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 based on individual discharge measurements and notes by engineers and observers are used in applying the gage heights to the rating tables. If the stage-discharge relation for a station is temporarily changed by the presence of aquatic growth or debris on the control, the daily mean discharge is computed by what is essentially the shifting-control method.

At some gaging stations the stage-discharge relation is affected by backwater from reservoirs, tributary streams, or other sources. This necessitates the use of the slope method in which the slope or fall in a reach of the stream is a factor in determining discharge. Information requisite for determining the slope or fall is obtained by means of an auxiliary gage set at some distance from the base gage. At some stations the stage-discharge relation is affected by changing stage. If so, the rate of change of stage is used as a factor in the determination of discharge.

A, COLUMBIA RIVER NEAR THE DALLES, OREG.
Gage shelter and stilling well.

B, WILLAMETTE RIVER AT ALBANY, OREG.
FIGURE 1.—GAGING-STATION STRUCTURES.

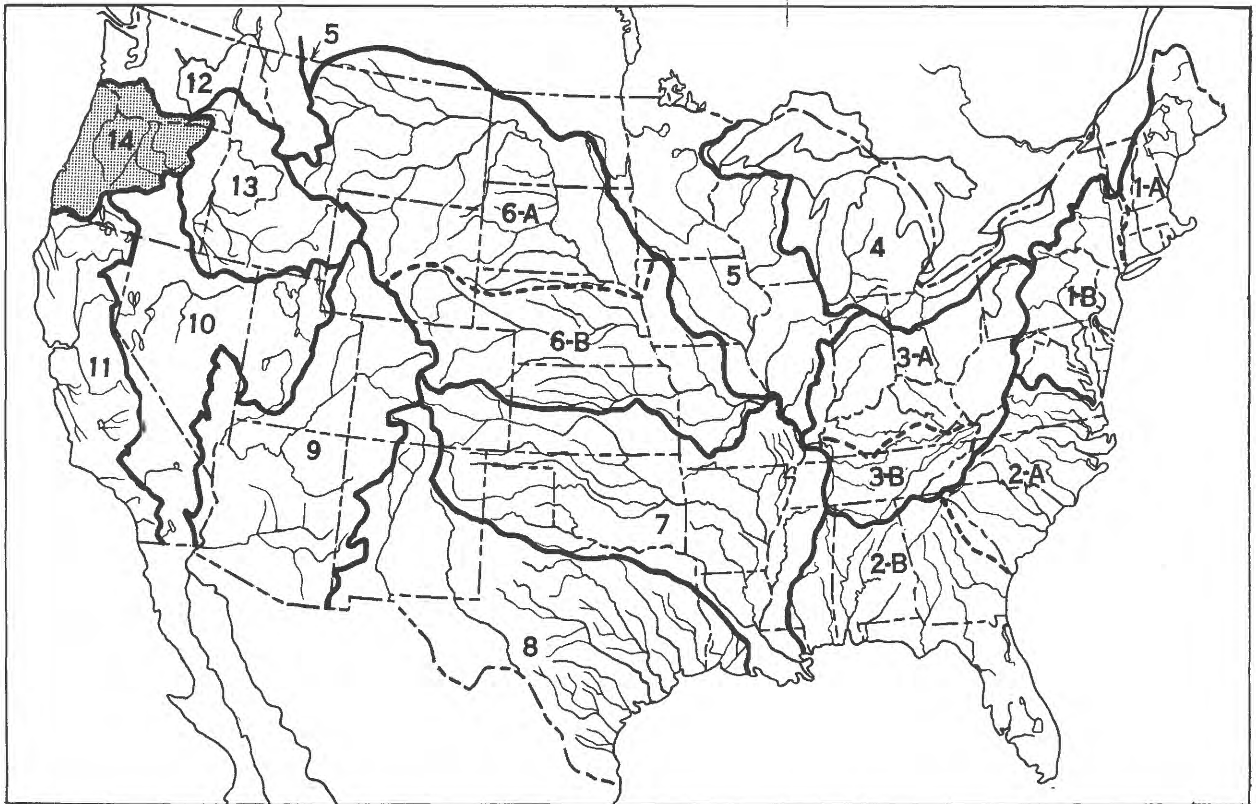

Figure 2.--Map of the United States showing areas covered by the 18 annual volumes on surface-water supply. The area covered by this report is shaded.

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

(A = Annual Reports; B = Bulletin)

Report	Character of data	Year
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.

Note.--Records for all stations in Oregon are contained in WSP 370, superseding all reports in this table for these stations.

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 Pacific slope basins in Oregon and lower Columbia River basin, 1899-1956

Year	WSP	Year	WSP	Year	WSP	Year	WSP	Year	WSP
1899	38	1912	332-C	1925	614	1937	834	1949	1154
1900	51	1913	362-C	1926	634	1938	864	1950	1184
1901	66, 75	1914	394	1927	654	1939	884	1951	1218
1902	85	1915	414	1928	674	1940	904	1952	1248
1903	100	1916	444	1929	694	1941	934	1953	1288
1904	135	1917	464	1930	709	1942	964	1954	1348
1905	a177,178	1918	484	1931	724	1943	984	1955	1398
1906	214	1919-20	514	1932	739	1944	1014	1956	1448
1907-8	252	1921	534	1933	754	1945	1044		
1909	272	1922	554	1934	769	1946	1064		
1910	292	1923	574	1935	794	1947	1094		
1911	312	1924	594	1936	814	1948	1124		

a Rogue, Umpqua, and Siletz Rivers only.
Note.--Records for all stations in Oregon through September 1910 are contained in WSP 370, superseding all earlier reports for these stations.

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 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.

Each of the reports on the surface-water supply for the year 1939 (Water-Supply Paper 884 for the Pacific slope basins in Oregon and lower Columbia River basin) contains, for the area included in that report, a summary of yearly discharge at gaging stations at which 10 or more complete years of record had been collected. These summaries were reprinted separately.

Reports also have been published that are compilations of records for various areas, usually a single State or drainage basin. These reports contain records previously published (some of which may have been revised), as well as some records not contained in the annual series of water-supply papers. The following table lists reports of this type for the Pacific slope basins in Oregon and lower Columbia River basin.

Reports containing compilations of records of discharge by States and drainage basins

WSP	Period	Report
370.............	1878-1910	Surface water supply of Oregon.
492.............	1878-1919	Summary of hydrometric data in Washington.
870.............	1919-35	Summary of records of surface waters of Washington.

Records of discharge have been published also in State reports. Some of these are not contained in the publications of the Geological Survey or are revisions of records previously published in its water-supply papers. The following table contains a list of these reports for the area covered by this report.

There were some unusual floods from local streams in the Rogue and Umpqua River basins of southwestern Oregon during February, although the main streams did not approach the stages of December. Moderate floods occurred in north-central and northeastern Oregon during the last 10 days in March as a result of snow melt. Runoff was excessive throughout Oregon during May as warm weather and above average rainfall cut deeply into the heavy snow pack at high elevations. Several destructive floods from cloud burst-type storms occurred during July in Oregon, on July 10 at Mt. Vernon where Beech Creek flows into the John Day River and on July 13 on Bridge Creek, a tributary of John Day River. The latter was a disastrous storm centered to the north of Mitchell and the greatest runoff came down Meyers Canyon about 5 miles downstream from Mitchell, computed as 54,500 cfs from 12.7 square miles. These two storms will be described in more detail in a summary report on floods during 1956.

Ranking of some of the mean monthly runoff figures for two stations in Washington indicates that high runoff occurred during much of the year. The rankings are as follows: Lewis River near Cougar, December, 3rd; May, 1st; June, 3rd; July, 2nd. Cowlitz River at Castle Rock, December, 3rd; May, 1st; June, 5th; July, 5th.

For two key gaging stations in the area covered by this report, a comparison of the monthly and yearly mean discharge during the 1956 water year with the median for the 25-year period 1921-45 is shown in figure 3 below.

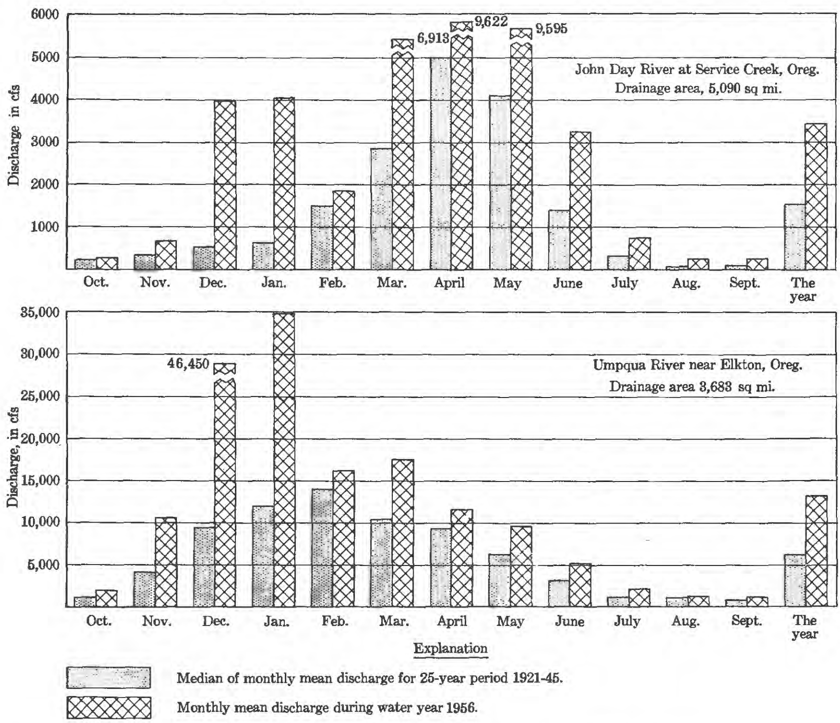

Figure 3. Comparison of discharge at two key gaging stations during 1956 water year with median discharge for 25-year period.

LOWER COLUMBIA RIVER BASIN

WALLA WALLA RIVER BASIN

South Fork Walla Walla River near Milton, Oreg.

Location.--Lat 45°50', long 118°10', in NE¼NE¼ sec. 15, T. 4 N., R. 37 E., on right bank 1 mile upstream from Pacific Power and Light Co.'s penstock intake, 1 mile downstream from Elbow Creek, and 13 miles southeast of Milton.

Drainage area.--63 sq mi, approximately.

Records available.--February to October 1903 (gage heights only), August 1906 to November 1917 (incomplete), May 1931 to September 1956. February to October 1903, published as "12 miles above Milton" and 1907-10 published as "above Pacific Power and Light Co.'s intake, near Milton".

Gage.--Water-stage recorder. Altitude of gage is 2,050 ft (from river-profile map). Prior to Mar. 23, 1934, water-stage recorder or staff gages at several sites within 1¼ miles of present site at various datums.

Average discharge.--32 years (1908-15, 1931-56), 175 cfs (126,700 acre-ft per year).

Extremes.--Maximum discharge during year, 1,360 cfs Dec. 21 (gage height, 3.55 ft); minimum, 101 cfs Aug. 22, Sept. 15-19, 22-26, 29 (gage height, 1.48 ft).

1906-17, 1931-56: Maximum discharge recorded, 2,430 cfs Dec. 12, 1946 (gage height, 4.20 ft), from rating curve extended above 240 cfs; minimum, 72 cfs Feb. 14, 1932.

Maximum stage known, about 6 ft Mar. 31, 1931, present site and datum.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. No regulation or diversion above station.

Revisions (water years).--WSP 964: Drainage area. WSP 1398: 1912, 1940, drainage area at former site.

Rating tables, water year 1955-56, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to May 10				May 11 to Sept. 30			
1.4	88	2.5	490	1.4	85	2.0	260
1.7	141	3.0	830	1.7	163	2.5	490
2.0	240	3.5	1,310				

Discharge, in cubic feet per second, water year October 1955 to September 1956

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	102	113	157	182	b140	133	240	266	299	139	111	105
2	102	112	154	171	b135	144	213	274	281	142	113	105
3	103	112	146	171	a138	165	195	279	267	142	116	105
4	106	122	137	182	a140	160	192	292	267	139	113	105
5	117	137	133	175	135	146	188	292	*240	136	111	103
6	106	130	133	171	133	139	182	302	229	133	111	103
7	102	130	128	171	133	135	182	330	220	130	111	103
8	103	128	126	175	130	135	178	425	216	127	108	103
9	112	133	130	171	128	133	*199	425	216	127	108	103
10	144	*139	128	*168	128	128	270	496	216	127	108	103
11	118	130	202	168	130	126	345	460	207	136	108	*103
12	117	124	526	175	135	124	360	385	200	125	108	103
13	115	122	311	188	135	128	380	*340	197	122	105	103
14	113	118	213	185	133	126	400	311	210	122	105	103
15	110	b117	182	304	128	126	400	315	236	119	105	101
16	108	b115	168	448	b128	133	355	335	216	116	105	101
17	108	113	157	350	128	154	311	371	204	*116	105	101
18	108	117	149	283	126	213	306	405	194	116	105	101
19	108	133	152	257	126	270	350	415	200	113	103	101
20	106	135	192	257	124	244	400	425	188	113	103	103
21	106	135	782	249	133	249	460	410	178	113	*103	103
22	106	128	*983	236	139	*325	460	385	172	113	101	103
23	105	126	568	225	137	316	410	400	169	111	103	101
24	103	126	385	210	133	321	*385	376	163	111	103	101
25	*103	146	306	195	130	340	355	335	157	111	103	101
26	105	217	288	185	130	355	345	327	154	111	119	101
27	103	221	283	175	126	288	340	323	151	111	*127	103
28	106	175	240	165	*126	244	306	303	148	111	111	105
29	113	157	210	160	128	229	283	*303	145	111	108	103
30	130	152	188	152	------	240	274	303	142	108	108	105
31	118	-----	188	b145	-----	257	-----	311	-----	108	105	-----
Total	3,406	4,063	8,056	6,449	3,815	6,226	9,264	10,919	6,082	3,759	3,353	3,084
Mean	110	135	260	208	132	201	309	352	203	121	108	103
Cfsm	1.75	2.14	4.13	3.30	2.10	3.19	4.90	5.59	3.22	1.92	1.71	1.63
In.	2.01	2.40	4.76	3.81	2.25	3.68	5.47	6.45	3.59	2.22	1.98	1.82
Ac-ft	6,760	8,060	15,980	12,790	7,570	12,350	18,370	21,660	12,060	7,460	6,650	6,120

Calendar year 1955: Max 983 Min 97 Mean 174 Cfsm 2.76 In. 37.53 Ac-ft 126,100
Water year 1955-56: Max 983 Min 101 Mean 187 Cfsm 2.97 In. 40.44 Ac-ft 135,800

Peak discharge (base, 600 cfs).--Dec. 12 (7 a.m.) 687 cfs (2.81 ft); Dec. 21 (9 p.m.) 1,360 cfs (3.55 ft).

* Discharge measurement made on this day.

a No gage-height record; discharge estimated on basis of weather records and record for North Fork Walla Walla River near Milton.

b Stage-discharge relation affected by ice.