

remainder of East Texas, and northern and western Louisiana. The warning was only partially verified. Frosts occurred on a few dates for which warnings were issued.

Northwest storm warnings were issued for the eastern portion of the Texas coast, and small-craft warnings for the western part on the morning of the 14th, and verifying velocities occurred within the period of the display. No general storm occurred without warnings.—*I. M. Cline.*

#### DENVER FORECAST DISTRICT

Disturbances that had developed on the Plateau, or had advanced from that portion of the Pacific coast immediately to the northwest, were present in the southern portion of the Rocky Mountain region during most of the time from the 5th to the 13th and from the 26th to the end of the month. These LOWS were attended, at some time during their passage eastward, by snow or rain in nearly all parts of the district except southeastern New Mexico, although the precipitation east of the Continental Divide was everywhere extremely light. On the 16th-17th a disturbance advanced southward along the eastern Rocky Mountain slope to northern Texas, where it recurved to the northeastward. It was attended by light snow in Colorado on the 17th and by violent and highly destructive local storms in southern Illinois when it crossed that region on the following day.

Warnings of moderate cold waves in eastern Colorado were issued on the mornings of the 10th, 13th, and 17th. The first of these was partially, and the last two were fully verified.

Warnings of freezing temperatures and frosts which were generally verified were issued as follows: Freezing temperature in southern New Mexico and southeastern Arizona on the 11th and 13th, and in extreme southeastern New Mexico on the 14th, 15th, 18th, and 19th. Warnings of frosts in southwestern Arizona on the 11th and 13th; in south-central New Mexico on the 14th, 15th, 18th, and 19th; in southern New Mexico on the 16th, and in the western valleys of Colorado on the 31st.

Owing to the extreme dryness on the eastern slope of the Rockies in Colorado, where some fires had already started, a fire-weather warning of strong shifting winds during the following day was issued for this portion of the State on the evening of the 31st, when a disturbance was advancing northeastward from Utah. The warning was fully justified.—*J. M. Sherier.*

#### SAN FRANCISCO FORECAST DISTRICT

As a rule the month of March was a relatively quiet one in the Pacific States Forecast District. Storm warnings were ordered on but two days, the 14th and 30th, for the north coast; on one day, the 29th, for the coast south of San Francisco; and on one day, the 30th for the San Francisco Bay region. Frost warnings were ordered for parts of California daily from the 6th to 13th and for Washington and Oregon for the 6th, 7th, and 8th, and the 23d, 25th, 28th, and 29th. These forecasts were verified in practically all instances, but the extent of damage from frosts is not definitely known. The early issue of frost warnings in Washington and Oregon was necessary because the growing season was considerably ahead of normal.

Considered from the standpoint of forecasting, the month was an interesting one, especially for California,

where except for two periods, namely the 7th to the 10th and the 26th to the 31st, inclusive, when rain fell in nearly all parts of the State, fair weather was general. The rainfall was heavy and general during the period beginning the 26th and continuing into the month of April. The occurrence of these rains was more than likely due to the abnormal developments and displacements of the area of high barometric pressure that normally is found off the California coast. In the former instance of rains in California, i. e., the 7th to 10th, this area of high barometric pressure was far north of its normal position, and its major axis paralleled the meridians, whereas usually its major axis lies more or less east to west, and with its eastern periphery impinging on the coast. In this instance, an area of low barometric pressure formed over Nevada and caused light to moderate, though general, rains in California. Beginning on the 26th, however, there was a radical departure from the normal pressure situation over the ocean. The area of high barometric pressure, normally central near latitude 32° and longitude (west) 140°, retreated westward approximately 20° in longitude, and permitted lows from the north Pacific to advance southeastward and bring California under their influence. The result was that a series of LOWS, the like of which had not occurred previously for a long time, crossed the coast line south of the Oregon border, and caused general and heavy rains throughout California. Occurrences such as this indicate that a knowledge of the behavior of this area of high barometric pressure is essential to determining the times of those changes from the usual fair-weather types of isobaric patterns which bring on periods of unsettled weather and rains in California.—*E. H. Bowie.*

#### RIVERS AND FLOODS

By H. C. FRANKENFIELD, in Charge of Division

With but two exceptions the floods of March in the larger rivers were very moderate, and all, aside from an ice-gorge flood in the Missouri River near Niobrara, Nebr., occurred east of the Mississippi River. The usual statistical data will be found in the table at the end of this report.

The most severe flood of the month occurred in the Connecticut River and its tributaries. Moderately heavy rains fell on March 28 and 29 but the temperatures had been high for several days, and there was a snow cover over the upper drainage basin ranging in depth from 7 to more than 20 inches, probably equivalent to at least 2 inches of water, so that with the rainfall there must have been approximately 3 inches of water, a sufficient quantity to have caused a severe flood at this time of the year regardless of other conditions. Reports, official and otherwise, indicate that disastrous floods occurred throughout New Hampshire and Vermont and in the smaller streams of the Adirondack region of New York. In the lower Connecticut River Valley the flood crest was not an unusual one for the time of the year and virtually no damage resulted. In the upper valley the damage was quite severe but it was impossible to obtain any estimates as to the amount thereof. The town of Randolph, Vt., suffered severely, two dams and 6 houses having been swept away, with resulting damage amounting to about \$50,000.

In connection with the Connecticut River it is interesting to note that all records for continuous navigation of the lower river have been surpassed, the river having been open without intermission since March 24, 1923.

The second flood of importance was that of the Wabash River of Indiana and Illinois. It was caused by the heavy rains of March 13 and 14 over the Wabash drainage basin. At Lafayette, Ind., the crest stage of 22 feet on March 15, was 11 feet above the flood stage, while below Lafayette the crests averaged from 4 to 5 feet above the flood stages.

As there were no growing crops in the lowlands the losses were small, probably as much as \$20,000, mostly through enforced suspension of certain business activities in the urban districts. The reported value of the property saved through the Weather Bureau warnings was \$30,000.

An ice gorge about 5 miles in length and 20 feet in height formed between March 3 and 5 in the Missouri River from the mouth of the Niobrara River westward. Bottom lands in some places were under 12 feet of water, but fortunately the ice gave away in about 36 hours and the river gradually receded. Warnings were issued promptly upon receipt of the first advices and the reported losses were only \$2,500, while the saving of property by reason of the warnings was estimated at \$8,000.

MEAN LAKE LEVELS DURING MARCH, 1925

By UNITED STATES LAKE SURVEY

[Detroit, Mich., Apr. 7, 1925]

The following data are reported in the "Notice to Mariners" of the above date:

Data	Lakes <sup>1</sup>			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during March, 1925:				
Above mean sea level at New York.....	Feet 600.80	Feet 578.38	Feet 570.91	Feet 245.20
Above or below—				
Mean stage of February, 1925.....	-0.16	+0.14	+0.42	+0.79
Mean stage of March, 1924.....	-0.26	-0.31	-0.31	+0.32
Average stage for March last 10 years.....	-0.85	-1.46	-0.71	-0.21
Highest recorded March stage.....	-1.52	-4.57	-2.94	-2.61
Lowest recorded March stage.....	+0.14	-0.31	+0.08	+0.90
Average relation of the March level to—				
February level.....		+0.1	+0.2	+0.2
April level.....		-0.3	-0.6	-0.6

<sup>1</sup> Lake St. Clair's level: In March, 1925, 573.41 feet.

FLOOD PROTECTION IN WICHITA, KANS.

By S. P. PETERSON

[Weather Bureau, Wichita, Kans.]

The city of Wichita is situated at the confluence of the Big Arkansas and the Little Arkansas Rivers, the Big Arkansas River passing through the southwestern part of the city with a southeasterly trend and the Little Arkansas flowing in a very winding course southward through the northwestern part of the city and emptying into the Big Arkansas River a short distance to the northwest of the central business section. To the east of these two rivers lies about two-thirds of the city, and this part is bisected by Chisholm creek and its continuation, the drainage canal, which flows in a general southward direction through it, emptying into the Big Arkansas River a short distance below the city.

The site of the city of Wichita has been subjected to three extensive floods, one in 1877, one in 1904, and the last in 1923. There have also been several minor floods. In extensive flooding the overflow waters of the three streams tend to merge and form a shallow lake, covering much of the city and surrounding territory.

Immediately after the flood of 1904 action was taken to control the flood waters, especially of the Little Arkansas River and Chisholm Creek (then flowing in its natural winding course southward through the eastern portion of the city) as these two streams caused the most damaging overflows. This control was accomplished to a certain extent by constructing dykes along the portion of the Little Arkansas River from which the overflow waters moved toward the central business section and by clearing the channel of that portion of the stream of such obstructions as would hinder the streamflow, while through the section drained by Chisholm Creek, a canal (the present drainage canal) was dug from the Stock Yards district, near the extreme northern portion of the city to the mouth of the stream, eliminating the windings of this stream within most of the city, making a straight course for the streamflow and also a considerably larger channel capacity than

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
<b>ATLANTIC DRAINAGE</b>					
Connecticut:					
White River Junction, Vt.....	Feet 15	28	( <sup>1</sup> )	22.5	29
Bellows Falls, Vt.....	12	30	30	13.4	30
Holyoke, Mass.....	9	31	( <sup>2</sup> )	9.4	31
Hartford, Conn.....	16	30	( <sup>2</sup> )	20.5	31
Unadilla, New Berlin, N. Y.....	8	15	15	8.2	15
Santee:					
Rimini, S. C.....	12	20	23	12.8	22
Ferguson, S. C.....	12	1	1	12.0	1
		21	25	12.3	23, 24
<b>EAST GULF DRAINAGE</b>					
Cababa, Centerville, Ala.....	25	18	18	25.0	18
Tombigbee, Lock No. 4, Demopolis, Ala.....	39	19	27	47.0	24
Pearl, Jackson, Miss.....	20	21	30	25.5	25
<b>GREAT LAKES DRAINAGE</b>					
Maumee:					
Fort Wayne, Ind.....	15	14	20	19.7	15
Napoleon, Ohio.....	10	16	16	10.0	16
St. Joseph, Montpelier, Ohio.....	10	15	16	11.5	15
		20	21	11.9	20
Auglaize, Defiance, Ohio.....	10	16	16	10.9	16
<b>MISSISSIPPI DRAINAGE</b>					
Tuscarawas, Gnadenhutten, Ohio.....	9	20	20	9.4	20
Scioto, LaRue, Ohio.....	11	15	15	11.0	15
Green, Lock No. 2, Rumsey, Ky.....	34	( <sup>1</sup> )	3	36.6	1
Wabash:					
Lafayette, Ind.....	11	14	22	22.0	15
Terre Haute, Ind.....	16	15	25	20.9	19
Vincennes, Ind.....	14	19	29	19.5	22, 23
Mount Carmel, Ill.....	16	19	28	20.5	23, 24
White, West Fork:					
Elliston, Ind.....	19	16	18	20.9	18
Edwardsport, Ind.....	14	17	21	17.3	19
Illinois:					
Peru, Ill.....	14	( <sup>1</sup> )	6	15.3	Feb. 25
		18	31	15.8	Mar. 23
Henry, Ill.....	7	( <sup>1</sup> )	( <sup>2</sup> )	9.6	24, 25, 26
Peoria, Ill.....	16	23	31	16.4	25, 26
Havana, Ill.....	14	24	( <sup>2</sup> )	14.3	27-30
Beardstown, Ill.....	12	( <sup>1</sup> )	( <sup>2</sup> )	15.4	28, 29
Cache, Patterson, Ark.....	9	2	6	9.9	4

<sup>1</sup> Continued from last month.  
<sup>2</sup> Continued at end of month.