*Rainbow Falls, Great Falls, Montana*



# Montana Geology '06

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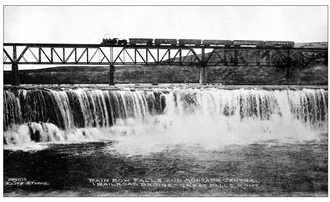

Figure 1. Rainbow Falls and Montana Central Railroad Bridge, Great Falls, Montana. Photo by Heyn's Elite Studio. Courtesy of the Montana Historical Society, Helena.

## RAINBOW FALLS AREA IN HISTORY

The falls of the Missouri probably have been a landmark for travelers since shortly after glacial ice retreated from the Great Falls area. Lewis and Clark learned about these falls from the Hidatsa Indians during the winter of 1804–1805 while at Fort Mandan in present-day North Dakota. The information the captains received, however, was sketchy. They had not expected to find so many falls, nor such high falls, nor "*a fall in an open, level plain*" (Clark, June 18, 1805).

Meriwether Lewis, searching for the rumored falls in advance of the main party, reached Big Falls on June 13. On June 14, 1805, he decided to explore farther up the river. After traveling about five miles Lewis arrived at another falls, this of about nineteen feet. From its horseshoe shape, he named it Crooked Falls. Then he encountered "Handsome Falls," now known as Rainbow Falls:

Figure 2. Rainbow Falls, Missouri River. Summer, 1880. Photo by F. Jay Haynes. Courtesy of the Haynes Foundation Collection, Montana Historical Society, Helena.

*. . . hearing a tremendous roaring above me I continued my route . . . and was again presented with one of the most beautiful objects in nature: a cascade of about fifty feet perpendicular stretching at right angles across the river from side to side to the distance of at least a quarter of a mile. Here the river pitches over a shelving rock with an edge as regular and straight as if formed by art, without a niche or break in it; the water descends in one even and uninterrupted sheet to the bottom where, dashing against the rocky bottom, [it] rises into foaming billows of great height and rapidly glides away — hissing, flashing and sparkling as it departs; the spray rises from one extremity to the other to [a height of] 50 feet. . . .*

William Clark reached these falls on June 18 while mapping the best route for a portage.

*June 18th Tuesday 1805*

*we . . . arrived at the second great cataract . . . this is one of the grandest views in nature and by far exceeds any thing I ever saw, the Missouri falling over a shelving rock for 47 feet 8 inches . . . at which place the river is 473 yards wide . . . a continual mist quite across this fall . . .*

Other travelers after Lewis and Clark visited Rainbow Falls: Crow, Blackfeet, Assiniboine, Hidatsa, fur trappers, and traders. Prince Paul of Wurttemburg, Germany ventured near the falls in 1830. Father Pierre DeSmet is the first person known to have left a written description of the falls after Lewis and Clark's. Father DeSmet passed the falls in the summer of 1846 as he was returning east from his St. Ignatius Mission in the Flathead Valley. He described them as:

*. . . not as sublime as those of the Niagara, but they may hold second place for grandeur among all the waterfalls of this vast continent. . . . The water, the rocks slightly covered with a veil of foam, the lofty cliffs which frame it all, that succession of rapid currents, the deafening noise of the fall and the cataract, spreading into the distance, the column of vapor rising and presenting to the sun all the vivid colors of the rainbow, make the scene very beautiful and very wild at the same time.*

The first known illustration of Rainbow Falls that has survived was painted by Gustavus Sohon, one of the two artists who accompanied the Pacific Railroad Survey; that expedition reached the falls in 1853. Artist A.E. Mathews sketched the falls for his book "Pencil Sketches of Montana," published in 1868 (figure 3).

Figure 3. This picture, artist A.E. Mathews explained, "represents the second principal fall, seven miles below the mouth of Sun River, and about ten miles from the stage road. The middle and left hand side of the fall has a descent of forty feet, while the right hand side consists of a succession of four falls (three of which are seen in the picture) with an island separating them from the main volume of water on a lower level." Courtesy of Joseph Musulman; reprinted with permission from "Pencil Sketches of Montana" (New York: published by the author, 1868), Alfred Edward Mathews (1831-1874), available at the Mansfield Library, Missoula, Montana.

Most gold seekers, heading from Fort Benton to the gold camps of southwest Montana from 1862 on, bypassed the falls, and it was not until 1882 that any permanent settlement began near them. The first settler was Paris Gibson, who quickly developed great plans for this area. By 1883 the city of Great Falls was platted and by 1885 it had a population of 100. In 1887, railroad magnate James J. Hill, a friend of Gibson, helped things along by developing a coal mine at Sand Coulee just southeast of Great Falls. In 1889 construction began on Black Eagle Dam, the first of five dams in the Great Falls area. The second dam to be built was at Rainbow Falls—construction began in 1908 and was completed in 1910 (figure 4). The dam's height was raised 10 feet in 1913, producing a reservoir of 1,060 acre feet and increasing the generating capacity to 35,000 kilowatts. Despite the scant flow of water in the front photo, the average flow over the falls is about 7,500 cubic feet per second.

Figure 4. Rainbow Falls, dam, and railroad bridge. Photo by Robert K. Schwartz, 2004.

The four visible falls of the Missouri—Big, Crooked, Rainbow, and Black Eagle Falls—annually draw tens of thousands of tourists. Rainbow Falls is especially favored because of its proximity to Giant Springs and to the Lewis and Clark Interpretive Center.

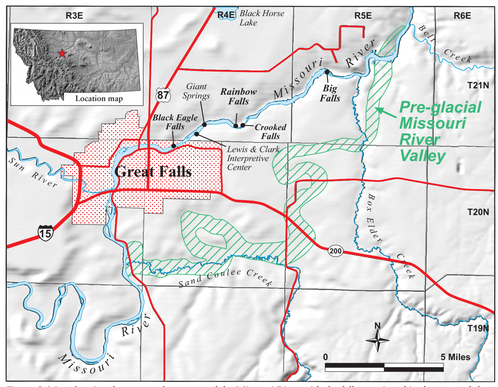


Figure 5. Map showing the present-day course of the Missouri River with the falls mentioned in the text and the pre-glacial Missouri River Valley.

## GEOLOGY

Although the Missouri River flows over many types of rock, its only waterfalls are over the "shelving rock" described by Lewis and Clark. The step-like layers of sandstone that form the shelving rock are not unusually resistant; some of the other rock types the river flows over are much more resistant. For example, not far southwest of Great Falls, the Missouri River flows through a deep gorge in hard volcanic rock between Craig and Wolf Creek. Farther to the southwest, at the Gates of the Mountains near Helena, the river flows through another gorge, cut in resistant limestone. Why did the layers of sandstone near Great Falls produce such spectacular waterfalls while the hard rocks of these gorges did not?

A wide valley south of Great Falls provides part of the answer (figure 5). The lower part of Sand Coulee Creek occupies this valley today, but the creek is too small to have carved this river-sized basin. Northeast of Sand Coulee Creek, the valley continues as a meandering swale in the landscape; at both ends, it joins the Missouri River. Wells drilled in the valley penetrated as much as 350 feet of sediment above bedrock, including river gravel. The Missouri River must have once flowed through this valley, later shifting to its present course.

The part of the Missouri River between its confluences with Sand Coulee Creek and Box Elder Creek is relatively young because of this shift in the river's course. In this young part of the valley, the river flows directly over bedrock. The Missouri River in the older valley no longer flows over bedrock, but rather over thick deposits of sediment.

What caused the Missouri River to leave the valley it once occupied south and east of Great Falls and shift to its present location to the north? Only extraordinary events would cause a river to leave an established well-worn valley to carve a new one. In this case, the extraordinary events were advances of continental glaciers from the north during the Ice Age. Glaciers advanced south of the old course of the Missouri River, creating a large lake called Glacial Lake Great Falls. Remnant patches of fine glacial lake sediment remain today. As the ice later retreated to the northeast, sediment left by the glaciers blocked the former course of the Missouri River, causing it to establish its new course by Great Falls. Glacial Lake Great Falls drained through this new channel. If the Missouri River had stayed in its old course, Lewis and Clark would not have encountered any waterfalls. They would have been spared a month of arduous portage, but they would have missed one of the highlights of their journey, the falls of the Missouri.

Figure 6. Middle Kootenai Formation red sandstone at Rainbow Falls. Photo by Robert K. Schwartz, 2004.

Lewis and Clark's "shelving rock" is sandstone of the Kootenai Formation, deposited during the Age of the Dinosaurs. The upper part of the Kootenai Formation visible near Black Eagle is mostly composed of soft red mudstone that is easily eroded by the Missouri River and produces no waterfalls. By contrast, the middle part of the Kootenai Formation is much more resistant to erosion, creating the waterfall ledges. This part of the Kootenai Formation has two types of sandstone—red layered sandstone with no formal name, and the underlying Sunburst Sandstone. The upper red sandstone, deposited in rivers and deltas, underlies Rainbow Falls (figure 6) and is also exposed at Giant Springs State Park.

Big Falls, downstream from Rainbow Falls, flows over the Sunburst Sandstone. During Sunburst time, a sea extended into Montana from the north to about 20 miles south of Great Falls, the first marine waters to reach Montana in about 40 million years. The Sunburst Sandstone was deposited in coastal areas of that sea. Visitors can see good exposures of estuary channels in the Sunburst Sandstone on the north side of the parking area for Ryan Island Park at Big Falls. Some of the estuary channels are filled with contorted sedimentary beds that slumped from channel walls (figure 7). Clean quartz sandstone deposited in marine coastal environments is exposed behind the picnic tables on the west side of the island. Visitors to Ryan Island Park this year will find new signs about the geology of the falls area and how it influenced this part of Lewis and Clark's journey.

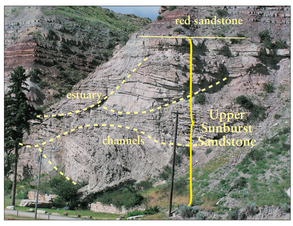


Figure 7. Middle Kootenai Formation near Ryan Island Park and Big Falls. Photo by Robert K. Schwartz, 2004.

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Front photo taken by Pete Norbeck. History text by Robert Bergantino; geology text by Susan Vuke. Edited by Susan Barth; layout by Susan Smith.

*Montana Bureau of Mines and Geology*

Montana Tech of The University of Montana

**Scope and Organization**

The Montana Bureau of Mines and Geology (MBMG) was established in 1919 as a public service agency and research entity for the State of Montana, *to conduct and publish investigations of Montana geology, including mineral and fuel resources, geologic mapping, and ground-water quality and quantity.* In accordance with the enabling act, MBMG conducts research and provides information but has no regulatory functions.

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