

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 367

PROFILE SURVEYS
OF
MISSOURI RIVER FROM GREAT FALLS
TO THREE FORKS, MONTANA

PREPARED UNDER THE DIRECTION OF

R. B. MARSHALL, CHIEF GEOGRAPHER



WASHINGTON
GOVERNMENT PRINTING OFFICE
1914

CONTENTS.

	Page.
General features of Missouri River basin.....	5
Gaging stations	7
Publications	7

ILLUSTRATIONS.

PLATE I. <i>A-M</i> , Plan and profile of Missouri River from Great Falls to Three Forks, Mont.....	At end of volume.
	3

PROFILE SURVEYS OF MISSOURI RIVER FROM GREAT FALLS TO THREE FORKS, MONTANA.

Prepared under the direction of R. B. MARSHALL, Chief Geographer.

GENERAL FEATURES OF MISSOURI RIVER BASIN.

Missouri River and its innumerable tributaries drain an immense area in the northern and western parts of the United States. The northern boundary of this area is approximately the fiftieth parallel; the southern, the thirty-ninth; on the west it is limited by the Rocky Mountains; on the east the divide between it and the upper Mississippi Basin crosses eastern North and South Dakota, western Iowa, and northeastern Missouri. Its extent east and west is about 900 miles; north and south, 600 miles; and it comprises a total of 492,000 square miles.

The basin shows all gradations of topography from the mountains of Montana, Wyoming, and Colorado to the rolling prairies of the Dakotas, Nebraska, and Kansas. The upper tributaries drain a forested region, but the main stream flows through a country almost wholly devoid of forests. The precipitation in the mountainous portion of the basin is mainly in the form of snow, but a great part of the area lies within the arid and semiarid regions, and the annual average precipitation throughout the entire basin is probably less than 20 inches.

Missouri River proper is formed in southwestern Montana by the union of three streams, which were discovered by Lewis and Clark in 1806 and named by them Jefferson, Madison, and Gallatin rivers. Jefferson and Madison forks come together first, and within 2 miles they are joined by the Gallatin. The head of the Missouri thus formed lies about in latitude $45^{\circ} 56'$ north and longitude $111^{\circ} 32'$ west. Each of the three headwater rivers is about 90 feet wide, flows with great velocity, and discharges large quantities of water. The Gallatin is the most rapid of the three, but the Jefferson drains the largest area and is here treated as the continuation of the main river. The Jefferson itself is formed by the union of two forks—Bighole and Beaverhead rivers, the Beaverhead draining the larger area and having as its master headwater stream Red Rock River.

The source of the Red Rock River—the Red Rock Lakes, lying in the Rocky Mountains 6,700 feet above sea level—may therefore be regarded as the ultimate source of the great Missouri.

Below the junction of the Jefferson, Madison, and Gallatin the course of the Missouri lies through mountain valleys and deep canyons, from which it finally emerges through a gorge in a range of rocks called by Lewis and Clark the "gates of the Rocky Mountains." Thirty-five miles above Fort Benton the river pours over Great Falls, and from that point onward it is navigable. For miles below the falls the river flows in a deep canyon, its banks ranging in height from 100 to 160 feet. Below the mouth of Marias River, which enters it from the north, its banks are less abrupt and rise with gentle slopes to the bluffs. The high-water width of the river, which in the vicinity of Fort Benton is 500 to 1,000 feet, increases to 1,500 feet at the mouth of Milk River and to 2,000 feet near the mouth of the Yellowstone. Below the Yellowstone the width gradually increases from 2,000 to 3,000 feet, which remains approximately the average width for 600 miles of its course.

From the mouth of the Yellowstone the Missouri follows a winding but on the whole southeasterly course until it is joined by the Kansas; thence it flows more nearly eastward, across the State of Missouri, and empties into the Mississippi 16 miles above St. Louis, 189 miles above the mouth of the Ohio, and 2,340 miles below the junction of its three upper forks.

For the first 350 miles below the union of the three forks the Missouri is comparatively clear, but about midway between the forks and the mouth of the Yellowstone its character begins to change, and it gradually becomes turbid. Although a large amount of the sediment carried by the Missouri is undoubtedly brought in by the drainage of its tributaries, the greater part is derived from the caving of its banks.

Except in the mountain canyons the Missouri flows through fertile alluvial bottom land, ranging in width from $1\frac{1}{2}$ miles near the mouth to 17 miles in the vicinity of Sioux City.

The tributaries are chiefly in the upper course of the river and come from the western side of the basin. The most important of these are Musselshell, Sun, Marias, Milk, Yellowstone, Cheyenne, Platte, and Kansas rivers.

Owing to the high altitude and the northern climate ice prevails in the upper parts of this basin from November to April. The Missouri itself freezes over entirely, but many of its tributaries remain partly open on account of the extremely rapid flow of the water. The amount of snow falling on the prairies is usually small, but among the mountains the snows begin early, continue late, and accumulate to great depths.

The volume of Missouri River varies greatly, the ordinary high-water discharge at the mouth being about 28 times the low-water discharge. The freshets are caused by melting snows and heavy summer rains. The regular floods occur in May, June, and July, the June discharge being the greatest. Thereafter the river steadily decreases in volume, the minimum being reached during the winter.

Irrigation is practiced to a great extent on the numerous tributaries of the Missouri and agriculture has been extensively developed in many of the valleys. The Madison and Gallatin and many other of the mountain tributaries afford unsurpassed storage facilities, the waters of the Beaverhead, Bighole, Madison, Jefferson, and Gallatin rivers furnish great supplies for irrigation, and the basins of Milk, Sun, Yellowstone, and Musselshell rivers, already extensively utilized, still offer opportunities for broader irrigation, storage, and water-power development.

The Missouri itself has not been used for irrigation, for its banks are high, and it is, consequently, difficult of diversion. About 150,000 acres of land are now under irrigation in Beaverhead Valley, and by storing the waters of the upper Beaverhead or Red Rock River in Red Rock Lakes fully 125,000 acres more can be irrigated.

GAGING STATIONS.

The Survey has maintained in the basin of the Missouri a large number of gaging stations to obtain data for studies of the flow of the river and its tributaries. The stations listed below are in the stretch of the main stream covered by this report:

Missouri River near Townsend, Mont., 1891-1904.

Missouri River at Canyon Ferry, Mont., 1889.

Missouri River near Craig, Mont., 1890-1902.

Missouri River at Toston, Mont., 1890; 1910-

Missouri River at Cascade, Mont., 1902-

Missouri River at Great Falls, Mont., 1897-1905.

A dash following a date indicates that the station was being maintained June 30, 1913. A period after a date indicates discontinuance.

PUBLICATIONS.

The results of stream-flow measurements made by the Survey at gaging stations maintained on the Missouri and its tributaries have been published in the following reports:

Annual reports: 11th, pt. 2; 12th, pt. 2; 13th, pt. 3; 14th, pt. 2; 16th, pt. 2; 18th, pt. 4; 19th, pt. 4; 20th, pt. 4; 21st, pt. 4; 22d, pt. 4.

Bulletins: 131, 140.

Water-Supply Papers: 11, 15, 27, 36, 37, 49, 50, 66, 75, 84, 99, 130, 131, 172, 208, 246, 266, 286, 306, 326, and 356.

Water-supply papers and other publications of the United States Geological Survey containing information in regard to the water resources of the United States may be obtained or consulted as indicated below:

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C., but the edition printed for free distribution is small and soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will, on application, furnish lists giving prices.

3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey, as follows:

Albany, N. Y., Room 18, Federal Building.

Atlanta, Ga., Post Office Building.

St. Paul, Minn., Old Capitol Building.

Helena, Mont., Montana National Bank Building.

Denver, Colo., 302 Chamber of Commerce Building.

Salt Lake City, Utah, Federal Building.

Boise, Idaho, 615 Idaho Building.

Portland, Oreg., 416 Couch Building.

Tacoma, Wash., Federal Building.

San Francisco, Cal., 328 Customhouse.

Los Angeles, Cal., Federal Building.

Santa Fe, N. Mex., Capitol Building.

Honolulu, Hawaii, Kapiolani Building.

A list of the Geological Survey's publications will be sent on application to the Director of the United States Geological Survey, Washington, D. C.

