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Water-Supply Paper 796—B

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FLOOD ON  
REPUBLICAN AND KANSAS RIVERS  
MAY AND JUNE 1935

BY  
ROBERT FOLLANSBEE AND J. B. SPIEGEL

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Contributions to the hydrology of the United States, 1937  
(Pages 21-52)



UNITED STATES  
GOVERNMENT PRINTING OFFICE  
WASHINGTON : 1937

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FLOOD ON REPUBLICAN AND KANSAS RIVERS, MAY AND JUNE 1935

By Robert Follansbee and J. B. Spiegel

ABSTRACT

An unusually heavy storm of cloudburst intensity in eastern Colorado and western Nebraska during the night of May 30-31, 1935, which followed two periods of general rainfall over the Republican-Kansas River Basin earlier in the month, produced the greatest flood of record in the upper part of this basin and a flood nearly as great as any previously recorded on the lower part of the basin below Junction City, Kans.

The area of heaviest rainfall contained no precipitation stations of the United States Weather Bureau, but records obtained by local residents who measured the rainfall in miscellaneous receptacles indicate that the precipitation was 18 to 24 inches at some places in the upper part of the Republican-Kansas River Basin during the night of May 30-31. During the period May 26 to June 2 the storm extended over the greater part of the basin, causing local floods on many rivers in Nebraska and Kansas.

The South Fork of the Republican River and the Arikaree River were the principal sources of the flood and had the highest crest discharges in second-feet per square mile of any rivers in the basin, the crest discharge of the South Fork of the Republican River at Newton, Colo., being about 103,000 second-feet or 81.2 second-feet per square mile of drainage area. The crest discharge in second-feet continued to increase as the flood passed down the river until a maximum discharge of about 280,000 second-feet occurred between Cambridge and Arapahoe, Nebr. Below this point the effects of channel and flood-plain capacity in reducing the crest discharge were sufficient to offset the inflow from tributary streams, so that there was a flattening of the flood crest and a gradual reduction in the magnitude of the crest discharge to 170,000 second-feet at Ogden, Kans., and 120,000 second-feet at the mouth of the Kansas River at Kansas City, Kans.

The loss of life was greatest in the upper parts of the valley in Colorado and Nebraska, where the flood occurred at night. A total of 110 lives were lost. The loss of livestock was 20,593. More than 275,000 acres of farm land were damaged, most of which contained growing crops or hay. Several hundred miles of highways and railroads were destroyed or damaged, also 515 highway bridges and many railroad bridges. The number of homes destroyed or damaged was very large, especially in the upper part of the valley, where the water rose to unprecedented heights. In Kansas 1,485 homes and 1,552 buildings other than homes were flooded.

The river measurement stations maintained by the Geological Survey and cooperating parties in Nebraska and Kansas were in operation throughout the period of the flood with the exception of 5 stations that were destroyed or rendered inoperative. Determinations of discharge at these 5 stations were made from flood marks and data obtained by observers. In addition to information regarding maximum discharges at stations on the Republican and Kansas Rivers during the flood of May and June 1935, contained elsewhere in this report, the mean daily discharge for this period for 32 stations in the Republican-Kansas River Basin is given in the tables.

It appears that other floods, especially that of May and June 1903, have been greater than that of May and June 1935 for the Kansas River below Junction City, although the flood of 1935 was the greatest flood that had occurred in the upper part of the Republican-Kansas River Basin during the period of historical record. The flood that occurred in the spring of 1844 apparently exceeded the flood of 1903 in the lower part of the basin and is believed to be the maximum flood of record on the Kansas River, although no definite information is available as to its height or magnitude.

## INTRODUCTION

After a month of greater than normal precipitation, exceptionally heavy rains during the night of May 30-31, followed by moderately heavy rainfall during the next 2 days, caused the greatest flood on the Republican River that had occurred during a period of at least 70 years and, considering its magnitude as compared with other known floods of the Republican River, probably the greatest flood for a much longer period.

The Republican River Valley from the eastern part of Colorado to Junction City, Kans., a distance of over 350 miles, was overflowed for a width ranging from three-quarters of a mile to  $1\frac{1}{2}$  miles, with a loss of more than 100 lives, the destruction of much livestock and most of the buildings in the overflowed area, and great damage to thousands of acres of rich farm land by deposits of sand brought down by the flood waters. Nearly all the highway bridges over the river were either destroyed or rendered impassable, and the highway along the valley was washed out in many places. On the main line of the Burlington Route from Chicago and St. Louis to Denver about 40 miles of track was destroyed, and the line was out of commission for 3 weeks.

The high water in the Kansas River Valley below Junction City, Kans., was caused primarily by the flood of the Republican River rather than by flood water from other tributaries. At the time the peak of the Republican River flood reached Junction City the Smoky Hill River, which unites with the Republican River to form the Kansas River at Junction City, was supplying less than 8 percent of the total flow measured at Ogden, Kans., 7.5 miles below Junction City. The Big Blue River, which joins the Kansas River from the north at Manhattan, was at bank-full stage because of heavy rainfall over parts of its drainage basin in southeastern Nebraska and northeastern Kansas and added about 22 percent to the flow of the Kansas River at Manhattan. Other tributaries joining the Kansas River below Manhattan were not at abnormally high stages, and therefore the temporary storage afforded by channel capacity served to reduce the peak discharge from about 190,000 second-feet, estimated as the sum of the discharges of the Kansas and Big Blue Rivers at Manhattan, to about 177,000 second-feet at Wamego, 154,000 second-feet at Topeka, and 122,000 second-feet at Bonner Springs, Kans. It is probable that the peak of the discharge of the Big Blue River reached Manhattan ahead of the peak in the Kansas River by a few hours, but their identities were merged at Wamego. Because of

the reduction in peak discharge by the time the flood peak reached Kansas City, the levees were able to pass it safely into the Missouri River.

#### ACKNOWLEDGMENTS

The Missouri River division of the Corps of Engineers, United States Army, Kansas City, Mo., has furnished data on topography and river profiles, together with other information obtained by that office in connection with its studies of floods in the Kansas River Basin, including detailed studies of precipitation records and data regarding loss of life and damage to property. The United States Weather Bureau furnished timely information concerning the extent and progress of the flood along the lower valley of the Republican River and Kansas River in Kansas, and precipitation data obtained at various places in Colorado, Nebraska, and Kansas.

L. T. Burgess, chief hydrographer in the office of the Colorado State engineer, assisted in collecting field data in Colorado. Eads Lehman, of Idalia, Colo., furnished estimates of flood losses in Colorado. J. M. Sherier, meteorologist, United States Weather Bureau, Denver, Colo., gave information regarding the origin and nature of the storm of May 30-31. A. C. Tilley, State engineer of Nebraska, and G. S. Knapp, chief engineer, division of water resources, Kansas State Board of Agriculture, supplied data regarding flood losses in Nebraska and Kansas, and the Kansas State Highway Commission supplied data on cross sections and estimates of flood damages to highway structures and loaned airplane photographs. Engineers of the division of water resources, Kansas State Board of Agriculture, collaborated in making discharge measurements and in obtaining data at river measurement stations in Kansas. Acknowledgments to local residents and others are given throughout the report.

The field work in Colorado and Nebraska was done under the direction of Robert Follansbee and was begun June 5 by J. H. Baily, assisted by M. C. Boyer and H. H. Odell. The field work in Kansas was done by J. B. Spiegel, assisted by Charles Wells and R. V. Smrha. Computations and office studies were made by Follansbee and Baily for areas in Colorado and Nebraska and by Spiegel for stations in Kansas. Recomputations of discharge for the flood of 1903, which are included as a part of this report, were prepared by G. R. Williams. The individual reports prepared by Follansbee and Spiegel were reviewed and correlated by C. H. Pierce.

## RAINFALL

## Causes and intensity

The immediate cause of the flood was a rainfall of cloudburst intensity in eastern Colorado and western Nebraska during the night of May 30-31. During two periods earlier in the month general rainfall had occurred over the Republican-Kansas River Basin. In the first period, May 12-22, from 2 to 5 inches of rain fell, and in the second period, May 26-29, there was 1 inch or less over the area in northeastern Colorado, 3 inches or more in southwestern Nebraska, and 6 inches at some places in eastern Kansas. As a result of these two periods of rainfall the rivers reached fairly high stages a few days before the time of the major flood, and the soil was in condition to afford a high percentage of run-off from the storm of May 30-31. In Nebraska and Kansas the flood was augmented by heavy rains that occurred during the next 2 days. (See pl. 10.)

The daily weather maps for the period from May 28 to June 3 show that an area of high pressure (more than 30.1 inches) appeared over the province of Alberta on May 28. It gradually worked eastward and by May 31 was located over the Great Lakes, and the pressure had increased to 30.2 inches. On May 28 an area of low pressure (29.7 inches) was present over Arizona, and by May 30 it had moved over New Mexico, with a pressure of 29.65 inches. On the evening of May 30 the low area was over southwestern Colorado, and its trend was northeastward, toward the high-pressure area. As the circulation of air around a low-pressure area is counterclockwise, the air currents on the south side had an easterly and northerly direction, bringing in warm moisture-laden air from the Gulf region. At the same time the direction of the air currents from the south side of the high-pressure area was westerly and southerly, carrying moisture from the Lake region. There were thus two bodies of moisture-laden air moving in opposite directions, and at their line of contact heavy precipitation occurred, which on the night of May 30 was concentrated in eastern Colorado and western Nebraska. Experience has shown that the relative positions of the high-pressure and low-pressure areas at that time are those which are most favorable for heavy precipitation in southeastern Colorado.

In Nebraska heavy rains that fell around Hayes Center and other points in the Republican River Basin added their quota to the run-off, which moved down the valley so rapidly that the successive rises in river stages so noticeable in western Nebraska were obliterated before the flood reached

the Kansas-Nebraska State line about midnight on June 1. Rains in Kansas were heavy enough to create local floods on many rivers. These floods occurred slightly in advance of the arrival of the flood in the Republican River Basin and served to rob the onrushing waters from Nebraska of the channel storage and discharge capacity of the river.

#### Area of heavy rainfall

The storm that caused the heavy rainfall in the Republican River Basin during the night of May 30-31 began just east of the mountains in the forenoon of May 30, and in that area local residents measured, chiefly during the afternoon, as much as 20 inches (including some hail) in stock tanks. This storm followed a general northeasterly direction across the headwaters of the Republican River and ended a few miles east of Curtis, Nebr., on May 31. The air-line distance from the head of the Republican River in northeastern Colorado to Curtis, is 215 miles. Within this area the rainfall was concentrated chiefly in the basin of the South Fork of the Republican River but extended along the low ridge dividing that basin from the basin of the Arikaree River nearly to Benkelman, Nebr. Outside this concentrated area there were undoubtedly small areas of intensive rainfall, as shown by the record of 11 inches in sec. 24, T. 6 S., R. 55 W., but only 1 inch 2 miles farther south. The accompanying isohyetal map (fig. 6), shows the distribution of rainfall from the cloudburst storm of May 30-31, as plotted from data obtained by local residents. In the vicinity of McCook, Nebr., a tornado appeared on the afternoon of May 31 at the time of the flood crest, and a strong east wind brought clouds of dust to that area.

Unfortunately, the areas of heaviest rainfall contained no Weather Bureau precipitation stations, and it was therefore necessary, in determining the location and approximate amount of rainfall, to obtain from local residents such information as could be furnished by those who had measured the rainfall in improvised rain gages. Reports of such measurements in northeastern Colorado, southwestern Nebraska, and northwestern Kansas, together with data reported by the Weather Bureau from its stations in those areas, are listed in the following table:

Rainfall during night of May 30-31, 1936, at places in northeastern Colorado, southwestern Nebraska, and northwestern Kansas as compiled from statements of local residents and from U. S. Weather Bureau records

Place	Rainfall (inches)	Method of measurement	Time of occurrence
Colorado			
Sec. 2, T. 7 S., R. 56 W.	2	Measured in can.....	Less than 1 hour.
Sec. 25, T. 7 S., R. 56 W.	2	.....do.....	
Sec. 19, T. 5 S., R. 55 W.	4	Reported (method not stated).....	Chiefly between 4 and 6 p.m.
Sec. 31, T. 5 S., R. 55 W.	4	Measured in can.....	Started at 5 p.m.; heaviest 6 to 7 p.m.
Sec. 24, T. 6 S., R. 55 W.	11	Measured in paint can.....	Afternoon of May 30.
Sec. 36, T. 6 S., R. 55 W.	1	Measured in can.....	
Gemoa, sec. 12, T. 9 S., R. 55 W.	3	Rain and hail (measured in can).....	
Sec. 1, T. 9 S., R. 55 W.	5	Water standing on ground.....	
Sec. 19, T. 7 S., R. 54 W.	8	Can overflowed.....	
Arriba, sec. 1, T. 9 S., R. 53 W.	-	Storm did not touch Arriba; black clouds in all directions (Weather Bureau station)	
Flagler, sec. 2, T. 9 S., R. 51 W.	2.5	Measured in glass-tube rain gage.....	Chiefly between 6 and 6:30 p.m.
Near Cope, sec. 1, T. 4 S., R. 50 W.	4.8	Measured in oil can.....	10 p.m. to 1:45 a.m. (heaviest between 11 and 12). Night of May 30-31.
Near Cope, sec. 31, T. 4 S., R. 49 W.	1.85	Weather Bureau.....	
Seibert, sec. 34, T. 5 S., R. 49 W.	7	Measured in glass-tube rain gage.....	
Near Seibert, sec. 11, T. 8 S., R. 49 W.	13	Measured in concrete tank.....	
Near Cope, sec. 28, T. 5 S., R. 49 W.	4	Measured in 1-gallon fruit can.....	
Near Cope, sec. 5, T. 5 S., R. 48 W.	7	Measured in can.....	
Near Cope, sec. 6, T. 5 S., R. 47 W.	7.5	Measured in 5-gallon can.....	
Joes, sec. 6, T. 5 S., R. 47 W.	7.25	Measured in fruit can.....	
Do.....	0.2	Reported by Weather Bureau.....	
Stratton, sec. 35, T. 8 S., R. 47 W.	0.1	.....do.....	
Burlington, sec. 33, T. 8 S., R. 45 W.	4.5	In can.....	Chiefly between 6:30 and 8:30 p.m. 3 inches between 7 and 9 p.m.
Idalia, sec. 16, T. 4 S., R. 44 W.	5.5	Measured in vertical can.....	2.5 inches between 12 and 12:30 a.m.
Near Idalia, sec. 22, T. 4 S., R. 44 W.	10	18-inch cement tank more than half full....	Chiefly between 9 p.m. and midnight.
Near Idalia, sec. 33, T. 4 S., R. 44 W.	12.88	Measured in stock tank with vertical sides	7 to 9 p.m.; 11:30 p.m. to 2 a.m.
Near Newton, sec. 14, T. 5 S., R. 44 W.	18	Measured in oil barrel.....	
Near Newton, sec. 23, T. 5 S., R. 44 W.	-	Two severe storms.....	



Location	Amount	Description	Time
Near Newton, sec. 26, T. 5 S., R. 44 W.	24	24-inch stock tank overflowed	
Wray, sec. 6 T. 1 E., R. 43 W.	0.01	Reported by Weather Bureau	
Near Hale, sec. 23, T. 4 S., R. 43 W.	9	Measured in 5-gallon can	
Near Hale, sec. 24, T. 4 S., R. 43 W.	10	In 15-gallon oil drum	
Near Hale, sec. 18, T. 4 S., R. 42 W.	7.5	Measured in can on post	
Near Hale, sec. 16, T. 5 S., R. 42 W.	7	Rain hardly settled the dust	
Near Idalia, sec. 32, T. 3 S., R. 42 W.	7.5	Reported (method not stated)	
Near Idalia, sec. 8, T. 4 S., R. 42 W.	12	Measured in can	
Nebraska			
Haigler, sec. 27, T. 1 E., R. 41 W.	1.76	Reported by Weather Bureau	7:50 p.m. to midnight.
Imperial, sec. 4 T. 6 N., R. 38 W.	2.88	do	10:30 p.m. May 30 to 3 a.m. May 31.
Benkelman, sec. 18, T. 1 E., R. 38 W.	4.65	do	Do.
Culbertson, sec. 17, T. 5 N., R. 31 W.	1.75	On 30th during night	
Kansas			
St. Francis, sec. 22, T. 3 S., R. 40 W.	3.28	Reported by Weather Bureau	During night of May 30-31.
Sec. 31, T. 1 S., R. 39 W.	-	8-gallon pail 11 inches high overflowed by rain and hail	
Sec. 2, T. 1 S., R. 38 W.	8	Reported (method not stated)	
Atwood, sec. 5 T. 3 S., R. 33 W.	0.35	Reported by Weather Bureau	24 hours ending 6 p.m. May 31.
Rainfall at places east of Culbertson, Nebraska, chiefly on May 31.			
Nebraska			
Culbertson, sec. 17, T. 5 N., R. 31 W.	1.15		Beginning 4 p.m. May 31.
Trenton, sec. 35, T. 5 N., R. 33 W.	3.92	Measured in rain gage	10:15 p.m. May 31 to 4:30 a.m. June 1.
Do.	2.41	do	2:15 p.m. June 1 to 3:15 p.m. June 1.
Head of Red Willow Creek	7	Reported (method not stated)	
Curtis, sec. 23, T. 8 N., R. 23 W.	5.05	Reported by Weather Bureau	Night of May 30 to 5:30 May 31. (2.30 inches 4:30 to 5:30 p.m. May 31.)
Lebanon sec. 17, T. 1 E., R. 26 W.	.40	do	24 hours ending 6 p.m. May 31.
Orianna, sec. 15, T. 2 N., R. 19 W.	.46	do	Do.
Superior, sec. 26, T. 1 N., R. 7 W.	.95	do	3 a.m. to 6 a.m. chiefly, May 31.

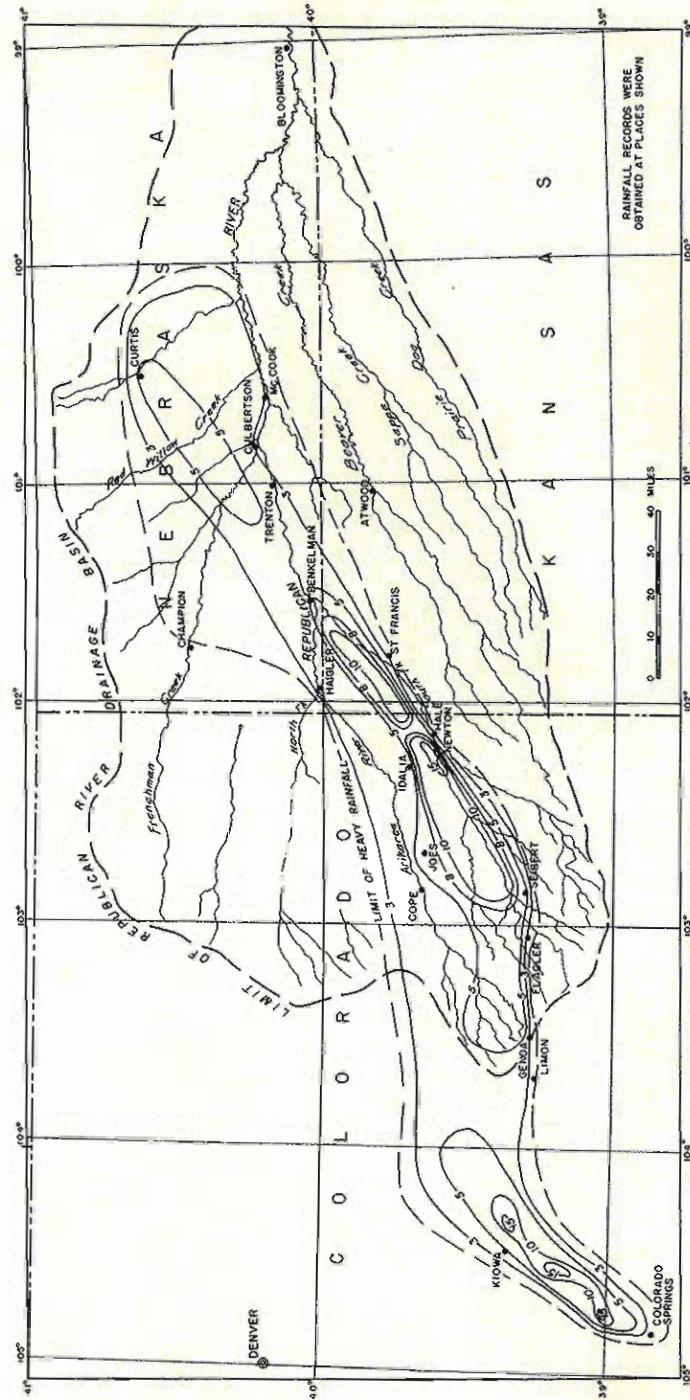


FIGURE 6--CLOUDBURST STORM IN UPPER PART OF REPUBLICAN RIVER DRAINAGE BASIN, MAY 30-31, 1935

There were four distinct areas of intensive precipitation in central and northeastern Kansas during the period May 26 to June 2. These areas were centered in the vicinities of Plainville, Enterprise, Valley Falls, and Mankato. The area covered by the storm that centered at Mankato included a part of the drainage basin of the Solomon River, a tributary of the Smoky Hill River from the west. At Beloit, Kans. (pl. 11, B), the Solomon River reached a stage of 34.5 feet (discharge 37,800 second-feet) at 12:30 a.m. June 3, the highest stage since the river measurement station at that place was established in 1929. This stage also was higher than any flood stage at Beloit reported by the United States Weather Bureau since observations at that place were begun in 1905. During the same period there were heavy rains in the upper Big Blue River Basin over a somewhat elliptical area with its major axis approximated by a line drawn through the cities of Hebron and Western, in southeastern Nebraska.

#### TOPOGRAPHY OF THE REPUBLICAN RIVER-KANSAS RIVER BASIN

The area drained by the Republican River and its tributaries in eastern Colorado, northwestern Kansas, and southern Nebraska is a part of the Great Plains and has for its characteristic topography smooth, flat surfaces traversed by broad, shallow valleys. In portions of the basin, particularly near Haigler, Nebr., cross drainage cutting deeply into the underlying rock has produced deep canyons bordered by precipitous walls. Trail Canyon, 4 miles east of Haigler, has a fall of 300 feet in less than 2 miles.<sup>1</sup> The northwestern part of the basin embraces a small portion of the vast sand-hill area of western Nebraska, which is a region of rounded sand dunes and sand ridges. Owing to the light rainfall in the upper part of the basin, the boundaries of that part are poorly defined. The general altitude decreases from 5,500 feet at the western edge to 1,500 feet at the Nebraska-Kansas line.

The Arikaree River, which rises near Limon, Colo., and throughout much of its course is an intermittent stream, unites with the North Fork of the Republican River at Haigler, Nebr., to form the Republican River. From this junction the Republican flows eastward to Benkelman, where it is joined by the South Fork. Its course is then generally eastward across southern Nebraska to a point 4 miles east of Superior, where it crosses the State line and continues in a southeasterly direction to Junction City,

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<sup>1</sup> Condra, G. E., Geology and water resources of the Republican River Valley and adjacent areas, Nebraska: U. S. Geol. Survey Water-Supply Paper 216, p. 8, 1907.

Kans. At Junction City the Smoky Hill River, from the west, unites with the Republican River to form the Kansas River, which flows in a general easterly direction 136.8 valley miles to the Missouri River at Kansas City.

The entire Republican-Kansas River Valley is well provided with tributary streams, and numerous tributaries join the main river, both from the north and from the south. Many of these tributaries are comparatively short, with a total fall of 200 to 300 feet, so that storm run-off is delivered quickly from them to the main stream.

The Republican River flows through a valley which, throughout most of its course, has a width of 2 to 3 miles, with bordering uplands rising 100 to 200 feet above the valley floor. The main valley and those of its principal tributaries are bordered by a definite system of terraces.

The topography of the Kansas River Valley, below Junction City is similar to that of the Republican River Valley except that the bordering uplands are lower and the river is somewhat meandering, with wide oxbows. The principal tributaries of the Republican-Kansas River system are listed in the following table:

Altitudes and distances in Republican-Kansas River Basin

(Figures in parentheses represent distances in river miles and the corresponding descent in feet per river mile. Other figures are for valley miles.)

Place	Altitude at low water (feet)	Distance (miles)		Descent (feet)	
		From Kansas City	From place to place	Total	Per mile
Arikaree River:					
Cope, Colo.	4,150	520	0 (0)		
North of Idalia, Colo.	3,600	489	31 (35)	550	17.7 (15.7)
Haigler, Nebr.	3,245	462	27 (28)	355	13.1 (12.7)
Republican River, Nebr.:					
Haigler	3,245	462	0 (0)		
Parks	3,090	451	11 (15)	155	14.1 (10.3)
Benkelman	2,955	439	12 (14)	135	11.2 (9.6)
South Fork of Republican River:					
Newton, Colo.	3,535	489	0 (0)		
St. Francis, Kans.	3,275	464	25 (25)	260	10.4 (10.4)
Benkelman, Nebr.	2,955	439	25 (27)	320	12.8 (11.9)
Republican River, Nebr.:					
Benkelman	2,955	439	0 (0)		
Max	2,890	431	8 (8)	65	8.1 (8.1)
Trenton	2,650	411	20 (24)	240	12.0 (10.0)
Culbertson	2,560	401	10 (10)	90	9.0 (9.0)
McCook	2,475	391	10 (14)	85	8.5 (6.1)
Cambridge	2,240	366	25 (29)	235	9.4 (8.1)
Arapahoe	2,140	352	14 (17)	100	7.1 (6.9)
Oxford	2,045	338	14 (19)	95	6.8 (5.0)
Alma	1,925	320	18 (32)	120	6.7 (3.8)
Bloomington	1,820	302	18 (25)	105	5.8 (4.2)
Red Cloud	1,670	274	28 (41)	150	5.4 (3.7)
Superior	1,535	249	25 (27)	135	5.4 (5.0)
Hardy	1,505	242	7 (8)	30	4.3 (3.8)

## Altitudes and distances in Republican-Kansas River Basin - Continued.

Place	Altitude at low water (feet)	Distance (miles)		Descent (feet)	
		From Kansas City	From place to place	Total	Per mile
<b>Republican River, Kans.:</b>					
Scandia	1,424	225.3	16.7	81	4.8
Concordia	1,338	207.3	18.0	86	4.8
Clay Center	1,160	170.3	37.0	178	4.8
Wakefield	1,120	156.8	13.5	40	3.0
Milford	1,096	150.0	6.8	24	3.5
Junction City (water plant)	1,056	138.7	11.3	40	3.6
Junction of Republican River and Smoky Hill River	1,047	136.8	1.9	9	4.7
<b>Kansas River and tribu- taries, Kans.:</b>					
Ogden	1,022	129.3	7.5	25	3.3
Manhattan	989	117.8	11.5	33	2.9
Big Blue River	986	116.3	1.5	4	2.7
Wamego	955	103.5	12.8	30	2.3
Vermillion River	941	97.9	5.6	14	2.5
Topeka	856	66.0	31.9	85	2.7
Soldier Creek	854	65.1	.9	2	2.2
Delaware River	824	50.5	14.6	30	2.1
Lecompton	823	50.0	.5	1	2.0
Lawrence	800	39.8	10.2	23	2.3
Wakarusa River	780	31.6	8.2	20	2.4
Stranger Creek	770	27.2	4.4	10	2.3
Bonner Springs	748	17.0	10.2	22	2.2
Junction of Kansas River and Missouri River	718	.0	17.0	30	1.8
<b>Smoky Hill River and tribu- taries, Kans.:</b>					
Ellsworth	1,507	251.8	0		
Lindsborg	1,298	207.8	44.0	209	4.8
Mentor	1,232	193.0	14.8	66	4.5
Salina	1,200	186.8	7.2	32	4.4
Saline River	1,175	180.4	5.4	25	4.6
Solomon River	1,140	172.6	7.8	35	4.6
Solomon	1,140	172.6	.1		
Abilene	1,128	164.0	8.5	12	1.4
Enterprise	1,100	158.4	5.6	28	5.0
Chapman	1,084	152.4	6.0	16	2.7
Junction City dam	1,055	139.1	13.3	29	2.2
Junction of Smoky Hill River and Republican River	1,047	136.8	2.3	8	3.5
<b>Solomon River, Kans.:</b>					
Beloit	1,339	230.6	.0		
Summerville	1,235	201.8	28.8	104	3.6
Minneapolis	1,216	196.1	5.7	19	3.3
Bennington	1,186	186.9	9.2	30	3.3
Niles	1,162	179.6	7.3	24	3.3
Junction of Solomon River and Smoky Hill River	1,140	172.6	7.0	22	3.1

## FLOOD DISCHARGES

## General features

The South Fork of the Republican River and to a lesser degree the Arikaree River were the principal sources of the flood. The first crest in the Arikaree originated near Haigler, Nebr., owing to the heavy rains in that vicinity, and was of short duration, although reaching a stage only 18 inches lower than that of the second crest. The discharge at Haigler was about 20,000 second-feet.

The main flood on the Arikaree River originated some distance west of Cope, Colo., where a heavy rain started at 6 p.m. May 30. The river started to rise shortly afterward and continued to rise slowly until about 3 a.m., then rose 4 inches in 15 minutes to its crest of about 6 feet. The discharge was 25,000 second-feet. At this time the water was  $1\frac{1}{2}$  feet deep in the main street of Cope, but by early forenoon the river was back in its banks.

Ten miles north of Idalia, Colo., the river rose to its crest of 9 feet about 7:30 a.m. and remained at that point for  $2\frac{1}{2}$  hours and then fell slowly. The crest discharge was later found to be 54,000 second-feet.

The heavy rain in the vicinity of Haigler, Nebr., caused the river to rise during the night to a stage of 10.2 feet, which was reached about 4:30 a.m. This stage was of short duration, and by 8 a.m. it had fallen 4 feet. At that time the flood from the upper river began to arrive, and by 11:30 a.m. the flood reached a stage of 11.8 feet, which was maintained for 3 hours. The fall was gradual from the crest discharge of 50,000 second-feet. Being on high ground, the town of Haigler suffered little damage. The railroad and highway bridges west of Haigler were destroyed, and the river cut a new channel 300 feet wide and several hundred feet long, eliminating a bend in the old channel.

At Parks, Nebr., the first rise started at 4:30 a.m. and reached its crest at 7 a.m. Two hours later the river started to fall and by 11 a.m. was back in its banks. At that time the second rise started, and by 1:30 p.m. the river had reached a higher crest than before. This high stage was maintained for several hours, and then the river fell slowly, and by the next day it was back in its banks. As Parks is on low ground, much of the town was flooded and considerable damage was done to buildings, some of them being moved from their foundations.

The South Fork of the Republican River and the Arikaree River both had two distinct flood crests several hours apart. On the South Fork the first crest was the larger of the two and coincided at Benkelman, Nebr., with the first crest coming from the Arikaree. The second crest on the Arikaree was somewhat larger than the first, and the two crests were distinguishable on the Republican River at Max, Nebr., 8 miles below the junction, but the second crest either flattened out or merged with the first some distance below that point.

At Benkelman heavy rain began about 9 p.m., and by 11 p.m. torrents of water from nearby hillsides were flowing over the highway at the lower edge of the town to a depth of 18 inches. At 3 a.m. the flood advance reached Benkelman, and by 5 a.m. the river bottoms were covered. The water continued to rise gradually until 9 a.m., when the crest stage of 10 feet was attained and the water almost reached the tracks of the Chicago, Burlington & Quincy Railroad at the railroad station. At this time the flood crest from the South Fork reached Benkelman and was the chief factor in flooding this vicinity during the time of the first crest from the Republican River above Benkelman. The flood from both streams remained at the crest stage about 4 hours and then started to fall. Within an hour, however, the second crest from the Republican River arrived, and the water rose to a new crest about 3:30 p.m., which was maintained until 5 p.m., when the river started to fall and receded slowly until the next morning it was back in its banks.

The Aristocrat, the fast train of the Burlington Route from Denver to Chicago, reached Benkelman just ahead of the flood and was marooned there for several weeks. Two days later, as soon as the highway was passable, the passengers were taken by motor cars to the Union Pacific Railroad at Ogalalla and sent on their eastward journey.

#### Progress of flood crests

The following tables, based on records at gaging stations and statements of local observers, show the approximate time of the crest and its rate of travel along the Arikaree, South Fork of Republican, and Republican Rivers. As McCook, about 50 miles below Benkelman, is on the dividing line between Mountain and Central standard time, all time reported locally has been referred to Central time.

Progress of flood crests on the Arikaree and Republican rivers  
above Benkelman, Nebr., May 31, 1936

(The distances are valley miles, which represent more closely than river  
miles the distances traveled by the flood crest.)

Point on river	Approximate time of crest (Central time)	Elapsed time (hours)	Distance (miles)	Rate of travel (miles per hour)	Crest discharge (sec.-ft.)
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First crest, which coincided with main flood on  
the South Fork of the Republican River

Arikaree at Haigler, Nebr.	4:30 a.m.				20,000
Republican at Parks, Nebr.	7 a.m.	2.5	11	4.4	
Republican above Benkelman, Nebr.	9 a.m.	2	12	6.0	

Second crest

Arikaree at Cope, Colo.	3:15 a.m.	0.0	0		25,000
Arikaree north of Idalia, Colo.	7:30 a.m.	4.25	31	7.3	54,000
Arikaree at Haigler, Nebr.	11:30 a.m.	4	27	6.8	50,000
Republican at Parks, Nebr.	1:30 p.m.	2	11	5.5	
Republican above Benkelman, Nebr.	3:30 p.m.	2	12	6.0	

Progress of flood crest on South Fork of Republican River and on Repub-  
lican River between Benkelman, Nebr., and Junction City, Kans.

(Distances are valley miles.)

Point on river	Approximate time of crest (Central time)	Elapsed time (hours)	Distance (miles)	Rate of travel (miles per hour)	Crest discharge (sec.-ft.)
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Newton, Colo.	May 31, 3 a.m.	0	0		
St. Francis, Kans.	4 a.m.	1	25	*	
Benkelman, Nebr.	9 a.m.	5	25	5.0	
Max	9:45 a.m.	.75	8	10.7	190,000
Trenton	Noon	2.25	20	8.9	
Culbertson	1:30 p.m.	1.5	10	6.7	
McCook	3:30 p.m.	2	10	5.5	245,000
Cambridge	8 p.m.	4.5	25	5.6	**
Oxford	June 1, 1 a.m.	5	28	5.6	
Bloomington	10:30 a.m.	9.5	36	3.8	260,000
Franklin	Noon	1.5	4	2.7	
Superior	June 2, 1 a.m.	13	49	3.8	
Hardy	2:30 a.m.	1.5	7	4.7	225,000
Scandia, Kans.	6 a.m.	3.5	16.7	4.8	215,000
Concordia	11:30 a.m.	5.5	18.0	3.3	
Clay Center	June 3, 2 a.m.	14.5	37.0	2.6	195,000
Wakefield	7 a.m.	5	13.5	2.7	
Milford	10 a.m.	3	6.8	2.3	
Junction City (water plant)	2 p.m.	4	11.3	2.8	168,000

\* Not comparable, as rainfall on intermediate areas increased the dis-  
charge.

\*\* The maximum crest discharge occurred between Cambridge and Arapahoe,  
and is estimated as about 280,000 second-feet.

† Above mouth of Smoky Hill River.



Progress of flood crest on Kansas River between Junction City and  
Kansas City, Kans., June 3-7, 1935

(Distances are valley miles.)

Point on river	Approximate time of crest (Central time)	Elapsed time (hours)	Distance (miles)	Rate of travel (miles per hour)	Crest discharge (sec.-ft.)
Junction City (Below Smoky Hill River)	June 3, 2 p.m.				179,000
Ogden Manhattan (Above Big Blue River)	June 3, 9:30 p.m.	7.5	7.5	1.0	170,000
(Below Big Blue River)	June 4, 5:30 a.m.	8.0	11.5	1.4	160,000
do	do				190,000
Wamego	June 4, 3:30 p.m.	10.0	14.3	1.4	177,000
Topeka	June 5, 2 p.m.	22.5	37.5	1.7	164,000
Bonner Springs	June 6, 8:10 p.m.	30.1	49.0	1.6	122,000
Kansas City	June 7, 5 a.m.	8.8	17.0	1.9	120,000

Note.- The flood peaks at Bonner Springs and at Kansas City were flat and of long duration; therefore it was difficult to determine the exact times of the momentary maxima at those places. The determination of the crest discharge at Kansas City is only approximate.

## Duration of flood crest

North of Seibert, Colo., the Republican River rose quickly to its peak about midnight May 30-31 and remained there for about an hour, then receded gradually.

Near Newton, Colo. (sec. 20, T. 5 S., R. 43 W.), the river started to rise at 10 p.m. May 30 and reached a stage of 11 feet at 3 a.m. May 31. It then fell 2 feet during the next 2 hours and was back in its banks at a stage of 3 feet in the evening. The overflowed area had a width of 4,700 feet, and the water was about 8 feet deep. Only one crest was reported.

Below Newton, two crests developed because of the heavy rainfall northeast of that point. Near the Kansas-Nebraska line south of Benkelman, Nebr., a rancher measured the rise and fall of the river by means of 8-inch concrete blocks in the foundation of his residence near the river. At 11 p.m., although there was a heavy rain, no sign of a flood appeared, but by 3 a.m. the river had risen 7 feet, and at 9 a.m. it reached its crest of 10 feet. It then fell 2 feet during the next hour and rose to a second crest of 9.5 feet at 1:15 p.m. This second crest, like the first, was of short duration, and the river fell to a stage of 7.5 feet by 3 p.m. A third rise of half a foot occurred within the next hour, after which the water receded very slowly to the bank-full stage of 6 feet. The width of the overflowed area was three-quarters of a mile.

At Max, Nebr., the river reached its crest of 11.8 feet about 9:45 a.m. and then fell to a stage of 8.8 feet by 11 a.m. It reached a second

crest of 11.2 feet at 2 p.m. This rise was of short duration, and the river again fell, reaching a stage of 8.6 feet by 4 p.m. and then falling more slowly until it was back in its banks within a few hours. The width of the overflowed area was 4,000 feet.

The flood reached Trenton, Nebr., at 5 a.m., May 30, and 3 hours later it had spread out over the bottom lands for a width of three-quarters of a mile. It continued to rise until 1 p.m., when it had backed up to the town, and then receded slowly. About 3 p.m. a heavy rain from the northwest filled the ravines and creeks in the vicinity, and these added to the flood conditions caused by the Republican River.

The Culbertson Progress reported that at the time the crest arrived at Culbertson Frenchman and Blackwood Creeks were overflowing their valleys and that the water of Frenchman Creek was over the tracks at the railroad bridge. The valley was overflowed for a width of 2 miles (pl. 11, C). The flood conditions at Cambridge, Nebr., about 35 miles below Culbertson, on June 1 are shown by plate 12, A.

At Bloomington, Nebr., the river rose from a stage of 7.5 feet at 6 p.m. May 31 to the crest of 20.4 feet at 10:30 June 1 and then fell half a foot in the next 4 hours. Subsequently the fall was more rapid, the river receding to a stage of 13 feet at 8 a.m. June 2 and to 10.2 feet 24 hours later. The width of the overflowed area was  $1\frac{1}{2}$  miles. Plate 12, B, shows the water at the highway bridge at Red Cloud, about 25 miles below Bloomington, on June 2.

The duration of the flood at Hardy, Nebr., is shown by the hydrograph obtained by the water-stage recorder at the gaging station, here reproduced (pl. 13). This hydrograph shows that a crest stage of 19.4 feet was reached at 2:30 a.m. June 2.

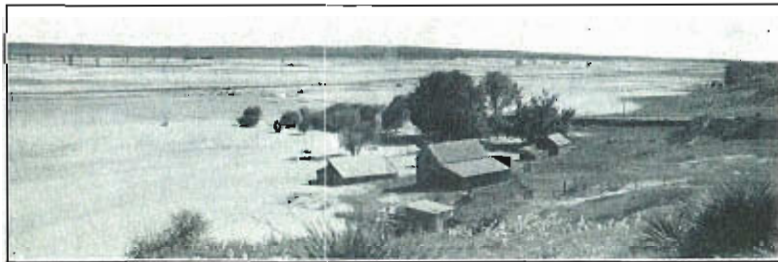
The flood crest reached Scandia, Kans., about 6 a.m. June 2, with a maximum stage of 17.8 feet. About an hour later the stage dropped about 1 foot, as noted by eyewitnesses, and after that time the recession was more gradual until at 4 p.m. the gage height was about 14.2 feet, which was the same as the high-water mark of the 1916 flood. The high water at Scandia during the afternoon of June 2 is shown in plate 14, A. The crest of the flood reached Wakefield, Kans., at about 7 a.m., June 3. Plate 14, B, shows the flood stage about  $1\frac{1}{2}$  hours later. The accompanying diagrams (pl. 13) show the progress and duration of the flood crest at gaging stations on the Republican, Kansas, and Big Blue Rivers in Kansas.



A. KANSAS RIVER AT TOPEKA, KANS., JUNE 5, 1935.



B. SOLOMON RIVER AT BELOIT, KANS., JUNE 3, 1935.



C. REPUBLICAN RIVER WEST OF CULBERTSON, NEBR., JUNE 11, 1935.



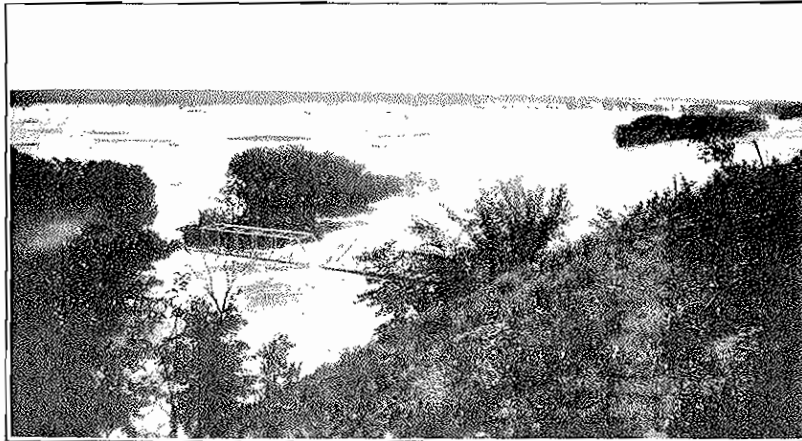
A. REPUBLICAN RIVER AT CAMBRIDGE, NEBR., JUNE 1, 1935.



B. REPUBLICAN RIVER AT RED CLOUD NEBR., JUNE 2, 1935.



A. REPUBLICAN RIVER AT SCANDIA, KANS., JUNE 3, 1935.



B. REPUBLICAN RIVER AT WAKEFIELD, KANS., JUNE 3, 1935.

## Crest discharge

In the upper valley the flood occurred during the night and came with little or no warning, so there was no opportunity to collect specific information regarding flood discharge until the area could be visited and surveys made of high-water marks and channel areas. From field surveys made soon after the flood, using well-defined high-water marks with measurements of slopes and overflow areas and observations of channel conditions that would assist in the selection of proper values of "n", determinations were made of the probable crest discharge at several places in the upper valley.

In the lower valley there were greater opportunities for obtaining field data while the flood was in progress, so that at gaging stations on the Republican River at Scandia and Clay Center, Kans., and on the Kansas River at Wamego and Topeka, Kans., determinations of velocity were made with current meters. Although current-meter measurements were not made at crest stages, the measurements that were obtained proved to be of great assistance in providing data for extension of rating curves, especially for the station on the Kansas River at Topeka (pl. 11, A), where a current-meter measurement was made at a stage of 26.2 feet (discharge 145,000 second-feet).

From data obtained at the river-measurement stations and at other places on the Republican and Kansas Rivers and their tributaries, the progress of the flood can be followed along the river, and an analysis can be made of the development of the crest discharge at the headwaters and the decrease in discharge as the crest moved down the valley from Newton, Colo., to Bonner Springs, Kans., a distance of 531 valley miles.

Starting near Seibert, Colo., where four small creeks unite to form the South Fork of the Republican River, the flow rapidly increased to 103,000 second-feet near Newton, Colo., and to 150,000 second-feet at the Kansas-Nebraska line, 4 miles above the confluence with the Republican River at Benkelman, Nebr. With the addition of the smaller of the two crests from the Republican River, which coincided with the major crest in the South Fork, the flow at the Max gaging station, 8 miles below their confluence, was increased to 190,000 second-feet.

Sweeping onward, the crest was increased by the run-off from the heavy rains of the preceding 24 hours, which swelled the numerous ravines and larger tributaries, and by the time it reached McCook, Nebr., the discharge was 245,000 second-feet. East of McCook the heavy rains had brought to flood stage Red Willow and Medicine Creeks and the numerous ravines, which

further increased the crest discharge to an estimated maximum of 280,000 second-feet between Cambridge and Arapahoe.

Down to this point the effect of overflow storage in reducing the crest discharge was lost by the increase in discharge from the tributary streams, but after the flood crest passed out of the area of heavy rainfall the tributaries entering farther down did not bring in sufficient water to offset the effect of storage, which was provided by an average overflow width of about  $1\frac{1}{2}$  miles and depths of overflow ranging from 7 to 10 feet. This effect was shown by the decrease in the crest flow to 260,000 second-feet at Bloomington and to 225,000 second-feet at Hardy. Although heavy rains had occurred northwest of Superior during the night of May 31, the peak of the run-off from those rains had disappeared before the arrival of the crest moving down the Republican River. A summary showing crest discharge at river-measurement stations and at other points where determinations of crest discharge were made is given in the accompanying table.

As might be expected, the greatest discharge per square mile occurred in the area of heaviest precipitation, in the vicinity of Newton, Colo. The rainfall was not excessive west of a north-south line through Seibert, Colo., and to determine the run-off from the drainage area of 669 square miles between that line and Newton it is only necessary to deduct from the 103,000 second-feet at Newton the discharge passing the north-south line through Seibert. Although this discharge was not measured, an inspection of the channels of the South Fork of the Republican River and Hell Creek, a tributary entering below, indicates that the combined flow passing the north-south line did not exceed 20,000 second-feet. Thus the maximum run-off from the area between Seibert and Newton was about 83,000 second-feet, or 124 second-feet per square mile.

Crest discharge of the flood of May-June 1935 at points along the valley of the Republican and Kansas Rivers.

Place	Drainage area (square miles)	Crest discharge (second-feet)	
		Total	Per square mile
<b>Arikaree River:</b>			
Cope, Colo.	890	25,000	36.2
North of Idalia, Colo.	1,190	54,000	45.4
Haiglen, Nebr.	1,600	50,000	31.2
<b>South Fork of Republican River:</b>			
Newton, Colo.	1,270	103,000	81.1
Kansas-Nebraska line	2,550	160,000	58.8
<b>Republican River:</b>			
Max, Nebr.	7,740	190,000	*32.5
McCook	12,000	245,000	**24.0
Cambridge (below Medicine Creek)	14,200	280,000	†22.8
Bloomington	20,900	260,000	12.4
Hardy	22,410	225,000	10.0
Scandia, Kans.	22,930	215,000	9.4
Clay Center	24,570	195,000	7.9
Junction City (above Smoky Hill River)	24,960	168,000	6.7
<b>Kansas River:</b>			
Junction City (below Smoky Hill River)	44,910	179,000	4.0
Ogden	45,240	170,000	3.8
<b>Manhattan:</b>			
Above Big Blue River	45,470	160,000	3.5
Below Big Blue River	55,070	190,000	3.4
Wamego	55,240	177,000	3.2
Topeka	56,710	154,000	2.7
Lecompton	58,420	144,000	2.5
Bonner Springs	59,990	122,000	2.0
Kansas City	60,060	120,000	2.0

\* The net area contributing to the flood and used in computing discharge per square mile at Max, Nebr., was 6,840 square miles.

\*\* The net area contributing to the flood and used in computing discharge per square mile at McCook, Nebr., was 10,200 square miles.

† The net area contributing to the flood and used in computing discharge per square mile at Cambridge, Nebr., was 12,300 square miles.



## LOSS OF LIFE AND DAMAGE TO PROPERTY

In the upper valley the flood, coming at night with little or no warning, caused the loss of 40 lives. The progress of the flood was accompanied by a roar that could be heard for miles. One of the best accounts of its approach was given by J. H. Mullison, manager of the Southern Nebraska Power Co., who was observing the approach of the flood from high ground near Bostwick, Nebr. While the flood was still several miles distant, he heard its roar, and when it appeared the advance was a mass of tumbling water and debris several feet in height, quickly filling the main channel, which at the point of observation was about 7 feet deep. Spreading out behind the advancing waves the flood quickly overflowed the bottom lands, giving the effect of an oncoming spearhead. Within a very short time the great quantity of tumbling debris blotted out the sight of the water itself. The flood made short work of bends and elbows in the old channel, taking the shortest course, which resulted in the formation of many new out-off channels.

Below Trenton, Nebr., the rate of advance, which gradually decreased from 7 to 4 miles an hour, gave ample time for the escape of the dwellers in the lowlands, but many of them, not realizing the unprecedented height of the flood, could not believe that their homes were endangered and refused to heed the warnings. The flood rose quickly after its arrival and in many places cut off escape, resulting in an additional death list of 60 persons. Others escaped by the narrowest margin. In this stretch the greatest loss occurred in the vicinity of Oxford, where the flood occurred during the night and surprised dwellers in the lowland who were asleep. At points farther downstream, where the flood occurred during the daylight hours, loss of life was due to delay in seeking safety while trying to save livestock and personal property.

Near Benkelman, Nebr., a family of eight living on the river bottom was caught in the night and retreated to the attic. All were drowned when a further rise undermined the house and caused its collapse.

On the Republican River above Benkelman two people drifted for a distance of 8 miles on the roof of their house, and by the time it grounded on an island the area of their raft was reduced to less than a quarter of its original size through striking floating trees and wreckage.

In the vicinity of Max, Nebr., a family trapped in their home came safely through the flood because the builder of the house many years previously had visualized a possible flood of this magnitude and had reinforced

the walls of the frame structure and anchored it to the concrete foundation by dozens of bolts. It withstood the flood safely.

Near Culbertson, Nebr., a family of six lost their lives when their home was swept from its foundation and carried away. It crashed against a tree some distance downstream and was destroyed. The house of another family in the same region was grounded after traveling a short distance and withstood the remainder of the flood. As an onlooker expressed it, "The next morning searchers saw the family outside the house drying clothing and cleaning mud from their home."

Trees lining the river banks prevented the loss of many lives. Near Culbertson a family of 12 fleeing from the flood were trapped close to a large cottonwood, and by climbing among its branches all were saved. Similar deliverances occurred throughout the flood area. In several localities those marooned in trees reported that snakes, rats, and other animals sought similar refuge, and it was a battle not only to keep out of the water but also to keep the animals at a distance.

At McCook, the largest city in the Nebraska portion of the valley, the flood submerged the electric-light plant located near the river bank some distance from the city and put the water system out of commission. The city itself, being chiefly on high ground, was submerged only to a very small extent.

Cambridge, being in the region of the maximum discharge and lying at no great distance above the river, suffered a heavy loss. The local newspaper described the flood as follows:

The Republican rose so fast between 6 and 8 p.m. (May 31) that it was impossible for many to get away from their homes. It was about 2 o'clock in the afternoon that Medicine Creek was nearing its highest point, and people who have lived there since the '70's claim it was a record height.

In the morning we had watched a flood sweep down Medicine Creek and then through our park. Then while we were watching this, the Republican on the south went to a record height. All afternoon the flood gradually subsided. Suddenly an awfully black cloud came up in the south and swept around to the west. At supper time the river rose to a record height. It rolled in in 15 minutes.

Saturday morning (June 1) at 3 a.m. the creek started to rise and the water came up higher than during the day. It did not remain up long and subsided. Also, the river started to lower.

Three-fourths of the homes in Cambridge were affected by the Medicine Creek and Republican River floods. Between the railroad track and the river 70 homes were seriously damaged, and 76 people were rescued from the submerged houses by means of boats. Only 20 houses remained on their foundations.

In the Oxford section the local newspaper had the following account:

Dwellers on the lowlands were warned of their danger, and in some cases trucks were waiting to take them to higher ground, but they had lived there so long and seen so-called high water so many times without trouble that all warnings and proffered help were rejected, with perilous results.

When the houses began to fill up and were finally toppled over by the force of the swift current, shrieks for help could be heard, but shrouded by darkness, nothing could be seen. As daylight broke, those on shore had been pushed back by the ever-rising waters until the scene of the disaster was invisible except by the aid of field glasses, and all sounds were hushed by the roar of the raging river.

Taking in the 5-mile stretch west of Oxford, two families suffered the heaviest fatalities. According to the survivors, as the water rose in the houses, the inmates "clumb up into the attic, kicked a hole in the roof, and climbed outside." Presently the houses began to float but only went a short distance before the bottoms struck trees or other objects and began to roll. Their human loads were thus dumped off into the swirling waters. Sometimes they would be successful in grabbing some objects, only to be brushed off like flies by floating debris. Thus it was a continuous fight until overcome by sheer exhaustion, rendering them an easy prey for the angry water.

The foregoing are only a few of the many incidents related by the local papers but are sufficient to give a picture of human conditions in the flood area. The refusal of many farmers to heed the warnings and the sudden rise when the flood finally appeared caused a large loss of livestock, and after the flood the stranded carcasses presented a serious health problem. This was especially acute in the vicinity of Bartley, Nebr., where a bend of the river lined with large trees caught many animals. In addition, the great amount of debris lodged at that point contained many live rattlesnakes, presumably brought down from the headwaters. The local newspaper reported that on the day after the flood 40 rattlesnakes were killed in the vicinity.

The main line of the Burlington Route to Denver, from Chicago and St. Louis traverses the Republican River Valley from Superior, near the Kansas line, to Haigler, near the Colorado line. The track, which was laid in 1880, is in the valley only a few feet above the river. The flood washed out 41.5 miles of roadbed and made many more miles impassable because ballast and fills were washed away. Ten permanent bridges were either destroyed or damaged. So great was the force of the current that in many places the track was twisted like wire, and long sections of rails with ties attached were turned up until they rested on the ends of the ties, presenting the appearance of a picket fence. The line was out of commission from May 31 to June 23, when service was resumed by means of temporary tracks in the areas where the damage was the greatest. The loss to the railroad company chargeable directly to the flood in the Republican River Valley was estimated at \$1,500,000.

The following tables showing losses are based on investigations made by the Missouri River division of the Corps of Engineers, United States Army, the State engineer of Nebraska, the division of water resources of the Kansas State Board of Agriculture, and Colorado State and county officials:

## Summary of losses in Colorado and Nebraska

	Colorado	Nebraska
Lives lost.....	6	94
Livestock lost.....	300	8,100
Poultry lost.....	*	46,500
Highways damaged.....miles..	†5	341
Highway bridges damaged.....	‡6	307
Crops damaged.....acres..	**	42,000
Farm land damaged.....do....	15,000	57,000
Total value of property loss.....	††\$790,000	‡‡\$7,532,000

\* No record.

† Estimated.

‡ Does not include county bridges.

\*\* Area damaged in Colorado was chiefly hay land and is included under farm land damaged.

†† Includes damage to county bridges and roads.

‡‡ Includes \$1,500,000 loss of Burlington Railroad directly chargeable to the flood, a small part of which occurred in Colorado.

## Summary of losses in Kansas

Lives lost.....	10
Livestock lost.....	12,193
Homes flooded.....	1,485
Buildings flooded, other than homes.....	1,552
Fence washed out.....miles..	1,549
Crops damaged or destroyed.....acres..	221,507
Farm land damaged.....do....	202,615
Highway damaged.....miles..	494
Highway bridges damaged or destroyed.....	202
Railroads damaged.....miles..	171
Railroad bridges damaged or destroyed.....	83
Levees and flood protection works damaged or destroyed.....	42

The summary for Kansas shows totals as compiled from individual reports for the following counties: Geary, Clay, Washington, Cloud, Republic, Jewell, Cheyenne, Wyandotte, Johnson, Leavenworth, Douglas, Jefferson, Shawnee, Pottawatomie, Wabaunsee, Riley, Dickinson, Saline, Ellsworth, Ottawa, Lincoln, Russell; also miscellaneous items from Brown, Newark, Marshall, Atchison, Thayer, Gage, Graham, Osborne, Rocks, and Mitchell Counties.

As a result of the great loss of livestock the carcasses of horses, cattle, and hogs were packed in the driftwood, laying on sand bars, and drifted in the current of the river. This menace to health required immediate attention, and to augment the efforts of the local citizens in destroying the dead animals, the Federal Government established C.C.C. camps containing 1,000 men and F.E.R.A. camps containing 600 men. When this work was completed, attention for several weeks was given to clearing the land of wrecked buildings, driftwood, and other debris and making emergency

repairs to public works. For this work Federal funds amounting to \$434,000 were made available in Nebraska, and \$5,922 in Cheyenne County, Kans.

#### DAILY DISCHARGE AT GAGING STATIONS

The Geological Survey, in cooperation with the State Engineer of Nebraska and the State Board of Agriculture of Kansas, maintains gaging stations on the Republican and Kansas Rivers and tributaries in the two States. (See pl. 15.) The stations on the Arikaree River at Haigler, Nebr., and on the Republican River at Max and at Culbertson, Nebr., were destroyed by the flood, but from available information, including crest discharge as determined from slope measurements and estimates based on data obtained after the flood, the hydrographs for Culbertson, Max, and Haigler were computed and used in determining the mean daily discharges. At the other stations records of gage heights during the flood period were obtained; the observer at the Bloomington station was unable to read the gage during the highest stages, but these were determined later from high-water marks and the time from the observer's notes. The station at Hardy is equipped with a water-stage recorder, from which a continuous gage-height record was obtained. The gage at Scandia, Kans., was attached to the bridge over the Republican River; this bridge was destroyed by the flood at about 5:30 a.m. June 2, but from information furnished by local residents it was possible to construct a fairly accurate hydrograph for the flood period (see pl. 13), and to estimate the discharge until a temporary gage was installed on June 11. Good records were obtained at gaging stations on the Kansas River and tributaries.

The mean daily discharge for the months of May and June for 32 stations in the Republican-Kansas River Basin is given in the following tables. Descriptions of these stations may be found in Water-Supply Papers 761 and 786 and other water-supply papers of the Geological Survey containing stream-flow records for the Missouri River Basin. Information regarding maximum discharges at stations on the Republican River and Kansas River during the flood of May and June 1935 is given elsewhere in this report.

Discharge, in second-feet, at stations in Republican-Kansas River Basin,  
May and June 1935

Day	Arikaree River at Haigler, Nebr.		Republican River at Max, Nebr.		Republican River at Culbertson, Nebr.		Republican River at Bloomington, Nebr.	
	May	June	May	June	May	June	May	June
1	29	5,000	137	22,000	171	25,000	450	116,000
2	28	4,000	142	8,000	165	11,000	466	47,000
3	26	2,000	118	3,800	160	5,500	364	17,700
4	32	800	100	2,500	134	3,800	303	9,300
5	30	400	95	2,100	130	2,600	310	3,420
6	26	289	87	1,600	138	2,700	286	2,610
7	21	275	78	1,200	134	2,000	286	2,730
8	22	266	87	1,000	160	1,600	272	2,580
9	23	232	95	860	126	1,400	275	1,660
10	18	228	87	790	114	1,200	242	1,840
11	19	224	74	700	114	850	266	1,910
12	23	911	78	800	114	1,100	2,930	1,660
13	17	470	70	650	100	1,000	1,480	1,720
14	17	322	82	640	90	980	772	1,540
15	24	192	100	700	126	900	418	3,300
16	28	188	104	5,000	138	7,000	369	2,200
17	33	383	109	12,000	146	13,000	472	4,380
18	44	208	137	3,200	171	4,000	654	14,000
19	70	115	244	1,500	285	2,000	1,170	8,600
20	63	112	327	1,800	409	2,300	2,150	5,010
21	40	118	318	1,550	409	1,950	2,970	4,060
22	40	78	291	1,300	548	1,700	1,660	5,410
23	33	73	238	1,050	505	1,400	1,350	4,090
24	40	73	190	910	345	1,100	1,170	2,740
25	150	60	180	820	305	880	1,040	2,820
26	38	357	250	774	315	760	911	1,930
27	35	112	300	417	225	565	1,020	1,680
28	485	173	8,740	1,110	8,000	2,350	2,550	3,210
29	37	80	8,500	530	7,800	1,540	10,400	2,750
30	3,500	232	11,000	976	11,000	2,910	8,230	2,530
31	17,000		85,000		90,000		15,900	
Mean	709	699	3,786	2,676	3,954	3,503	1,972	9,343

Day	Republican River near Hardy, Nebr.		Republican River at Soandia, Kans.		Republican River at Clay Center, Kans.		Kansas River at Ogden, Kans.	
	May	June	May	June	May	June	May	June
1	598	12,000	642	15,500	466	13,500	832	21,900
2	490	117,000	580	115,000	652	20,600	735	30,600
3	456	45,100	480	56,200	610	103,000	900	54,300
4	456	12,600	520	20,000	550	37,500	936	96,200
5	425	7,980	435	9,000	490	22,000	832	56,700
6	420	6,170	435	6,000	486	16,000	800	44,000
7	410	6,000	435	3,500	458	9,980	702	32,900
8	395	4,050	405	2,500	434	4,550	702	23,900
9	360	3,390	335	2,300	414	2,400	640	21,500
10	345	2,850	393	2,250	402	2,300	556	21,100
11	350	2,350	359	2,240	390	2,250	610	21,900
12	302	1,950	383	1,980	398	2,200	582	21,900
13	728	1,870	409	2,120	630	2,150	582	16,100
14	2,180	1,780	1,980	1,770	550	2,100	800	8,400
15	1,240	1,660	1,540	1,880	470	2,100	1,080	6,780
16	744	3,260	875	2,760	1,380	2,200	832	6,250
17	562	3,990	700	4,270	1,130	2,290	1,240	6,070
18	562	5,100	632	6,130	780	3,810	1,840	10,200
19	1,000	13,200	875	15,000	835	3,810	2,600	11,200
20	3,540	11,000	4,730	15,000	2,360	7,360	4,520	11,700
21	2,180	7,820	2,770	7,050	7,730	18,300	7,750	16,400
22	3,910	5,550	4,040	6,590	4,520	11,500	11,400	24,700
23	2,430	6,540	2,360	5,320	3,120	7,120	10,400	17,800
24	1,870	5,310	1,640	4,950	3,330	5,580	10,400	16,400
25	1,450	3,620	1,360	3,490	2,020	4,960	11,700	16,400
26	1,270	3,050	1,100	2,900	1,620	3,990	11,200	17,100
27	1,320	3,390	1,360	3,040	1,350	2,770	10,900	16,400
28	4,260	5,270	11,100	7,050	2,180	6,020	26,700	18,100
29	3,200	5,030	7,750	7,060	6,230	8,960	16,800	20,800
30	8,790	3,980	10,700	4,270	10,430	8,270	17,800	22,300
31	9,780		12,700		10,810		19,600	
Mean	1,807	10,390	2,388	11,200	2,169	11,320	6,709	23,670

Discharge, in second-feet, at stations in Republican-Kansas River Basin,  
May and June 1935 - Continued

Day	Kansas River at Wamego, Kans.		Kansas River at Topska, Kans.		Kansas River at Bonner Springs, Kans.		North Fork of Repub- lican River at Colo- nebr. State line	
	May	June	May	June	May	June	May	June
1	4,370	33,900	3,530	50,900	1,150	63,600	46	275
2	3,890	44,700	4,090	42,900	2,080	77,700	19	168
3	3,060	60,400	3,690	50,200	5,230	77,700	14	149
4	2,490	140,000	2,910	66,800	4,660	77,700	21	119
5	2,210	129,000	2,400	141,000	3,700	76,800	42	110
6	1,930	82,800	2,200	116,000	3,020	117,000	40	98
7	1,670	81,900	1,880	61,100	2,750	101,000	56	92
8	1,350	35,200	1,760	41,000	2,410	60,600	14	90
9	1,240	27,200	1,540	31,200	2,660	42,200	14	88
10	1,070	24,600	1,390	27,000	3,400	33,000	14	76
11	1,150	24,200	1,340	25,400	3,120	47,200	14	72
12	1,030	26,800	1,390	26,000	2,660	44,000	14	168
13	1,860	25,500	1,300	27,700	5,230	36,400	16	135
14	6,030	14,700	2,470	21,600	5,810	33,000	18	86
15	4,180	11,400	6,480	14,100	7,980	20,900	47	59
16	2,880	9,470	4,520	11,600	9,080	16,400	25	63
17	2,490	8,930	3,210	10,200	8,250	12,800	30	86
18	2,800	12,300	3,060	10,400	8,820	11,500	40	67
19	3,420	17,100	4,340	15,400	24,000	15,800	65	56
20	5,070	19,400	7,500	19,800	28,400	22,200	110	58
21	16,200	19,100	10,200	19,500	24,600	21,800	102	61
22	26,100	30,800	21,900	24,100	23,100	21,300	84	47
23	27,900	25,600	27,000	29,400	35,200	27,800	82	58
24	18,400	20,900	23,200	21,900	30,900	27,600	74	42
25	16,200	19,400	16,200	20,400	24,000	21,800	72	25
26	15,600	20,500	16,200	20,700	17,900	19,100	62	42
27	15,600	19,800	17,100	20,700	18,700	20,900	58	88
28	27,000	20,500	51,600	21,300	67,600	22,200	108	47
29	30,300	28,500	40,100	25,100	95,600	24,000	90	46
30	29,200	29,000	24,800	27,700	71,600	27,800	86	32
31	33,400		50,900		41,600		266	
Mean	9,874	34,450	10,970	34,670	18,860	40,700	55.7	86.8

Day	Frenchman Creek near Champion, Nebr.		Frenchman Creek below Champion, Nebr.		Frenchman Creek near Hamlet, Nebr.		Frenchman Creek at Culbertson, Nebr.	
	May	June	May	June	May	June	May	June
1	16	123	42	129	97	1,020	92	2,080
2	17	71	29	81	98	442	93	1,160
3	17	52	37	56	101	256	89	630
4	18	50	31	58	104	203	84	453
5	18	40	27	56	96	179	74	410
6	20	9	31	36	94	164	76	356
7	20	16	37	35	99	144	64	338
8	18	21	22	35	88	144	57	314
9	20	18	30	27	94	140	53	298
10	20	18	24	44	95	135	44	284
11	18	16	24	38	92	126	42	266
12	18	28	24	50	90	124	44	253
13	21	50	32	61	90	127	42	254
14	24	38	32	53	96	125	53	254
15	26	32	33	49	93	126	62	253
16	24	32	37	42	99	153	79	436
17	26	57	31	68	99	132	94	380
18	32	52	50	75	110	125	106	368
19	42	39	57	46	119	122	162	282
20	42	45	56	61	126	128	170	258
21	57	44	55	49	132	121	182	260
22	60	44	54	45	145	118	196	235
23	56	44	62	49	134	120	198	224
24	52	44	61	66	136	117	194	220
25	51	44	46	54	132	116	182	221
26	42	44	45	47	131	116	177	210
27	26	32	70	48	178	118	183	210
28	232	27	371	36	1,120	112	4,920	207
29	112	32	81	35	310	112	2,080	210
30	46	33	68	34	354	104	780	211
31	121		220		927		5,500	
Mean	42.3	39.9	58.7	51.8	183	176	522	394

Discharge, in second-feet, at stations in Republican-Kansas River Basin,  
May and June 1935 - Continued

Day	Smoky Hill River at Ellsworth, Kans.		Smoky Hill River at Lindsborg, Kans.		Smoky Hill River at Enterprise, Kans.		Saline River near Wilson, Kans.	
	May	June	May	June	May	June	May	June
1	32	1,700	34	2,080	252	11,100	19	3,880
2	27	2,340	49	2,120	194	12,800	18	8,460
3	24	7,070	30	3,030	190	13,300	15	3,000
4	23	3,260	60	4,070	204	12,800	14	1,380
5	21	1,610	19	5,270	166	12,900	14	784
6	18	1,100	46	2,260	163	13,600	14	1,250
7	19	1,300	8	1,230	166	14,300	12	556
8	19	794	30	1,000	124	16,900	12	388
9	16	547	10	933	122	19,900	12	325
10	16	453	44	707	122	18,600	10	302
11	453	393	26	654	122	11,900	23	292
12	163	339	26	637	122	5,800	53	298
13	393	365	234	588	412	3,780	295	585
14	1,560	7,990	166	588	293	3,310	1,660	375
15	1,430	4,000	1,080	3,580	250	3,080	630	241
16	2,130	1,700	957	5,180	350	3,660	675	204
17	1,440	1,840	1,610	2,420	670	5,730	470	268
18	1,930	6,960	1,380	1,860	1,890	7,000	691	1,900
19	4,000	10,500	2,650	4,400	3,090	7,000	2,900	3,830
20	4,980	4,980	4,070	5,720	3,840	6,290	2,840	1,380
21	8,350	3,140	3,900	6,810	4,710	7,750	2,640	615
22	4,990	2,610	4,700	5,140	6,880	9,250	1,000	401
23	2,560	1,480	6,220	2,650	8,660	9,920	615	310
24	1,260	1,100	2,840	1,740	9,400	11,500	470	251
25	908	908	1,230	933	10,000	12,900	375	840
26	683	3,080	886	1,610	9,550	14,200	268	7,860
27	757	4,480	725	3,580	6,430	12,200	2,200	3,830
28	2,720	10,400	3,210	3,030	10,100	11,600	3,060	2,950
29	1,640	4,720	5,220	5,450	9,550	11,800	3,340	5,630
30	3,200	5,520	2,330	7,000	9,700	10,900	1,030	5,600
31	1,880		3,740		9,860		939	
Mean	1,543	3,223	1,533	2,876	3,466	10,630	849	1,863

Day	Saline River at Tescott, Kans.		Solomon River at Beloit, Kans.		Solomon River at Miles, Kans.		Big Blue River at Barnston, Nebr.	
	May	June	May	June	May	June	May	June
1	44	4,020	33	10,800	59	5,720	1,800	8,630
2	36	2,560	3	26,200	77	6,840	1,140	9,630
3	30	5,590	10	29,400	85	8,120	869	9,080
4	24	6,630	28	14,200	81	9,300	702	7,350
5	20	6,410	3	3,260	94	14,300	508	4,710
6	9	5,830	18	1,280	59	24,200	334	5,320
7	22	1,960	4	852	53	28,900	224	4,870
8	18	990	5	788	50	23,200	182	3,300
9	19	626	25	575	45	8,050	165	2,190
10	19	324	2	429	41	2,290	119	2,000
11	5	270	2	555	56	1,920	151	4,180
12	158	229	7	1,330	355	1,780	440	2,370
13	59	213	18	1,600	104	1,890	720	1,310
14	79	229	63	1,660	75	1,740	836	919
15	425	333	394	874	61	2,330	706	625
16	1,180	297	237	519	56	2,840	917	516
17	597	253	67	1,310	55	2,520	800	658
18	311	601	273	4,480	277	2,520	663	2,990
19	1,380	903	1,140	12,300	622	3,520	751	2,420
20	2,440	1,430	5,050	11,400	468	4,200	5,320	2,420
21	2,850	2,680	6,380	3,190	2,180	5,210	4,850	3,870
22	3,870	3,400	3,980	1,880	4,670	6,410	3,360	5,000
23	3,760	1,100	1,440	1,580	5,010	8,010	2,420	3,660
24	1,930	333	805	964	5,310	9,300	2,710	3,400
25	205	353	552	962	3,090	8,580	2,450	2,160
26	28	972	439	2,140	929	5,630	1,900	1,770
27	2,220	2,160	1,080	3,520	1,160	4,430	2,270	1,720
28	3,570	3,610	3,790	4,150	1,820	4,240	4,790	1,800
29	3,570	6,220	7,990	4,570	1,920	5,570	5,710	1,800
30	3,840	6,520	9,000	3,480	3,440	6,680	5,620	2,180
31	4,160		4,110		4,860		4,100	
Mean	1,180	2,234	1,514	4,976	1,199	7,374	1,856	3,362



Discharge, in second-feet, at stations in Republican-Kansas River Basin,  
May and June 1938 - Continued

Day	Big Blue River at Hull, Kans.		Big Blue River at Randolph, Kans.		Little Blue River near Endicott, Nebr.		Little Blue River at Waterville, Kans.	
	May	June	May	June	May	June	May	June
	1	2,060	12,300	3,800	16,800	288	6,760	461
2	1,280	14,800	2,660	27,600	250	7,060	365	21,400
3	900	13,200	1,790	34,100	228	3,920	320	20,000
4	660	10,800	1,400	32,600	214	3,520	278	10,200
5	440	6,480	1,110	22,600	204	2,650	252	7,100
6	310	6,110	958	11,700	192	2,510	240	5,360
7	280	5,480	740	11,300	185	1,970	240	3,940
8	248	3,540	605	8,970	176	964	228	2,420
9	208	2,280	551	6,320	168	770	217	1,540
10	252	1,940	495	4,740	176	638	206	1,560
11	222	4,280	477	4,320	1,160	588	196	2,000
12	1,680	2,340	965	7,390	1,780	884	2,420	1,890
13	732	1,810	7,060	5,060	770	467	3,940	1,490
14	966	1,400	4,220	3,480	483	366	1,440	1,130
15	822	1,260	2,200	2,760	426	377	1,180	925
16	966	1,170	1,940	2,120	373	328	649	805
17	966	1,110	1,620	1,740	314	1,210	461	2,180
18	858	2,700	1,620	5,160	426	2,630	461	2,980
19	1,340	2,760	1,960	9,340	1,010	2,240	1,640	4,010
20	6,740	2,400	8,470	7,060	5,940	1,640	7,020	2,420
21	5,570	4,130	16,700	8,100	5,000	936	10,900	2,920
22	3,850	3,180	19,400	7,730	2,210	513	11,100	1,440
23	2,460	2,460	11,900	5,480	1,270	391	3,520	965
24	2,700	2,280	5,270	4,320	808	342	2,060	845
25	2,580	2,160	4,640	4,120	660	314	1,490	765
26	1,840	1,840	3,900	4,120	499	286	1,220	687
27	4,200	1,730	3,060	3,280	696	290	1,130	611
28	6,200	1,840	7,280	7,060	595	1,550	1,260	4,220
29	6,560	1,940	7,850	8,100	4,920	4,050	3,450	4,980
30	7,900	2,000	11,800	8,720	3,960	2,840	8,690	7,360
31	5,400		13,600		3,380		7,790	
Mean	2,296	4,031	4,807	9,503	1,250	1,760	2,417	4,245

Day	Soldier Creek at Topeka, Kans.		Delaware River at Valley Falls, Kans.		Wakarusa River near Lawrence, Kans.		Stranger Creek near Tonganoxie, Kans.	
	May	June	May	June	May	June	May	June
	1	2	3,360	34	2,930	4	7,720	12
2	940	2,100	156	10,600	7	9,450	194	3,120
3	10	800	51	8,600	8	7,220	226	4,000
4	2	480	32	768	9	1,440	43	3,250
5	2	350	24	608	6	702	24	514
6	2	280	22	1,440	8	744	32	511
7	2	220	20	415	11	459	26	243
8	2	190	366	298	9	305	20	178
9	2	160	467	608	223	249	463	166
10	35	130	133	257	334	223	344	121
11	37	110	200	9,170	123	5,000	92	3,160
12	65	93	114	1,310	118	681	210	4,430
13	94	80	193	257	108	364	72	4,000
14	70	69	218	200	1,650	249	1,370	730
15	40	61	164	187	1,680	186	657	199
16	30	52	277	200	1,380	198	631	169
17	25	43	147	187	526	162	367	215
18	20	53	237	5,470	951	139	915	248
19	800	94	7,630	3,300	7,850	123	3,690	199
20	3,220	84	9,700	1,380	3,150	103	3,840	231
21	800	72	15,400	1,310	951	84	2,190	284
22	300	64	3,110	320	427	84	439	110
23	100	58	608	218	305	84	367	79
24	75	50	415	155	223	76	194	53
25	50	44	298	136	186	71	145	69
26	25	39	257	277	162	84	151	141
27	15	64	1,930	437	9,590	154	290	69
28	8,990	98	14,700	819	11,400	491	5,300	275
29	3,550	75	2,930	366	11,200	620	7,050	79
30	1,850	50	1,250	2,000	3,070	162	5,770	53
31	150		1,380		681		1,530	
Mean	687	314	2,015	1,811	1,818	1,187	1,173	969

## PREVIOUS FLOODS

Although the flood of May and June 1935 was the greatest flood that had occurred in the upper part of the Republican-Kansas River Basin during the period of historical record, it appears that other floods, especially that of May and June 1903, have been greater than that of 1935 for the Kansas River, below Junction City. The magnitudes of most of the floods prior to that of 1903 are largely a matter of conjecture, there being few records upon which to base estimates of discharge.<sup>2</sup> In a report on the Kansas River by the Chief of Engineers, United States Army, the following information is given regarding early floods:<sup>3</sup>

One of the early floods in the Kansas Basin apparently occurred in 1785, a year that was known in Middle Western regions as "the year of big waters." \* \* \* The next great flood occurred in 1826. \* \* \* Conditions on the Kansas River are not accurately known, although available data indicate that a major flood occurred.

The next great flood of record occurred in the spring of 1844. No definite high-water marks were obtained of this flood, although sufficient information is available to establish it as the maximum flood of record in the Kansas Basin. \* \* \* A very careful study of available information at Topeka, Kans., indicates that the 1844 flood was approximately 2 feet higher than that of 1903. \* \* \*

Other general floods covering a large part of the Kansas Basin occurred in 1845, 1851, 1858, 1870, 1881, and 1886. Little is known of these floods. A flood on Chapman Creek, a small tributary of the Smoky Hill River, occurred on June 26, 1869, and resulted in the loss of 15 lives.

The most important flood of accurate record occurred during the latter part of May and the first part of June of 1903, and resulted in very high stages throughout the central and eastern part of the basin. It was exceeded only by the flood of 1844.

Floods on the Kansas River subsequent to that of 1903 occurred in 1904, 1908, 1915, 1923, and 1935, but none of them equaled the flood of 1903 in eastern Kansas, although in the upper Kansas River the flood of 1935 approached it closely.

Severe floods have occurred less frequently on the Republican River than on the Kansas River during the past century. Of the known floods on the Republican River that of 1915 is generally considered the greatest prior to that of 1935. The longest stream-gaging record on the Republican River is that at Superior and Bostwick, Nebr., from 1896 to 1915. During that period the maximum observed stage was a gage height of 12.5 feet at Bostwick on June 19, 1915. The second highest observed stage at Bostwick was a gage height of 10.4 feet on July 4, 1905, for which the estimated discharge was 24,500 second-feet. Records obtained near Superior during 1903 indicate that the flood of that year was of lesser magnitude on the

<sup>2</sup> See report of the Flood Control and Water Conservation Committee to the Governor of the State of Kansas, December 27, 1928, p. 5, for a list of years in which Kansas floods are known to have occurred.

<sup>3</sup> 73d Cong., 2d session, H. Doc. 195, pp. 38-39, 1934.

Republican River than those of 1905 and 1915, the estimated discharge at Superior being 14,100 second-feet on May 29, 1903.

A comparison of the flood of 1935 with other floods that had occurred during the preceding 70 years was obtained near Oxford, Nebr., at a house occupied by the Clarine family. This house was on the same site as one built in 1865, and prior to 1935 flood waters had never approached the house. Attached to the house is a lean-to more than 10 feet high, which was completely submerged by the crest of the flood of 1935. From this fact it is clearly indicated that the flood of 1935 was at least 12 feet higher than any flood during the preceding 70 years. As this additional 12 feet in height corresponds to a greatly increased width of overflowed area, it is evident that previous floods at this locality were so much smaller that they were comparable with the floods of 1905 and 1915 referred to above.

For the Republican River, as for many other western streams, there is the usual Indian tradition of a higher flood before the days of the white man. Engineers, in the course of their investigations of the flood of May and June 1935, found three separate references to such flood. An old Indian in the vicinity of Benkelman made the statement that 40 years before he was born there was a great flood 2 feet higher than that of 1935. As he was about 70 years old, this would date the legendary flood as approximately 1825. A resident near Cambridge stated that when his father settled there, about 1870, an old Indian told him that all people who settled the Republican River bottoms would be flooded out, as he had seen, while a boy, the waters "extending from bluff to bluff." At Red Cloud several residents stated that one of Chief Red Cloud's relatives who lived nearby was authority for the statement that more than 100 years ago a flood covering the bottoms "from bluff to bluff" had occurred. These statements are consistent and apparently had partial historic confirmation. At the time of this earlier flood there were no white settlers in the Republican River Basin, and the only white travelers were fur traders on the way from St. Louis to the Rocky Mountains and points beyond. Search through the available writings of these travelers fails to reveal any reference to such a flood. It is therefore necessary to rely on inferential evidence from localities where whites had settled. According to a published statement,<sup>4</sup> in the spring of 1826, during the June high water, which was much greater than usual, a tremendous rise, like a wall of water, came down from the Kansas River. No other reference to that flood is given, but the same volume contains a

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<sup>4</sup> Kansas State Hist. Soc. Trans., vol. 8, p. 479, Topeka, 1904.

letter from the superintendent of missions among the Osage Indians, from which the following is quoted:

The whole summer (1826) might be called a rainy season. The season before (1825) was remarkably dry. \* \* \* About the 1st of March our river (Neosho) rose and overflowed its banks beyond anything seen before. \* \* \* Through the summer the rains continued; the ground was wet and the air chilly. \* \* \* The most appalling scene was reserved for the month of September. It was in this month, about the middle, that the earth, already overflowing, could no longer drink in the rain that came upon it. Fresh torrents from the clouds descended; the Neosho commenced its second great rise, and it was great indeed. (A footnote states that this rise was 10 feet higher than that in the spring.)

The chief value of this evidence for the Republican River flood lies in the statement that 1825 was a dry year and 1826 an exceedingly wet one. If the rainfall was sufficiently heavy to cause a great flood on the Neosho River, it probably must have been general, extending also over the basin of the Republican River.

Of the two published statements cited, perhaps the first, mentioning the "tremendous wall" of water on the Kansas River in June 1826, is more pertinent to the Republican River flood. The second statement, mentioning 1825 as a "remarkably dry" year, indicates that the flood of Indian tradition occurred not in 1825 but in 1826. Although the evidence is not conclusive, it strengthens belief in the flood reported by the Indians. This in turn indicates that the flood of 1935 may be classed as one of the 100-year type.

#### REVISION OF RECORDS FOR 1903

As a result of additional high-water measurements and improved ratings for several stations on the Kansas River and tributary streams obtained in connection with the flood of May and June 1935, revisions have been made of the records for May and June 1903 for six gaging stations, and these revised records appear in the following table. Descriptions of these stations may be found in U. S. Geological Survey Water-Supply Paper 99, pages 208-215, 224-232.

Discharge, in second-feet, at stations in Kansas River Basin,  
May and June 1903

Day	Republican River at Junction City, Kans.		Kansas River at Leecompton, Kans.		Smoky Hill River at Ellsworth, Kans.	
	May	June	May	June	May	June
	1	6,450	58,000	5,000	239,000	823
2	3,400	50,000	5,000	222,000	557	3,410
3	1,780	38,800	14,000	207,000	557	2,130
4	1,180	22,300	13,300	191,000	510	1,690
5	945	18,700	12,100	171,000	1,840	1,410
6	787	13,200	12,100	134,000	2,050	1,340
7	735	9,160	11,700	107,000	2,850	1,080
8	735	6,880	11,200	90,200	2,510	883
9	735	5,400	10,300	74,000	2,200	823
10	662	4,520	10,400	65,200	1,840	765
11	1,260	4,000	11,700	55,000	1,760	710
12	9,820	3,500	16,500	45,900	1,410	657
13	19,900	3,020	24,400	38,000	2,200	657
14	28,400	2,600	32,600	34,000	2,280	606
15	16,000	2,520	47,800	30,600	1,480	557
16	10,300	2,290	43,100	28,300	1,140	510
17	7,500	2,150	29,600	26,100	1,010	465
18	6,500	1,950	26,400	23,700	883	422
19	8,250	1,840	25,200	22,400	765	381
20	4,650	1,660	27,200	20,800	657	465
21	4,300	1,660	26,200	18,600	557	465
22	5,150	1,540	28,000	17,100	606	381
23	11,500	1,480	46,300	16,000	623	465
24	9,000	1,370	56,800	14,300	657	465
25	6,880	1,480	56,400	15,200	557	422
26	12,600	2,680	41,000	22,400	1,480	765
27	23,500	3,700	79,600	30,600	1,690	1,080
28	33,600	2,600	93,800	30,600	12,900	557
29	69,500	2,210	131,000	28,300	15,700	465
30	71,000	2,680	181,000	26,400	12,300	342
31	65,000		266,000		6,980	
Mean	14,260	9,120	45,020	68,160	2,700	948

Day	Saline River near Salina, Kans.		Solomon River at Niles, Kans.		Big Blue River at Manhattan, Kans.	
	May	June	May	June	May	June
	1	955	24,600	2,490	28,900	5,860
2	1,710	19,000	2,490	35,200	6,490	69,000
3	1,350	14,000	1,640	39,800	4,140	53,200
4	1,250	10,000	997	39,800	2,060	41,200
5	910	8,000	915	31,800	1,770	35,000
6	1,200	6,200	635	24,100	1,630	30,700
7	925	5,100	970	13,800	1,630	21,100
8	1,250	4,500	1,050	6,820	1,490	15,000
9	1,690	3,940	2,160	4,590	1,350	10,900
10	1,860	2,490	3,820	3,680	1,220	8,960
11	1,820	1,640	4,670	3,320	1,160	7,700
12	1,620	1,550	5,080	3,460	2,060	7,020
13	1,350	1,450	5,190	3,280	8,820	6,240
14	1,750	1,340	6,610	2,810	17,700	5,500
15	1,960	1,270	6,920	2,680	16,000	5,150
16	2,000	1,210	11,600	2,460	7,430	4,800
17	2,090	1,150	19,700	2,340	5,150	4,470
18	1,950	1,090	19,000	2,220	4,360	4,140
19	1,300	1,040	7,010	2,120	3,650	3,940
20	1,080	1,000	4,150	2,060	3,240	5,980
21	1,250	1,080	2,940	2,000	7,840	5,380
22	2,470	1,090	4,070	1,820	22,900	4,690
23	3,220	1,000	4,300	1,820	27,700	4,140
24	2,490	1,020	3,460	1,760	27,500	3,730
25	2,180	1,000	3,250	1,660	19,600	3,940
26	6,500	955	3,820	1,940	33,200	8,260
27	19,300	880	5,120	1,940	46,600	7,420
28	13,400	835	4,880	2,820	54,600	4,470
29	24,600	880	17,300	2,480	69,000	3,940
30	27,000	1,040	19,700	3,010	86,000	3,430
31	25,900		21,600		93,800	
Mean	5,120	4,010	6,340	9,210	18,890	15,890