

RIVERS AND FLOODS, FEBRUARY, 1911.

By Prof. H. C. FRANKENFIELD, in charge of River and Flood Division.

During the month of January, 1911, rainfall and snowfall over the State of California were practically continuous and abnormally heavy, and by January 18 a general rise had set in over all the rivers of the State. A description of the antecedent conditions as well as detailed data for the month of January will be found in the report of District No. 11 in the Monthly Weather Review for that month, and need not be repeated here. It is well to note, however, that the average precipitation in the State of California for the month of January, 1911, was 13.20 inches, or 7.79 inches above the normal amount, while snowfall to the amount of 400 inches was reported at Tamarack, Cal., with a total water precipitation for the month of 39.80 inches.

The following report on the floods was prepared by Mr. N. R. Taylor, official in charge of the local office of the Weather Bureau at Sacramento, Cal.:

Until about January 12 all streams in the central valleys of California showed little departure from the unprecedentedly low stages that had been general during the past few months, but on the date referred to the Sacramento River below Redding, and the eastern tributaries of this stream, began responding to the rains that prevailed throughout the Sacramento watershed from the 9th to 15th, inclusive. While the rains of the San Joaquin watershed were practically identical with those of the Sacramento little effects were noted in the stages of the rivers in the section first named.

By January 17 a general fall was in progress throughout the rivers of both watersheds, but the heavy, warm rains that occurred between January 18 and 21 resulted in rapid rises in the Sacramento, American, Feather, and Yuba rivers, and increased the run-off of the tributaries of the San Joaquin.

On January 20 advisory messages were telegraphed to points on the Sacramento River between Colusa and Knights Landing indicating the approach of a heavy rise in the river during the next two or three days. By the morning of January 21 the Sacramento at Colusa had risen to a stage of 19.4 feet, a rise of over 14 feet in 24 hours, and by the morning of January 22 the river at Knights Landing had risen to 13.4 feet. Heavy rises also occurred in all the eastern tributaries, except Pitt River, with freshets in many of the smaller forks of the Feather-Yuba system.

From January 24 until February 1 general and heavy rains occurred over both watersheds, and during the greater part of this period rain fell heavily along the western flanks of the Sierra Nevadas as high as the 5,000-foot level, melting a large amount of the snow that had accumulated since January 9.

On January 24 warnings of heavy rises were telegraphed to Bellota and Stockton for distribution to points along Mormon Slough, and by the evening of January 25 this stream had overflowed its banks between Linden and Bellota, inundating several thousand acres of farm land. The Government Drainage Canal, which diverts the water of Mormon Slough back into the Calaveras River below Stockton, protected the city of Stockton from overflow.

On January 28 advisory messages were telegraphed Colusa to the effect that all new levees should be watched during the next two or three days, and on January 29 this advice was also telegraphed our observer at Knights Landing and given verbally to the official in charge of the Sacramento levees. This advice was followed in all cases, and it has been stated that some of the new levees, that had not been tried since their construction after the floods of 1909, were probably saved as a result of the warnings.

On January 30 it became evident that the heavy rains and rapidly melting snows would result in critical conditions in the lower Sacramento Valley between Colusa and Walnut Grove and that serious floods would occur in the valley of the San Joaquin. On the morning of this date advisory messages were telegraphed to points on the Sacramento indicating heavy rises between the mouth of Stony Creek and Sacramento City, and warnings were wired to Stockton, Bellota, and Galt to the effect that dangerous floods would occur in the vicinity of Stockton, along Mormon Slough, between Linden and Stockton, and over a large section of the country contiguous to the junction of the Mokelumne and Cosumnes rivers. During the afternoon of January 30 general flood warnings were issued for the San Joaquin River from the mouth of the Calaveras northward to Mendota and Firebaugh indicating heavy and damaging floods for all lands subject to overflow between those points. By the morning of January 31 the Sacramento River was dangerously high from Monroeville to the mouth of the American, and critical stages were reported from many points in the

Feather and Yuba above Marysville, and in the American above Fair Oaks. By the afternoon of this date over 10,000 acres of land were overflowed in the vicinity of the junction of the Mokelumne and Cosumnes rivers with the combined overflow of these streams rapidly backing up along the east side of the Sacramento River, and it has been estimated that an area comprising 75,000 acres was under water between the junction of the Calaveras and Mormon Slough and the city of Stockton.

At this time the flood waters of the Merced, Stanislaus, and Tuolumne rivers had reached the San Joaquin River and an immense flood wave was moving rapidly down this stream. This flood reached the lowlands in the vicinity of Lathrop and San Joaquin Bridge by the morning of February 1, and by night of that date many levees had given way and many thousands of acres were flooded. The river observer's house, located near San Joaquin Bridge, was washed away, and many other residences in that vicinity were either washed from their foundations or else undermined by the water. By promptly spreading the warnings sent from this station the Lathrop observer saved hundreds of head of valuable stock. About 10,000 acres were flooded in the vicinity of Firebaugh and Mendota, mostly the property of the Miller & Lux Co., but the warnings sent to the agent of this company gave ample time for the saving of all stock.

By the morning of February 2 the flood had spread over a large territory between San Joaquin Bridge and Roberts Island, destroying many miles of levees and inundating thousands of acres of reclaimed land, and considerable water had backed into Stockton from the lower Calaveras and from the overflow of Mormon Slough. The diverting canal, mentioned in another part of this report, undoubtedly saved Stockton from a damaging flood, as the floods in the surrounding country were the most disastrous and widespread ever recorded in the San Joaquin Valley.

It is estimated that nearly 300,000 acres of land were under water from the night of January 31 until February 2.

On the morning of February 2 the water had commenced to subside, but it was not until February 5 that normal conditions prevailed.

Advisory messages were sent to the lower island districts indicating that all levees should be patrolled, but with the exception of a rise of about 2 feet the delta lands showed little effects of the floods that prevailed above, which is probably due to the fact that the flood waters spread over such a large area and that much of the overflow was impounded, so that the run-off was gradual, especially between the mouth of the Calaveras and Antioch.

It is gratifying to be able to state that warnings were received at all points affected by the floods in ample time to guard against danger and damage, and that many thousands of dollars' worth of stock were saved and levees protected as a result of the warnings.

The following table gives the precipitation for the month of January, 1911, the highest river stages and dates during the floods, and the departures from the flood stages at the various stations of observation:

SACRAMENTO WATERSHED.

Station.	River.	Precipitation, January, 1911.	Highest stage.	Date.	Above or below flood stage.
		Inches.	Feet.		Feet.
St. John	Stony Creek	4.2	Jan. 30	+ 7.8
Colgate	Yuba	28.49	10.2	Jan. 31	- 3.8
Marysville	do	13.55	20.0	do	- 5.0
Oroville	Feather	14.32	13.3	do	-11.7
Folsom City	American	21.06	19.8	do
Kennett	Sacramento	14.84	8.9	do	-14.1
Red Bluff	do	9.08	18.5	do	- 4.5
Monroeville	do	9.36	14.8	do	- 7.2
Colusa	do	7.68	24.3	Feb. 1	- 3.7
Knights Landing	do	12.22	17.2	Feb. 2, 3	- 0.8
Sacramento	do	12.72	26.9	Feb. 2	- 2.1
Rio Vista	do	12.48	10.1	Feb. 5	- 1.9

SAN JOAQUIN WATERSHED.

Merced Falls	Merced	11.05	* 9.1	Jan. 31
Jacksonville	Tuolumne	18.78	* 27.0	do	+ 7.0
Melones	Stanislaus	21.66	* 14.0	do
Jenny Lind	Calaveras	14.03	* 14.0	do	+ 4.0
Bellota	Mormon Slough	13.91	† 22.0	do	+ 2.0
Electra	Mokelumne	22.96	9.3	do	- 2.7
Pollasky	San Joaquin	7.61	12.0	do	+ 2.0
Firebaugh	do	3.48	12.5	Feb. 2	+ 0.5
Lathrop	do	7.95	* 22.5	Feb. 1	+ 5.5

* Highest of record.

† Estimated.

So far as could be learned, the estimated losses from the floods were as follows:

Property, including railroads, but excluding crops.....	\$425,000
Crops.....	25,000
Damage to farm lands.....	75,000
Suspension of business.....	25,000
Total.....	550,000

Value of property saved through Weather Bureau warnings, estimated, \$230,000.

The general appreciation of the value of the service rendered by the Weather Bureau was indicated by the number of letters received from those especially interested.

The flood in the Ohio River was caused by the rains of January 27, 28, and 29, and the first warnings were issued at Pittsburg, Pa., on the evening of January 29, for a stage of 25 feet, or 3 feet above the flood stage. On the following day warnings were issued for a still higher stage at Pittsburg and for a stage of 39 feet at Wheeling, W. Va., but the freezing temperatures that set in during the afternoon checked the rise from the tributaries, and the crest stage at Pittsburg was but 25.2 feet, or 3.2 feet above the flood stage, at 7 a. m., January 31. At Wheeling the highest stage was 35.2 feet, 0.8 foot below the flood stage, at midnight, January 31.

The flood was very severe along the Monongahela River, and has been exceeded but once during the winter months. Some crest stages were as follows: Fairmont, W. Va., 29.2 feet, 4.2 feet above flood stage; Greensboro, Pa., 32 feet, 14 feet above flood stage; and Lock No. 4, Pa., 36.7 feet, 8.7 feet above flood stage.

The warnings proved to be very timely, and the estimated losses from the flood were consequently quite small. They were about as follows:

Property, excluding crops.....	\$50,000
Crops.....	None.
Damage to farm lands.....	None.
Suspension of business.....	15,000
Total.....	65,000

Value of property saved through Weather Bureau warnings, estimated, \$250,000.

Under date of January 31, 1911, the Pittsburg Dispatch commented as follows:

WARNINGS VALUABLE.

Never was the value of warnings from the Weather Bureau more apparent than those which were given to the public through the newspapers yesterday morning. Almost before the rise began everybody who had access to a newspaper and who had interests which might be affected was on the alert.

In the Parkersburg district the crest stages were 36.3 feet, 0.3 foot above flood stage, at Parkersburg, W. Va., and 45.4 feet, 6.4 feet above the flood stage at Point Pleasant, W. Va., on February 1, and at the latter place the river was above the flood stage from January 31 to February 3, inclusive. The usual warnings were issued, and no damage was done in the district.

From Huntington, W. Va., to Louisville, Ky., flood stages were not reached although they were closely approximated, except at Madison, Ind., and Louisville, Ky. Below Louisville flood stages were exceeded as far down as Shawneetown, Ill., but no damage was done. The usual warnings were issued at the proper time, and the highest stage reached was 38.8 feet at Evansville, Ind., 3.8 feet above the flood stage. The river remained above the flood stage from February 4 to 12, inclusive.

At Paducah, Ky., and Cairo, Ill., the crest stages were about 7 feet below the flood stage.

The Wabash River was above the flood stage below the mouth of the White River from February 1 to 6, inclusive, with a crest stage on February 4 of 16.7 feet at Mount Carmel, Ill., 1.7 feet above the flood stage. Warnings were first issued on January 30, and no damage occurred.

Along the Ohio River, below the mouth of the Wabash, the estimated losses were about as follows:

Property, exclusive of crops.....	None.
Crops.....	\$10,000
Damage to farm lands by erosion, etc.....	5,000
Losses through suspension of business.....	25,000
Total.....	40,000

Value of property saved by the Weather Bureau warnings, estimated, \$25,000.

There was a moderate flood in the lower Tennessee River, due to heavy rains from February 6 to 9, inclusive, and warnings were first issued on February 11. The crest stages were but slightly above the flood stage, and little or no damage was done.

The crest of the Ohio River rise passed into the Mississippi River on February 14, and reached New Orleans, La., on March 3 with a stage of 11.8 feet.

Severe floods occurred in the smaller streams of northwestern Illinois and northeastern Iowa from February 14 to 18, inclusive. There were from 8 to 10 inches of moist snow on the frozen ground, and high temperatures from February 10 to 12, inclusive, followed by heavy rains on February 13, 14, 16, and 17, sent most of the snow into the rivers. The trouble was confined principally to the rivers that have their outlets between Dubuque and Davenport, Iowa. The Galena River of Illinois was higher on February 14 than at any time since 1892, while in the Maquoketa River of Iowa the rise was the most rapid ever known, with a crest stage at Maquoketa, Iowa, shortly after midnight on February 13-14, about 8 inches higher than the high-water mark of June, 1892. The waterworks plant was put out of commission and several small bridges were washed away.

The most serious damage occurred in the bottoms along the Wapsipicon River. One human life and 73 head of cattle were lost and several bridges were carried away. These floods caused a marked rise in the Mississippi River, and flood stages were almost reached between Quincy, Ill., and Hannibal, Mo.

The mild and rainy weather that prevailed during the early part of the month carried away nearly all the snow from the lower peninsula of Michigan, and the combined run-off of melted snow and rain caused sudden rises in both the Saginaw and Grand River watersheds. For a few days conditions were quite threatening, as heavy sheets of rotting ice covered both rivers, and gorges were feared. A gorge 4 miles in length formed in the Grand River during the afternoon and night of February 20 just below the city of Portland, Mich., and the back-water reached the flood stage on the following morning. Some damage was done to basements, but the gorge was successfully dynamited during the afternoon, and the waters afterward receded rapidly. There were also fears that cold weather would form a gorge in the low stretches of the river just below Grand Rapids, and on the advice of the official in charge of the local office of the Weather Bureau a large boom was stretched across the river just above the city on February 21. This stopped

the running ice, and allowed the formation of a sheet of surface ice.

ICE.

At the end of the month the Mississippi River remained frozen as far south as Prairie du Chien, Wis. The ice moved out below the drawbridge at Dubuque, Iowa, during the afternoon of February 17, and above the bridge on February 26, the earliest opening of the Mississippi River at Dubuque in 29 years. The previous earliest date was March 3, 1892. At Davenport, Iowa, the ice moved out on February 15, and at Keokuk, Iowa, on February 1.

The Missouri River remained closed from Omaha northward, and the rivers of New England and New York also remained frozen.

MOUNTAIN SNOWFALL.

As a whole, conditions improved materially during the month, only a limited number of localities reporting a probable deficiency in water supply during the coming spring and summer. Estimates are of course based upon the assumption that the spring temperatures will not be unusually high.

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Librarian.

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Anonymous publications are indicated by a ———.

- Angenheister, G.**
Wolkenbeobachtungen in Samoa. [Göttingen.] [1909.] 8 p. 8°. (Separatabdruck: Nachr. k. Gesell. Wiss., Göttingen, Math.-Physik. Kl., 1909.)
- Austria. K. k. Zentralanstalt für Meteorologie und Geodynamik.**
Allgemeiner Bericht und Chronik der im Jahre 1908 in Oesterreich beobachteten Erdbeben. Wien. 1910. vi, 281 p. 8°.
- Bavaria. K. Bayerischen meteorologische Central-Station.**
Deutsches meteorologisches Jahrbuch: Bayern, 1909. München. 1910. v. p. f°.
- Brillmann, Reinhard.**
Untersuchungen über das diffuse Wandlicht. Emden. 1910. 39 p. 8°. (Diss.—Kiel.)
- Capodimonte. Reale osservatorio.**
Osservazioni meteoriche, 1907, 1908, 1909. n. p. n. d. 8°.
Riassunto delle osservazioni meteoriche . . . 1907, 1908. n. p. n. d. 8°.
- Fassig, Oliver [Janard].**
Average annual rainfall of Porto Rico [and other papers]. Washington, etc. 1909, 1910. v. p. 4°.
- Fourier, [Jean Baptiste Joseph].**
Mémoire sur les températures du globe terrestre et des espaces planétaires. [Paris.] [1824.] p. 569-604. 4°.
- Germany. K. Marine-Amt. Observatorium in Wilhelmshaven.**
Veröffentlichungen . . . Neue Folge, Heft 1, 2. Übersicht über . . . Erdmagnetismus, 1910. Berlin. 1911. 6 p. f°.
- Golitsyn, B.**
Ueber einen neuen Seismographen für die Vertikalkomponente der Bodenbewegung. St. Petersburg. 1910. 34 p. 4°.
- Greece. Observatoire national d'Athènes.**
Annales . . . Tome 5. Athènes. 1910. 592 p. f°.

Hedges, Killingworth.

Modern lightning conductors; . . . Report of the Lightning research committee of 1905, also the Phoenix fire office 1910 rules, with notes as to the methods of protection and specifications . . . 2d ed. London. 1910. v. p. 8°.

Lenard, P.

Ueber die Strahlen der Nordlichter. Heidelberg. 1910. 9 p. 8°.

Lenard, P., & Ramsauer, C.

Ueber die Wirkungen sehr kurzwelligen ultravioletten Lichtes auf Gase und über eine sehr reiche Quelle dieses Lichtes. Heidelberg. 1910. v. p. 8°.

Lisbon. Observatorio do Infante D. Luiz.

Annaes . . . 1907, v. 45. Lisboa. 1910. 131 p. f°.

Mémery, Henri.

Météorologie et phénomènes solaires. Bordeaux. 1910. 63 p. 8°. (Soc. d'océanographie du Golfe de Gascogne.)

Russia. Ministry of Agriculture. Meteorological bureau.

Annalen der Landwirtschaftlichen Meteorologie. [T. p. Russian and German. Text in Russian.] Bd. 1, Lfg. 1—Wintergetreide. (Roggen und Weizen.) St. Petersburg. 1910. x, 33 p. f°.

Solvay, Ernest.

De la condensation électrique dans l'atmosphère. Bruxelles. 1907. 19 p. 8°. (Repr.: Ciel et terre, 1907. T. 28.)

Strub, Walter.

Temperaturverhältnisse von Basel. Basel. 1910. 139 p. 8°. (Diss.—Basel.)

Wiesbaden. Meteorologische Station.

Beobachtungen, 1909. Wiesbaden. 1910. 54 p. 8°. (S.-Abdr.: Nassauer Verein für Naturkunde.)

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Librarian.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology and other cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ———.

- Journal of geology. Chicago. v. 19. January-February, 1911.*
- Coleman, A. P.** Climate and the physical conditions of the Keewatin. p. 1-14.
- Meteorological society of Japan. Journal. Tokio. 30th year. January, 1911.*
- Fujiwara, S.** On kites and kite lines. (2d report. English.) p. 1-7.
- Nature. London. v. 85. February 2, 1911.*
- Colliery warnings. p. 437-438. [Signed "The author of the warnings." Reply by H. Louis.]
- Royal society of Edinburgh. Proceedings. Edinburgh. v. 31. 1911.*
- Wedderburn, E. M., & Williams, A. M.** The temperature seiche p. 257-258. [Abstract from Transactions.]
- Royal society of Edinburgh. Transactions. v. 44, pts. 1, 2. 1904.*
- Buchan, Alexander, & Omond, Robert Trail.** The Ben Nevis observations. 1898-1904 and appendix. p. 1-714.
- Royal society of London. Proceedings. London. Ser. A. v. 85. No. A 575.*
- Schuster, Arthur.** The origin of magnetic storms. p. 44-50.
- School science and mathematics. Chicago. v. 9. March, 1911.*
- Brown, Robert M.** The humidity of the air in school rooms. p. 252-256.
- Science. New York. v. 33. March 3, 1911.*
- Gulick, Luther H.** The air we breathe in buildings. p. 326-328.
- Scientific American. New York. v. 104. March 4, 1911.*
- The southernmost meteorological station of the world p. 219.
- Fog and fog signals. p. 227. [Abstract of paper by A. G. McAdie.]
- Scientific American supplement. v. 71. March 25, 1911.*
- The world's daily weather maps. Systems used in various countries. p. 188.