. The map depicts a broad, meandering river channel with numerous bars and islands. This map specifically identifies the Kansa Indian village associated with Fort de Cavagnial.

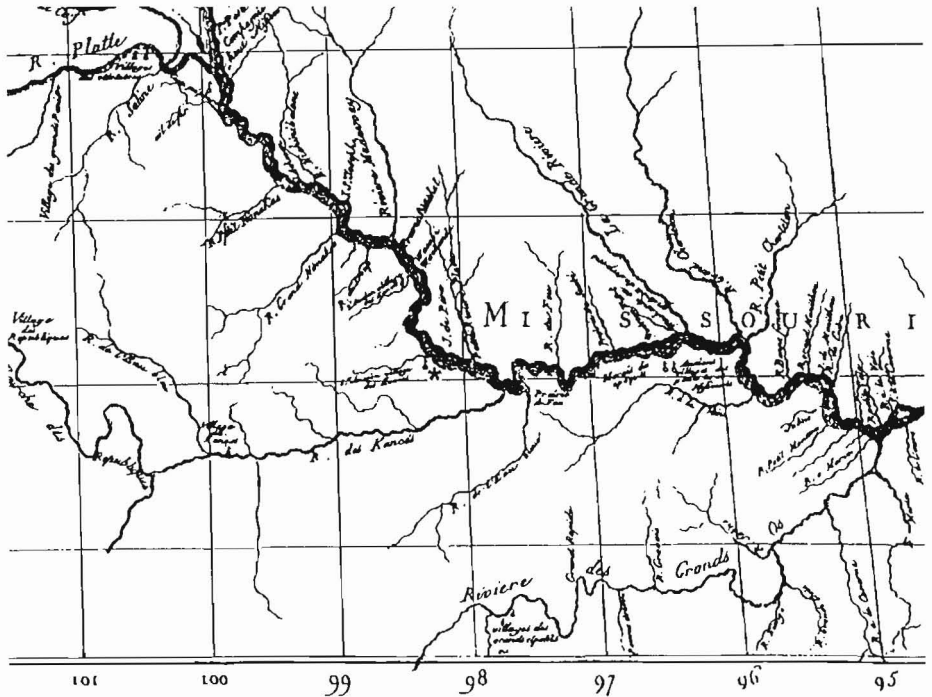


Figure 3. Portion of *Carte du Missouri* by F.P. du Lac (1802). The Kansas Indian village associated with Fort de Cavagnial is indicated by asterisk. Note the broad character of the Missouri River channel which contains numerous bars. Map obtained from the Kansas State Historical Society.

Perhaps the best near-contemporary source of information on the location of Fort de Cavagnial is the map compiled by Clark himself. Clark's map is considered to be quite accurate in its depiction of the actual



route followed by the *Corps of Discovery* (Fig. 4). For the lower Missouri region, Lewis and Clark had various maps and French guides, as well as their own careful surveys, as the basis for map making. In particular, Peter Cruzatte, son of an Omaha woman, was a member of the party. He had previously ascended the Missouri as far as the Platte River.

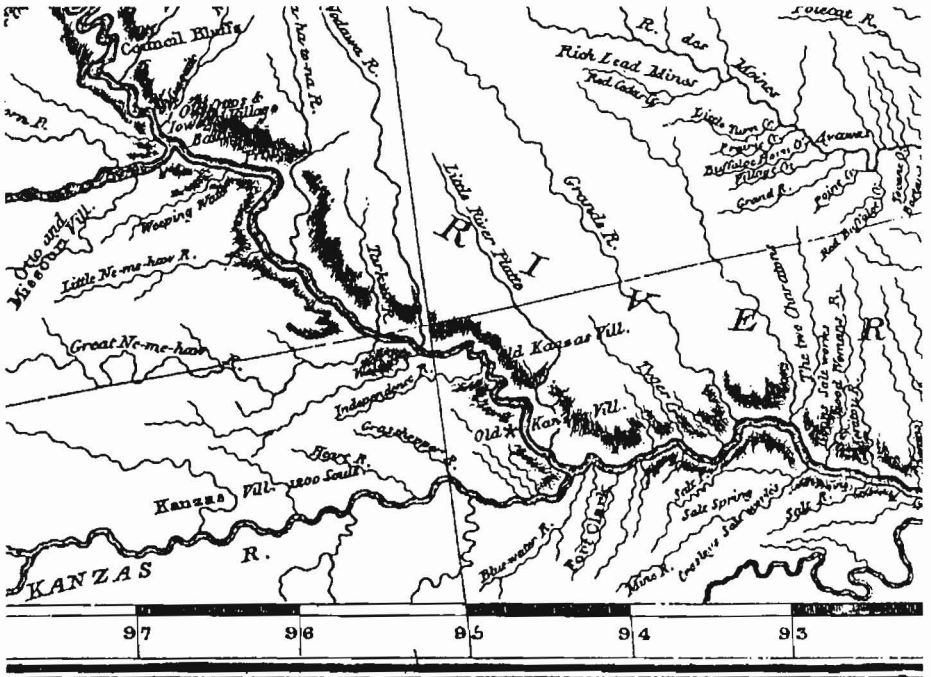


Figure 4. Portion of *A map of Lewis and Clark's track across the western portion of North America from the Mississippi to the Pacific Ocean, by Order of the Executive of The United States in 1804, 5 & 6*. Approximate location of Fort de Cavagnial indicated by asterisk. Note the lack of any large meanders south of Fort de Cavagnial. Adapted from a reproduction of Clark's original map; Oregon Historical Society Press (1998).

Clark's map shares certain basic characteristics with the earlier British and French maps presented here. In the vicinity of Fort de

Cavagnial and the Kansa Indian village, all the maps depict a relatively straight river channel that followed the western side of the Missouri valley bottomland. It appears this characteristic of the Missouri River was present from Kawsmouth to well north of the Kansa Indian village, as no large meanders or other deviations in the channel are portrayed for this section on any of these maps. The maps likewise illustrate a relatively broad and presumably shallow river channel.

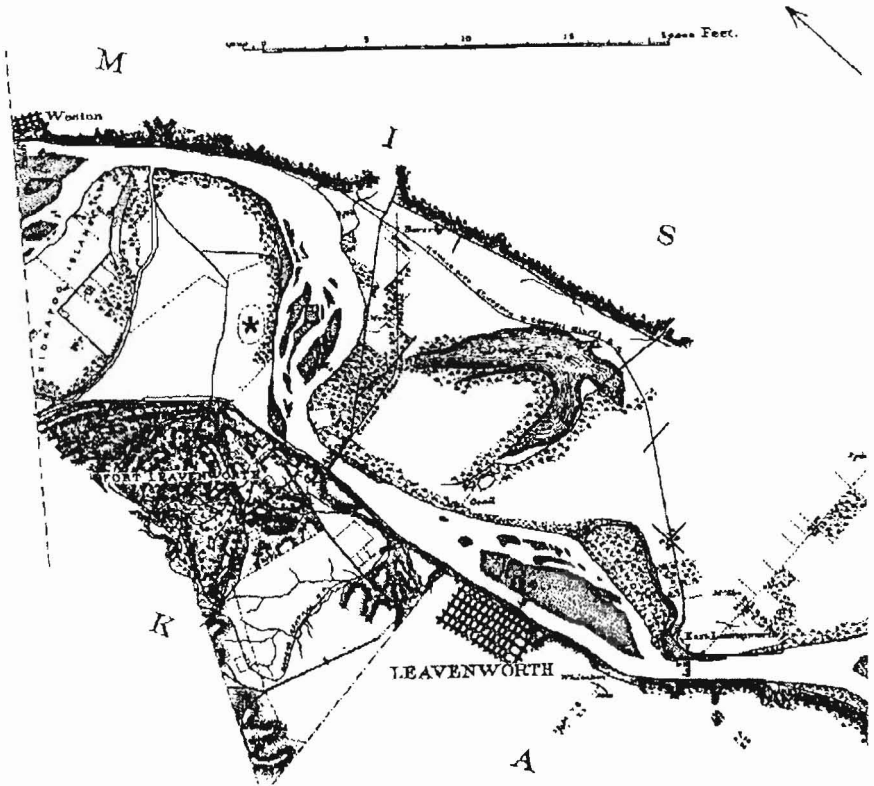


Figure 5. Portion of the *Map of the Missouri River* compiled by the U.S. Army Corps of Engineers (1878-81, plate XV). The main river channel passed north of Kickapoo Island at Weston, Missouri, and around a large meander loop at Fort Leavenworth, Kansas. Asterisk indicates supposed track location. Map obtained from the Kansas State Historical Society.

When Fort Leavenworth was founded in 1827, it was sited where the Missouri River flowed against the western side of the valley, from whence keelboats and later steam-powered riverboats could unload supplies onto a slope leading to high ground. By all accounts, the fort was established a short distance south of former Fort de Cavagnial and the old Kansa Indian village.<sup>14</sup> At this time, a large river meander existed immediately upstream from Fort Leavenworth. Ten years later, Weston was erected where the Missouri River swung against the eastern side of its valley upstream from Fort Leavenworth. This large meander loop came to be known as *Weston Bend*.

The general condition of the river in the mid-19th century is portrayed in a river survey chart (Fig. 5). The Missouri River is shown as a wide channel with numerous sand bars and larger islands, such as Kickapoo Island. The main channel passed north of Kickapoo Island, near Weston, and then crossed to the western side of the valley at Fort Leavenworth. The river chart also shows roads and other man-made structures adjacent to the river channel. In particular, roads are indicated in the bottomland of Fort Leavenworth along with an oval structure beside the river. This oval (\* in Fig. 5) presumably represents the race track where Nez Percé Indians were imprisoned following their defeat by the U.S. Army in the late 19th century.

By the early 20th century, flooding led to significant changes in the Missouri River, particularly in the vicinity of Weston (Fig. 6). The old channel north of Kickapoo Island was abandoned in favor of a main channel south of the island, and the former island was joined to the mainland on the eastern side of the valley. Weston was left high and dry. The old Missouri-Kansas state border on the 1910 map indicates the former channel position; this border was later adjusted to follow the modern river channel. Meanwhile the large meander loop had migrated gradually downstream leaving the historic riverboat landing at Fort Leavenworth as bottomland. The river still retained a more-or-less natural appearance with broad, multiple channels and many sand bars.

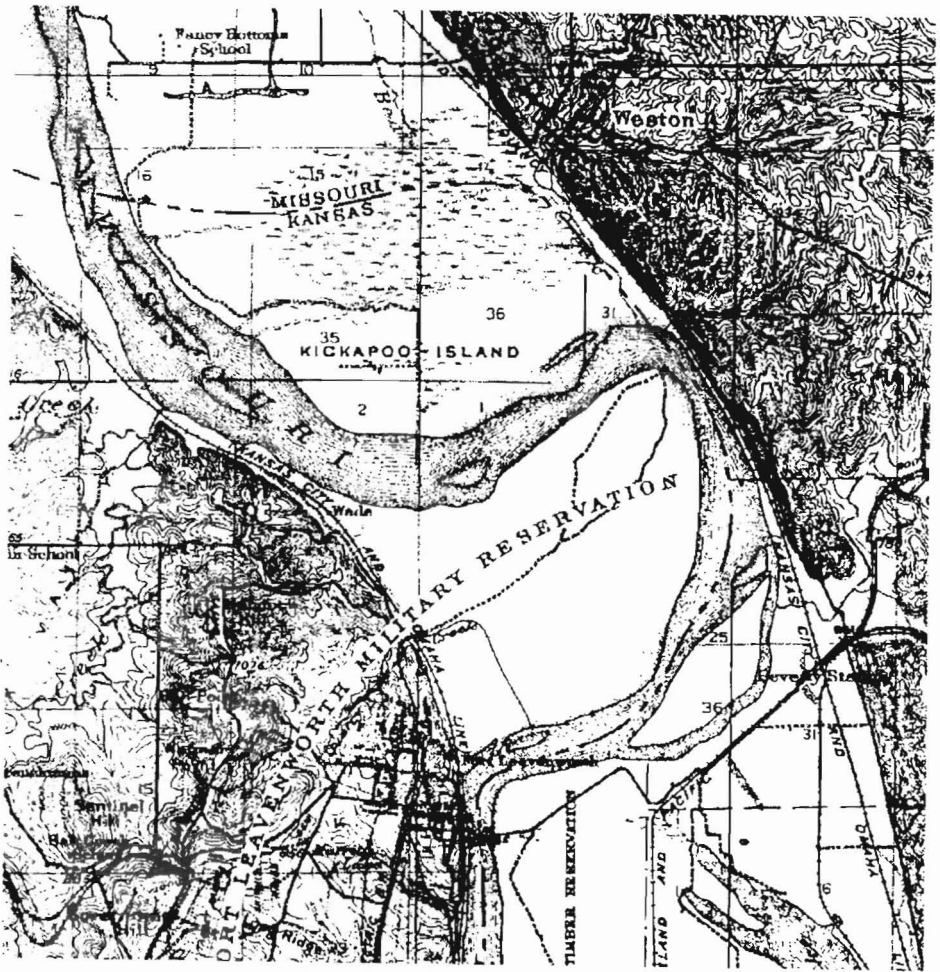


Figure 6. Portion of Leavenworth, 15-minute topographic quadrangle dating from 1910, U.S. Geological Survey. Missouri River channel passes south of Kickapoo Island, and Weston has no connection to the river. Position of old river channel shown by Missouri-Kansas boundary, which was later shifted to the modern river channel.

### Satellite imagery

Aerial photography and satellite imagery are the basis for modern surveying and topographic mapping. Remotely sensed images contain a

wealth of information about the landscape, as recorded in visible and infrared portions of the spectrum.<sup>15</sup> Many aspects of the environment can be recognized and analyzed—agriculture, water bodies, vegetation, soils, minerals and rocks, urbanization, etc. The Ikonos satellite is a commercial system that began operating in 1999. It contains a high-resolution scanner that operates in the visible and near-infrared portions of the spectrum. The panchromatic band (green, red & near-infrared) of this satellite provides the highest resolution, in which each image pixel represents a ground area of one square meter. This resolution is comparable to conventional air photos. In the panchromatic band, active vegetation appears light, whereas water bodies are black.

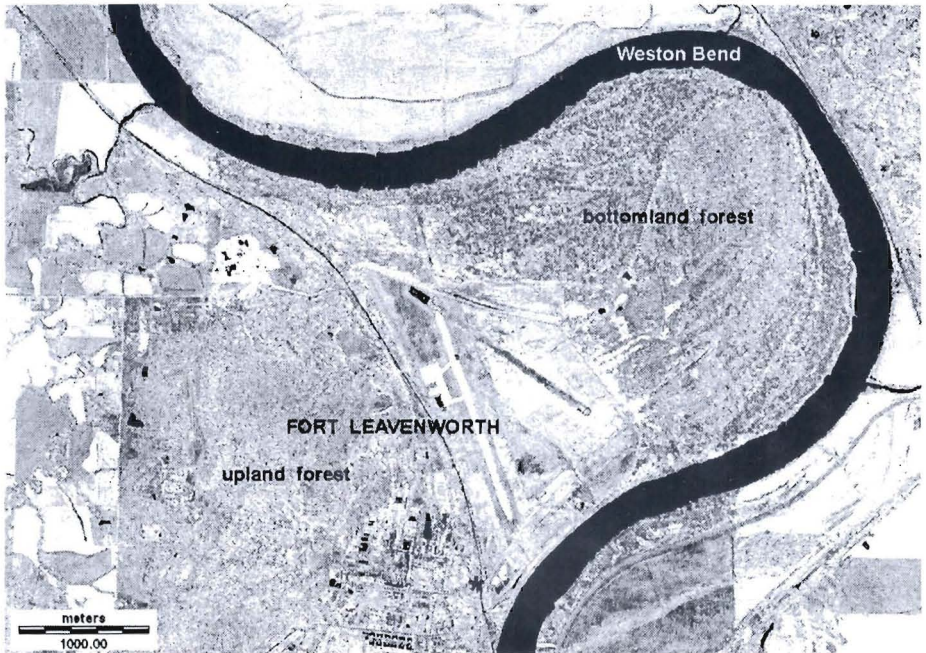


Figure 7. Ikonos satellite panchromatic image consisting of green, red, and near-infrared portions of the spectrum showing Fort Leavenworth and Weston Bend vicinity, Kansas, and Missouri. Asterisk indicates approximate position of the original riverboat landing and beginning of the Santa Fe Trail (military branch). Image date August 4, 2000.

Figure 7 is an Ikonos image showing the area of Fort Leavenworth, including Weston Bend of the Missouri River. The fort's military airfield is most evident in the river bottomland. A levee surrounds the airfield, and a railroad (black line) follows the western edge of the valley, adjacent to the airfield. In this image, agricultural fields appear as rectangular patterns that vary from light to dark gray tones. Forested portions appear in mottled gray tones. The buildings and roads of the fort are quite distinct. All water bodies are black, which aids for identification of small streams and ponds. This image was acquired in the summer of 2000, during a drought period, so the bottomland has relatively few water bodies aside from the Missouri River itself. The prairie portion of the bottomland was subjected to a controlled fire the prior spring (April 2000), which may have enhanced visible variations in vegetation. The Missouri River as revealed in the Ikonos image is a single, narrow channel of uniform width and lacking sand bars or islands. The margins of the river channel are marked in places by artificial berms and levees.

### **Kite aerial photography**

In order to obtain more detailed imagery of the bottomland forest at Fort Leavenworth, kite aerial photography (KAP) was employed on several occasions during spring and summer seasons of the last few years.<sup>16</sup> KAP provides low-height, large-scale pictures in vertical and oblique views under various lighting conditions. One KAP mission was designed specifically to identify features of historical interest, such as roads, old river channels, and the former race track in which the Nez Percé Indians were held in the late 19th century (see Fig. 5). This mission took place in autumn 2001, during a drought period when differences in vegetation phenology were especially clear.

The KAP images reveal the positions of a former road and old river channel in the Fort Leavenworth bottomland. These features appear mainly as differences in vegetation cover in both the prairie and forest portions of the bottomland. A linear boundary in vegetation trends east-west across the northern portion of the bottomland (Fig. 8). This observed boundary in vegetation is not related to any current agricultural field or fence line within the prairie area. The change in vegetation

presumably corresponds to an old road from the late 1800s.

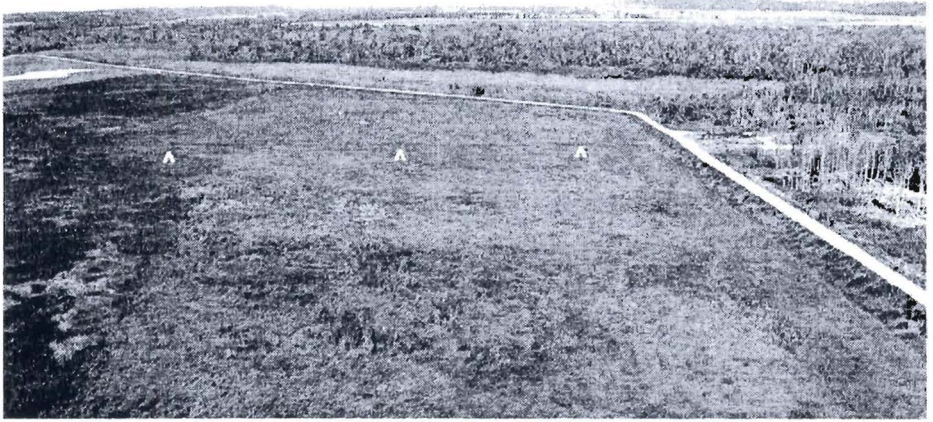


Figure 8. Oblique view toward the north across the Fort Leavenworth bottomland. The modern road runs on top of the levee around the airfield, which is visible in upper left corner. The position of an assumed former road (^) is marked by a change in vegetation. Although indistinct in this black-and-white version, the boundary is quite noticeable in the original color photograph. Kite aerial photograph; digital image acquired Oct. 13, 2001.

An old river channel is also plainly evident within the forested portion of the bottomland (Fig. 9). This channel contains no trees. At the time of KAP, the old channel was completely dry and had a cover of grass and herbaceous vegetation. The channel extends roughly NE-SW through the forest and continues southwestward across the southern prairie portion of the bottomland. Within the prairie, the channel contains distinctive vegetation that clearly stands out in the imagery (Fig. 10). This view reveals that fort water wells are located within the old channel, where thick sand and gravel may be present in the channel fill. The western end of the channel is concealed today by construction for the airfield and sewage treatment plant. Nonetheless, this channel would have extended in the past to approximately the position of the original riverboat landing and beginning of the military branch of the Santa Fe Trail.



Figure 9. Oblique view toward the northeast across the Fort Leavenworth bottomland. A former river channel (c) is highlighted by treeless ground-cover vegetation within the surrounding forest. Kite aerial photograph; digital image acquired October 13, 2001.

### **Interpretation of maps and images**

The large meander of Weston Bend has been a fixture of the Missouri River since the founding of Fort Leavenworth, Kansas, and Weston, Missouri. However, such a meander apparently did not exist at the time of Lewis and Clark's journey or in the previous several decades (see Figs. 2, 3, 4). Given the expedition's focus on river travel, the Corps of Discovery hardly could have missed such a prominent meander, especially in light of the substantial geographic information already available for the vicinity. The Missouri River of Lewis and Clark's time probably followed the western side of its valley in this vicinity, although branch channels and islands undoubtedly existed nearby. It seems most



likely that Weston Bend developed as a consequence of river flooding or channel migration between the time of Lewis and Clark's return passage in 1806 and the founding of Fort Leavenworth in 1827. This same flooding or channel shifting may have wiped out traces of the earlier Fort de Cavagnial, as modern searching for the fort has been fruitless.

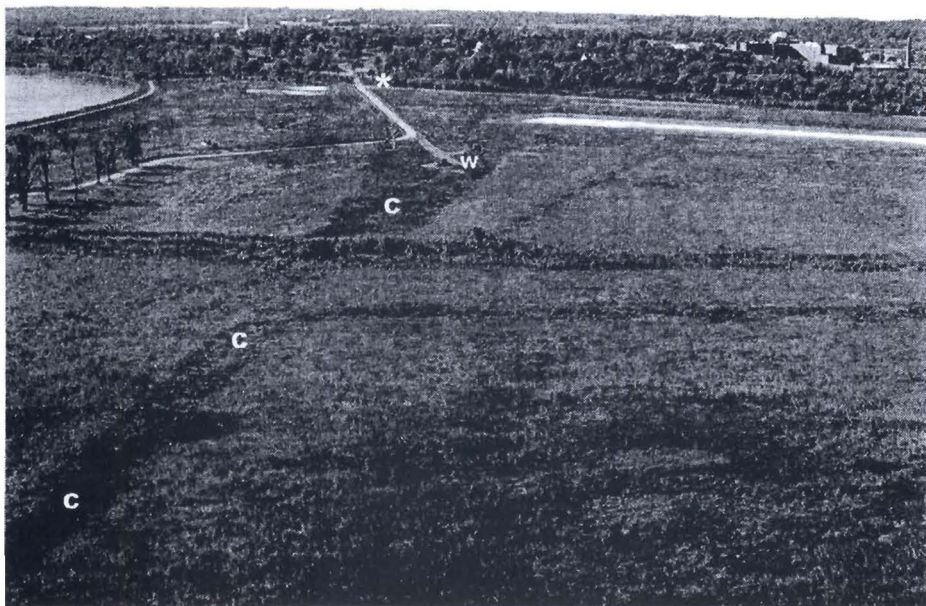


Figure 10. Oblique view toward the southwest across the Fort Leavenworth bottomland. Position of a former river channel (c) is marked by distinctive vegetation. Base water wells (w) are located within the old channel. Asterisk indicates approximate position of the original riverboat landing and beginning of the Santa Fe Trail (military branch). Missouri River is visible to far left side of view, and part of the airfield appears to right. Kite aerial photograph; digital image acquired October 13, 2001.

Since the appearance of Weston Bend in the early 1800s, several significant changes have happened to the Missouri River in the vicinity. In general, the meander has migrated downstream as is typical of

meandering rivers. The downstream movement has occurred in two modes—sudden shift during flooding and gradual migration due to channel sedimentation and bank erosion. During a flood in the late 1800s, the main channel shifted from north to south of Kickapoo Island. The island eventually disappeared as the abandoned channel was infilled, and Weston was left without river access. Also the southern portion of the meander loop migrated southward in a less dramatic way.

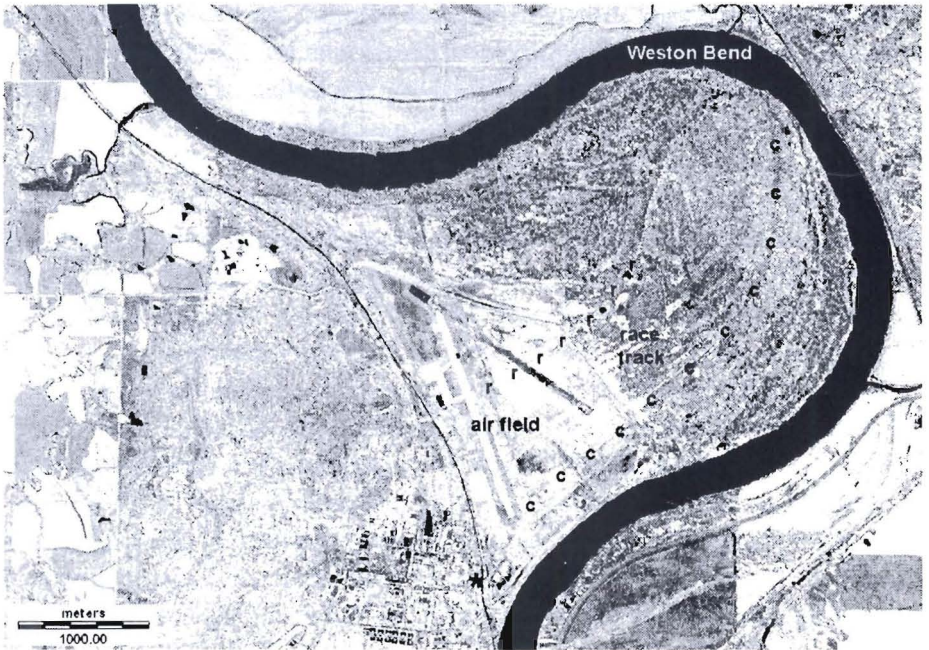


Figure 11. Ikonos satellite panchromatic image of Fort Leavenworth environs annotated with historical features related to the Missouri River and human structures of the 19th century: r = old road, c = old river channel. Approximate location of race track is indicated by caption; asterisk indicates position of the original riverboat landing and beginning of the Santa Fe Trail (military branch). Image date August 4, 2000.

The former position of the Missouri River at Fort Leavenworth is reconstructed here on the basis of historical maps and modern imagery (Fig. 11). An old river channel and part of an old road, identified in kite

aerial photographs, seem to correspond to the river survey chart (compare Figs. 5 and 11). The old river channel appears to extend toward the western side of the river valley at the spot of the original riverboat landing for Fort Leavenworth. The race track of the late 19th century is, unfortunately, not definitely visible today. However, some suggestive oval patterns appear in the Ikonos image just outside the modern levee in a position that agrees with the river survey chart. This location is today covered with a wetland forest. Further ground survey and excavation would be necessary to verify this identification of the race track where the Nez Percé Indians were brought following the defeat of Chief Joseph by the U.S. Army.

### **Character of the Missouri River**

The modern Missouri River bears little resemblance to the river seen by Lewis and Clark. The river of their time was uncontrolled in any way by human effort. The historical Missouri River had a wide, shallow channel with numerous side branches, bars and islands, and was subject to frequent flooding. During floods, the banks were eroded rapidly and often collapsed taking with them whole forests. Trees were swept downstream and eventually became lodged on the bottom. Their branches extended downstream and bobbed up and down in the current. Known as "sawyers," such trees could appear without warning and were a constant danger to Lewis and Clark as well as later riverboat captains. For example, Clark reported on June 15, 1804 "... *we wheeled on a Sawyer which was near injuring us verry much.*"<sup>17</sup> According to Gillespie, the river distance from Saint Louis to Fort Leavenworth was 467 miles (752 km) in 1846. The distance for Lewis and Clark was probably similar, although the actual course of the river was undoubtedly quite different in many places. The mouth of the Missouri itself has shifted several miles since the time of Lewis and Clark,<sup>18</sup> and both Camp Dubois (Illinois) and Camp Mandan (North Dakota) were destroyed by flooding.

The Missouri River has been tamed during the 20th century by the U.S. Army Corps of Engineers. The primary means of flood control are enormous upstream dams and reservoirs on the Missouri River itself in

the Dakotas and Montana, plus reservoirs on principal tributaries of the lower Missouri. In northeastern Kansas, for example, all major tributaries of the Kansas River, including the Wakarusa, Delaware, Big Blue, Republican, Smoky Hill, and Solomon rivers, have flood-control reservoirs. In addition, the lower Missouri River has been dredged, straightened, and confined within levees. The overall result is a single river channel that is relatively narrow, deep, and constant in flow. The modern river distance from Saint Louis to Fort Leavenworth is 412 miles (663 km), a 12% reduction from the pre-control distance.<sup>19</sup>

By the late 20th century, the Missouri River had become little more than a source for water, a canal for barge traffic, and a means to dispose of waste water. The Missouri River bottomland is devoted largely to industry, such as railroad yards and power plants, and to agriculture, which relies on heavy use of fertilizers, herbicides, and pesticides. This stands in stark contrast to Clark's description of the Fort Leavenworth environs.<sup>20</sup>

*The plains of this countrey are covered with a Leek green Grass ... Groops of Shrubs covered with the most delectious froot is to be seen in every derection, and nature appears to have exerted herself to butify the senery by the variety of flours ... which strikes & profumes the Sensation.*

Taming of the lower Missouri River for modern industrial purposes seemed to be successful under management by the Corps of Engineers until the devastating flood occurred in the summer of 1993. The *Great Flood of 1993* was the largest flood of the 20th century in the north-central United States. This included the upper Mississippi, lower Missouri, Kansas, Des Moines, Illinois, and other rivers. Millions of acres of farmland and urban areas were inundated for weeks, and property damage exceeded \$10 billion. The flood resulted from persistent rains that fell throughout much of the region during the spring and summer. Most of the region received 150% of normal precipitation, and some spots had more than 200% of normal rainfall.<sup>21</sup> Many stream gauging stations in the Mississippi and Missouri basins set all-time historical records. The

bottomland at Fort Leavenworth was completely submerged in flood water, as were bottomlands upstream and downstream from the fort. The City of Leavenworth lost its water supply, but water wells at Fort Leavenworth continued to function and supplied both the fort and the city. The 1993 flood of the lower Missouri showed that total flood prevention is not feasible in the long run. Rivers are natural systems that function to remove excess water and sediment from the landscape. Any human disturbance in the supply of water or transport of sediment will lead eventually to changes in the river system with environmental consequences that cannot be foreseen in all cases.

### **Conclusions**

The modern Missouri River at Fort Leavenworth, Kansas, and Weston, Missouri, bears little resemblance to the river travelled by Lewis and Clark two centuries ago. The Missouri River seen by the Corps of Discovery followed the western edge of its valley from Kawsmouth to well north of Fort Leavenworth. The large meander loop, known as Weston Bend, apparently came into existence sometime during the two decades between Lewis and Clark's expedition and the founding of Fort Leavenworth in 1827. Since that time, Weston Bend has experienced considerable changes in its location and character. Prior to the 20th century, the Missouri River consisted of multiple channels that were wide, shallow, and filled with sand bars, and the river was subject to frequent flooding and shifts in channel location. Historical features of the 19th century landscape are reconstructed within the bottomland at Fort Leavenworth on the basis of old maps, satellite imagery, and kite aerial photography. These features include a road, the former Missouri River channel, and the probable location of a race track. The Great Flood of 1993 demonstrated that total flood control is an illusory goal for long-term management of the lower Missouri River.

### **Acknowledgements**

I am indebted to Matthew C. Nowak, Natural Resources Director at Fort Leavenworth, Kansas, for his insights and encouragement to pursue this study of the Missouri River bottomland. Kite aerial photography for

this study was conducted by students in a field geomorphology course at Emporia State University. Stephen Wallace supplied the Ikonos image dataset. M. Landis read an early draft of this article and offered valuable suggestions for improvements. Financial support for this research was provided by a Kansas NASA EPSCoR grant for remote sensing of rural resources and by the Kemper Foundation, Commerce Bank of Kansas City, Missouri.

## NOTES

1. Hoffhaus, C.E. 1964. "Fort de Cavagnial: Imperial France in Kansas, 1744-1764." *Kansas Historical Quarterly* 30/4:425-454. Hoffhaus, C.E. 1984. *Chez les Canses: Three Centuries at Kawsmouth, the French Foundations of Metropolitan Kansas City*. (Kansas City: Lowell Press).
2. Hoffhaus, C.E. 1984., 53.
3. Ibid.
4. Cutright, P.R. 1969. *Lewis & Clark: Pioneering Naturalists*. (Champaign-Urbana: University of Illinois Press, reprinted 1989 by University of Nebraska Press), 9.
5. Hoffhaus, C.E. 1984.
6. Hoffhaus, C.E. 1964, 425-454.
7. Fanselow, J. 1994. *Traveling the Lewis & Clark Trail*. (Helena: Falcon Press)
8. Cutright, P.R. 1969.
9. Aber, J.S., Wallace, J. and Nowak, M.C. 2002. Response of forest to climatic events and human management at Fort Leavenworth, Kansas. *Kansas Geological Survey, Current Research in Earth Sciences, Bulletin* 248, part 1--online article <<http://www.kgs.ukans.edu/Current/2002/aber/aber1.htm>>.
10. Cutright, P.R. 1969.
11. Ibid.
12. Ronda, J.P. *Lewis and Clark Among the Indians*. (Lincoln: University of Nebraska Press, 1984).
13. Cutright, P.R. 1969.
14. Hoffhaus, C.E. 1984.
15. Jensen, J.R. *Remote Sensing of the Environment: An Earth Resource Perspective*. (Upper Saddle River, New Jersey: Prentice Hall, 2000).
16. Aber, J.S., Wallace, J. and Nowak, M.C. 2002.
17. Cutright, P.R. 1969, 50.
18. Gillespie, M. *Wild River, Wooden Boats: True Stories of Steamboating and the Missouri River*. (Stoddard: Wisconsin: Heritage Press, 2000)
19. Cutright, P.R. 1969, 62.
20. Gillespie, 2000.

21. Melcher, N.B. and Parrett, C. "1993 Upper Mississippi River floods," *Geotimes* 38/12 (1993): 15-17.