horizontal plane, which is so enclosed by a topographic divide that direct surface runoff from precipitation normally would drain by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontributing areas, within the area unless otherwise noted.

WSP is used as an abbreviation for "Water-Supply Paper" in references to previously published reports.

DOWNSTREAM ORDER OF LISTING GAGING STATIONS

Beginning with the series of reports for the water year ending September 30, 1951, the order of listing gaging-station records was changed. In this report, in a downstream direction along the main stem all stations on a tributary entering above a main-stem station are listed before that station. If a tributary enters between two main-stem stations, it is listed between them. A similar order is followed in listing stations on first rank, second rank, and other ranks of tributaries. To indicate the rank of any tributary on which a gaging station is situated and the stream to which it is immediately tributary, each indention in the listing of gaging stations in the table of contents of this report represents one rank. This downstream order and system of indention show which gaging stations are on tributaries between any two stations on a main stem and the rank of the tributary on which each gaging station is situated.

The order of listing used before the publication of the 1951 report listed first all stations on the main stem from headwaters toward mouth, then all stations on the uppermost tributary to the main stem from the tributary's source to mouth, and then all stations from source to mouth of the uppermost tributary to the tributary.

EXPLANATION OF DATA

The base data collected at gaging stations consist of records of stage and measurements of discharge. In addition, observations of factors affecting the stage-discharge relation, weather records, and other information are used to supplement base data in determining the daily flow. The records of stage are obtained either from direct readings on a nonrecording gage or from a water-stage recorder that gives a continuous record of fluctuations. Measurements of discharge are made with a current meter by the general methods adopted by the Geological Survey on the basis of experience in stream gaging since 1888. These methods are described in Water-Supply Paper 888 and are also outlined in standard textbooks on the measurement of stream discharge. Typical structures in use at gaging stations are shown in figure 1.

Rating tables giving the discharge for any stage are prepared from stage-discharge relation curves defined by discharge measurements. If extensions to the rating curves are necessary to define the extremes of discharge, they are made on the basis of indirect determinations of peak discharge (such as slope-area or contracted-opening determinations, computation of flow over dams or weirs, and by other methods), velocity-area studies, and logarithmic plotting. The application of the daily mean gage height to those rating tables gives the daily mean discharge, from which the monthly and the yearly mean discharge are computed. If the stage-discharge relation is subject to change because of frequent or continual change in the physical features that form the control, the daily mean discharge is determined by the shifting-control method, in which correction factors

A. **COLORADO RIVER AT LEES FERRY, ARIZ.**
Note landing tower.

B. **CRYSTAL RIVER NEAR REDSTONE, COLO.**

FIGURE 1.—GAGING-STATION STRUCTURES

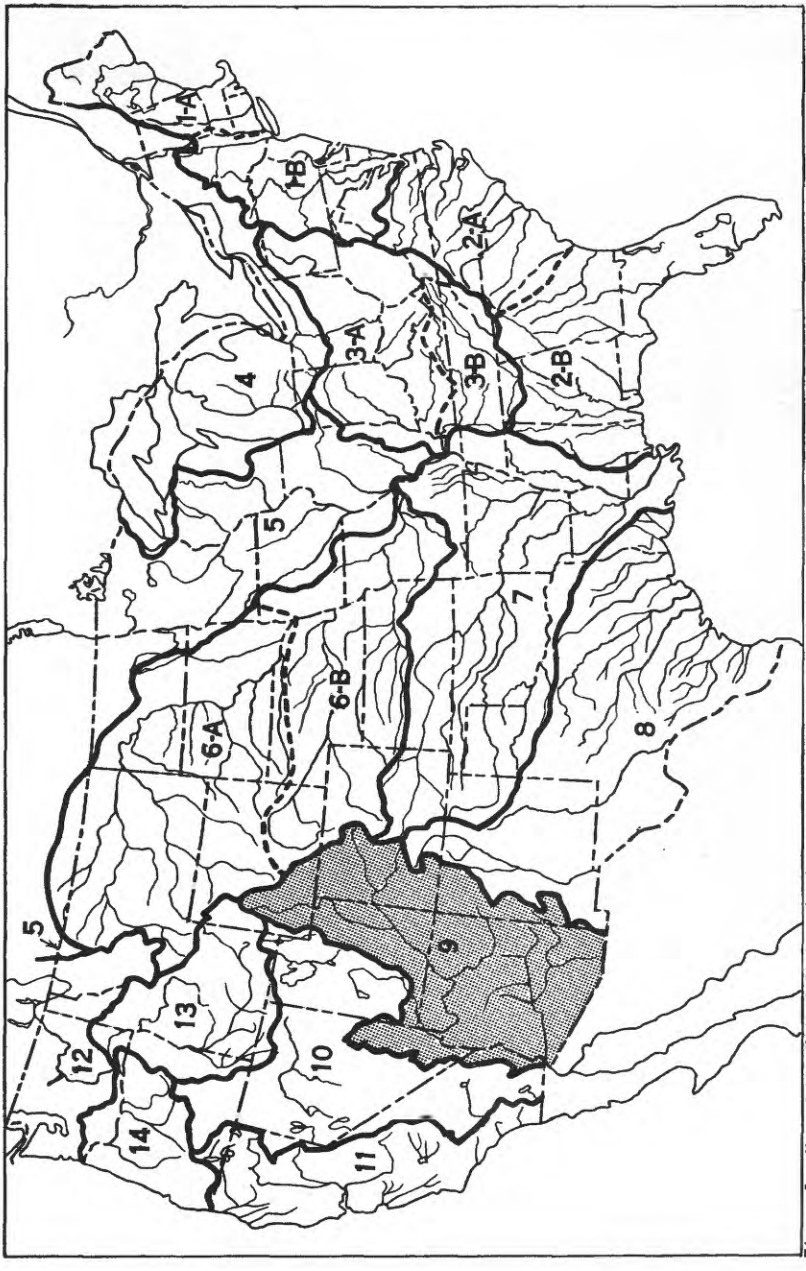

Figure 2.--Map of the United States showing areas covered by the 18 annual volumes on surface-water supply. The area covered by this report is shaded.

Streamflow data for the years 1884-1901, in reports of the Geological Survey--Continued

(A = Annual Report; B = Bulletin)

Report	Character of data	Year
B 131.....	Descriptions, measurements, gage heights, and ratings.....	1893-94.
16th A, pt. 2	Descriptive information only.	
B 140.....	Descriptions, measurements, gage heights, ratings, and monthly discharge.	1895.
WSP 11.....	Gage heights.....	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge...	1895-96.
WSP 15.....	Descriptions, measurements, and gage heights of streams east of the Mississippi River, and Missouri River and tributaries above Kansas River.	1897.
WSP 16.....	Descriptions, measurements, and gage heights of streams west of the Mississippi River, except Missouri River and tributaries above Kansas River.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge..	1897.
WSP 27.....	Measurements, ratings, and gage heights of streams east of the Mississippi River, and Missouri River and tributaries.	1898.
WSP 28.....	Measurements, ratings, and gage heights of streams west of the Mississippi River, except Missouri River and tributaries.	1898.
20th A, pt. 4	Monthly discharge.....	1898.
WSP 35 to 39.	Descriptions, measurements, gage heights, and ratings.....	1899.
21st A, pt. 4	Monthly discharge.....	1899.
WSP 47 to 52.	Descriptions, measurements, gage heights, and ratings.....	1900.
22d A, pt. 4.	Monthly discharge.....	1900.
WSP 65, 66...	Descriptions, measurements, gage heights, and ratings.....	1901.
WSP 75.....	Monthly discharge.....	1901.

Reports on surface-water supply containing records from 1899 to date for drainage basins in this report are listed below. The data for any particular gaging station will, in general, be found in the reports covering the years during which the station was maintained.

Numbers of water-supply papers containing results of stream measurements in Colorado River basin, 1899-1954

Year	WSP	Year	WSP	Year	WSP	Year	WSP	Year	WSP
1899	a37,38	1911	309	1923	569	1934	764	1945	1039
1900	50	1912	329	1924	589	1935	789	1946	1059
1901	66,75	1913	359	1925	609	1936	809	1947	1089
1902	85	1914	389	1926	629	1937	829	1948	1119
1903	100	1915	409	1927	649	1938	859	1949	1149
1904	133	1916	439	1928	669	1939	879	1950	1179
1905	175,b177	1917	459	1929	689	1940	899	1951	1213
1906	211,b213	1918	479	1930	704	1941	929	1952	1243
1907-8	249	1919-20	509	1931	719	1942	959	1953	1283
1909	269	1921	529	1932	734	1943	979	1954	1343
1910	289	1922	549	1933	749	1944	1009		

a Green and Gunnison Rivers and Colorado River above Gunnison River.
b Below mouth of Gila River.

The records at most of the stations discussed in these reports extend over many years. Discharge measurements at many points other than regular gaging stations have been made each year and are published under "Miscellaneous discharge measurements" at the end of each report. The streams and points of measurement are listed in the same order as the streams and gaging stations in the body of the report. An index of the records obtained before 1904 has been published in Water-Supply Paper 119.

A compilation of records for the area covered by this report through September 1950 has been published as WSP 1313. That report contains a summary of monthly and annual discharges for all previously published records as well as some records not contained in the annual series of water-supply papers. All records were reexamined and revised where warranted. Estimates of discharge were made to fill short gaps whenever practical.

Records of discharge have been published also in State reports. Most of these records are compiled in WSP 1313, however some of them are not contained in the publications of the Geological Survey. The following table contains a list of these reports for the area covered by this report.

State reports containing compilations of records of discharge

State	Period	Report	Issued by
Colorado.....	1881-1935	Water resources of Colorado, Appendix 2, Data on stream-gaging stations of Colorado. a/	State Planning Commission, Water Conservation Board, State engineer.
Do.....	1881-1938	Water resources of Colorado, Appendix 3, vols. 1 and 2, Stream-flow data of Colorado.	Do.
New Mexico....	1888-1925	Surface water supply of New Mexico.....	Office of the State Engineer.
Utah.....	1889-1905	5th biennial report.....	Do.
Do.....	1906-10	7th biennial report.....	Do.
Do.....	1910-16	10th biennial report.....	Do.

a/ Contains records of yearly discharge only.
Note.--In addition to the records contained in the reports listed above, the States of Colorado, New Mexico, and Wyoming have issued annual or biennial reports in which are contained records of discharge.

The reports listed in the foregoing tables contain the customary records of discharge collected during the systematic operation of gaging stations. Detailed information on the stage and discharge of many streams during major floods has been included in special reports on these floods published by the Geological Survey. The more recent of these special reports also contain other pertinent hydrologic information and analyses and compilations of data relating to earlier notable floods. The following list gives the numbers and titles of these reports.

WSP	Report
147.....	Destructive floods in the United States in 1904.
162.....	Destructive floods in the United States in 1905.
771.....	Floods in the United States, magnitude and frequency.
847.....	Maximum discharges at stream-measurement stations through September 1938.
967-A.....	Floods of September 1939 in Colorado River basin below Boulder (Hoover) Dam.
994.....	Cloudburst floods in Utah, 1850 to 1938.
997.....	Floods in Colorado.

RECORDS OF DISCHARGE COLLECTED BY AGENCIES OTHER THAN THE GEOLOGICAL SURVEY

The Agricultural Research Service of the United States Department of Agriculture has been collecting records of runoff near Safford, Ariz., beginning in 1938, from 6 areas of less than 800 acres. These records are in the files of the Agricultural Research Service.

HYDROLOGIC CONDITIONS

The water year was characterized by deficient runoff over most of the area covered by this report. New record-lows were experienced in Arizona during the period October to February. In March the Upper Gila River basin was above median for the first time since June 1952. Runoff of Colorado River near Cisco, Utah, was the lowest ever recorded in May and June. A notable flood occurred in Queen Creek in the Gila River basin August 19 causing an estimated one million dollar damage. Runoff was also the highest for August since 1934 for Gila River at head of Safford Valley near Solomon, Ariz. In the Tucson area, the runoff for Santa Cruz River for the July and August period was the highest for period of record beginning in 1906. For those key gaging stations in the area covered by this report, a comparison of monthly and annual mean discharges during the 1954 water year with the median discharges for the 25-year period 1921-45 is shown in figure 3 on the following page.

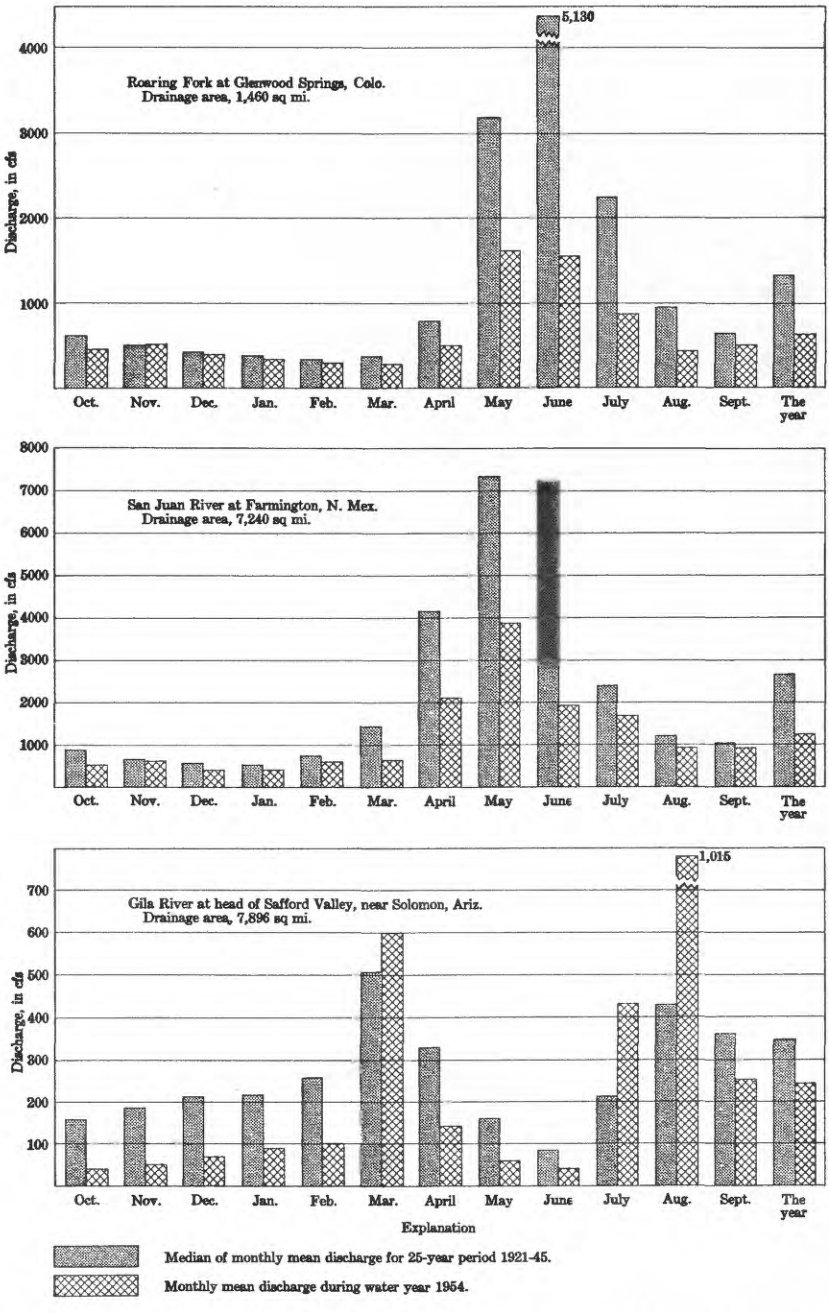

Figure 3. Comparison of discharge at three key gaging stations during 1954 water year with median discharge for 25-year period.