Lewis and Clark’s Observations of Geomorphology and Hydrology

Meriwether Lewis and William Clark are famous as explorers, but they were also scientists who led one of the first scientific expeditions, Corps of Discovery, across the United States from Pennsylvania to the Pacific Ocean. Both men were keen observers and provided early insights into the yet unfamiliar fields of geomorphology and hydrology. They made observational descriptions of the rivers they described, the processes that formed them, and the adjacent landforms. They made hydrologic measurements (water level, temperature, and velocity) of many streams and rivers. Lewis and Clark recorded extensive observations related to biology, botany, ethnology, meteorology, phenology, and zoology as well as geomorphology and hydrology. This fact sheet provides some of their written observations and measurements (given in italics), taken from Moulton’s (1983–93) eight annotated volumes of the journals of Lewis and Clark.

**Geomorphology Maps**

Clark made some of the first accurate maps of the rivers and the surrounding country (fig. 1). The maps were based not only on personal observations and measurements but also on information they obtained from the native people. Clark recorded the compass bearing and distance for each reach of river traversed during the day. The distances he gives are comparable to those that the Missouri River Commission published about 90 years later (fig. 2).

**Meanders**

Lewis and Clark commented on river processes, which they observed as they traveled. For example, on the Missouri River about 100 miles above the Platte River in Nebraska, Clark noted, “…I have observed a number of places where the River has once run and now filled, or filling up & growing with willows & Cottonwood…” 11 August 1804, and 50 miles above Big Muddy Creek in Montana Lewis wrote, “…traces of the ancient beds of the river are visible in many places through the whole extent of this valley…” 3 May 1805.

They collected data from which the “crookedness” or sinuosity (river distance/valley distance) can be calculated. On the Jefferson River in 1805, Clark recorded the number of bends, the river distances, and the valley distances. Based on his data, the wavelength or distance between two bends of a meandering river, is about 9.4 times the river width, which is similar to an empirical relation for rivers published about 150 years later.

**Landslides**

Lewis and Clark recorded their direct observations of the plains, hills, and mountains through which they passed. “…from this hight we had a most beatifull and picturesque view of the Rocky mountains which we perfectly covered with Snow… this was an augest spectacle and still rendered more formidable by the recollection that we had them to pass …” 12 June 1805.

The two men often commented on specific geomorphic features within the larger landscapes. While descending the Ohio River, Lewis wrote this description of flood plains and terraces before any descriptions of these types of geomorphic features were published in the scientific literature. He refers to terraces as bottoms: “…on each side of the river there are three banks, or sudden rises … the first bank or that which the river washes is generally the first and is always safe or secure from inundation; …what second bottom usually rises from twenty five to thirty feet above the first and is always safe or secure from inundation …what is called the third bottom is more properly the high benches of the large range of hills before noticed …” 2 September 1803.
The braided character of the Missouri was first noted on October 6, 1804: “...we made Severl. Attempts to find the main Channel between the Sand bars...we have been obliged to hunt a Chant. For some time past the river being divided in many places in a great number of Channels...” and along a braided reach in the Rocky Mountains, the beaver’s role as a geomorphic agent was mentioned: “...the river in many places among the clusters of islands is constantly changing the direction of such isles as the beaver are capable of stopping or of 20 yds. in width. This anamal in..." 20 August 1806.

Lewis described this vegetation as follows: “...the water we Drink, or the Common water of the Missourie at this time, contains half a Comn Wine Glass of sediment concentration downstream from the Kansas River: many journal entries give qualitative measures of the velocity of the current: “...the water 73 °F...” 9 May 1805.

Lewis and Clark described the navigation, color, width, and type of bed material for many of the rivers and streams (fig. 5). In addition, they often noted the air and water temperature: “...the water in the air to stand at 7° water 7°...” 23 August 1804. Water chemistry was also mentioned: “...this river is about 30 yds. wide, and has So many Licks & Salt Springs on its banks that the Water of the Creek is Brackish, one Verry large Lick is 9 ms. up on the left Side...” 6 June 1806.

Lewis and Clark, like most Americans of that time, were accustomed to Eastern rivers that flow all year and in which the flow usually increases downstream. Dry channels, in what is now Montana, were unexpected: “...today we passed the bed of the most extraordinary river that I ever beheld. It is as wide as the Missouri is at this place or 1/2 a mile wide and not containing a single drop of running water; some small standing pools being all the water that could be perceived...” 9 May 1805.

Lewis and Clark measured the channel widths of virtually every stream or river they encountered. They made the important distinction between bank full width, full width, and the width of the water surface: “...this river wthin is 90 yds wide...” 18 July 1805.

They also noted seasonal effects: “...passed Debouche's river at 3 3/4...it appears to spread over it’s bottom at certain seasons of the year and runs a neat torrent tearing up the trees by the roots which stand in it’s bottom...” 18 July 1805.

Lewis and Clark made about 275 width measurements of rivers, streams, and creeks ranging from 4 to 875 yards. Some of the larger rivers (Missouri, Yellowstone, and Columbia) were measured in several locations. Their data can be plotted to show a hydraulic geometry relation between the width of a river at the mouth and drainage area of that river (fig. 7).

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channel-scale geomorphic features include riffles, rapids, falls, sandbars, point bars, and braided streams. These features are generally considered obstacles to the expedition. For example, while descending the Ohio River in the fall of 1803, when the Ohio River was of unusually low stage, they noted:

"...The Wind blew hard...and raised the Sands off the bar in Such Clouds that We Could Scarcely See this Sand being fine and very light, & swept it every thing it touched, and in the Plain for a half a mile the distance I was out every Spire of Grass was covered with the Sand..." 23 August 1804.

Lewis and Clark described many examples of the geomorphic processes that change rivers and landscapes. Bank erosion was reported primarily during periods when the river was rising (fig. 4). Eolian transport was first mentioned near the Big Sioux River:

"...Struck on a ruffle which we got over with some difficulty and in the distance of two miles and a half passed 4 others three of which we were obliged to drag over with horses; the main charge me the exorbitant price of two dollars for his troubles..." 6 September 1803.

At the Great Falls of the Missouri River Clark, took time to measure the falls (fig. 3). Sandbars were numerous on the Missouri and were often referred to as the party labored upriver. However, during the return trip in 1806, they traveled down the Missouri River after the summer peak runoff, and Clark commented on how the river had changed:

"...in places where there was Sand bars in the fall 1804 at this time the main Current passes, and where the current passes now is a Sand bar-Sand bars which were then nacked are now covered with willow Several feet high..." 20 August 1806.
Dams for navigation, flood control, agriculture, and water supply coupled with navigation improvements have changed the rivers. Both men were keen observers and made geomorphic observations when they described the rivers, the processes that form them, and the adjacent landforms. They made hydrologic measurements (water level, temperature, and velocity) of many streams and rivers. Lewis and Clark recorded extensive observations related to biology, botany, ethnology, meteorology, phonology, and zoology as well as geomorphology and hydrology. This fact sheet provides some of their written observations and measurements (given in italics), taken from Moulton’s (1983–93) eight annotated volumes of the journals of Lewis and Clark.

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Lakes

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