

tricts. The damage by frosts, if any, was small.—*F. H. Brandenburg, District Forecaster.*

SOUTH PACIFIC FORECAST DISTRICT.

The month was quite uneventful. Over the greater portion of the State no rain fell. In the extreme north and extreme south there were a few light showers.—*A. G. McAdie, Professor and District Forecaster.*

NORTH PACIFIC FORECAST DISTRICT.

The month was unusually dry with nearly normal temperatures. At Portland, Oreg., the river was above the danger line throughout the month, but as ample warning of the coming stages were issued several days in advance precautionary measures were taken to prevent avoidable losses.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

The Mississippi River fell steadily after the high stages of the preceding month, remaining, however, above the danger line at New Orleans until the 23d. The Missouri also fell generally, but during the last few days of the month heavy rains over the lower watershed, including that of the Kansas River, started a rapid rise, which by the end of the month had become manifest in the Mississippi between Alton, Ill., and the mouth of the Ohio. In the lower Kansas Valley the waters of course did not reach by many feet the abnormal heights of the preceding year. Nevertheless, considerable damage was done between Topeka and Kansas City, principally by the flooding of lowlands. In the vicinity of Kansas City the damage was much greater. Several temporary pile bridges over the Kansas River were swept away, and the bottoms were covered with water. Many of the inhabitants were driven from their homes. Business was suspended in some localities, and railroad service badly demoralized.

During the first decade of the month the high water in the Mississippi River caused considerable damage in the vicinity of Cairo. On the Illinois side of the river hundreds of acres of wheat were submerged and destroyed, while on the Missouri side the loss to the St. Louis and San Francisco Railroad between St. Louis and Poplar Bluff, Mo., was about \$100,000.

The following report on the spring flood in the Memphis district, where the highest proportionate stages were reached, was prepared by Mr. S. C. Emery, Official in Charge of the United States Weather Bureau office, Memphis, Tenn. This report will be found to be very interesting. It apparently decides a much mooted question that arose during the close of the flood of 1903, as to the effect of the railroad embankments opposite in ponding the water above. It now seems that the embankments were not seriously at fault, the surplus water having come through a 10-mile gap near the upper end of Reelfoot Lake district. This water left the main stream in the vicinity of Hickman, Ky., and reentered it in the neighborhood of Fulton, Tenn. Mr. Emery also remarks that for the first time the St. Francis levee successfully resisted a severe flood.

Moderately low river stages prevailed in the Memphis district throughout the winter months, and until March 1 the water was considerably below normal. As this was later than the usual time for the formation of floods, it was generally thought that no serious rise was likely to occur this year, and farmers and levee contractors began the season's work. During the first ten days in March two sharp swells started in the upper Ohio, the crests of which soon merged into one and reached Cairo during March 17, with a stage of 36.2 feet. On March 11, twelve days previous to the arrival of the crest of the rise at Memphis, announcement was issued from the Memphis office that the maximum stages in that district would be as follows: New Madrid, 29 feet; Memphis, 25 feet. On March 16 the estimate for Memphis was increased to 26.5 feet, and a stage of between 35 and 36 feet predicted for Helena, Ark. The repeated assertion that the water would not exceed the estimates given was generally accepted, and work along the river continued without interruption. The greatest variation from the predicted stages and those that actually oc-

curred was 0.3 of a foot, while the average time given was eight days. The maximum stages on this rise were as follows: New Madrid, 29.1; Memphis, 26.8; and Helena, 35.1 feet. After the passing of this wave, the river fell slowly for a few days, the total fall being only two feet, when the decline was arrested by a second swell, which was first felt at Cairo on March 25. This rise was caused by general and heavy rains throughout Missouri, Illinois, Indiana, and Kentucky, swelling the Ohio at a rapid rate, and many of its tributaries to unprecedented stages. The Mississippi above Cairo also rose rapidly for several days, so that by March 30 it was apparent that a flood of considerable magnitude was on its way to this section.

On March 30 warning bulletins were mailed to every post office in the district and to all interests likely to be affected to prepare for a stage exceeding 36 feet on the Memphis gage. On the following day a second warning was issued to the effect that the stage would exceed 37 feet at Memphis, and reach at least 47 feet at Helena. The prediction was also made that New Madrid would have a stage of at least 38 feet. The people were warned that the stages indicated would severely tax the levees in the St. Francis district, and to be prepared for possible breaks. On April 6 the river at New Madrid, after rising slowly during the four preceding days, came to a stand at a stage of 38.6 feet. From the fact that the crest had passed New Madrid and the rise at Memphis from April 1 to 6 was only moderate and slowly decreasing, doubts were freely expressed regarding the probability of the Memphis stage reaching the 37-foot mark as predicted. On the latter date, however, the rise suddenly and unexpectedly increased to one foot or more per day, and continued at that rate for three days, carrying the water about one and one half feet above the highest estimate heretofore made. This unlooked for rise is now known to have been caused by the ponding of water in the Reelfoot country, which lies immediately south of Hickman, Ky.

This water entered that basin through a 10-mile gap near the upper end of the Reelfoot Lake district, and, after making its way slowly through the wooded lowlands, where it increased in volume, again entered the main stream near Fulton and Fort Pillow, Tenn. In that way the water passed around New Madrid and caused the deceptive changes recorded by that and other gages as far south as Osceola, Ark. This accumulated water then poured out upon the top of the flood, and raised the stage at Fulton about 3 feet in as many days. The ponding of water in the Reelfoot basin is due in a great measure to the changed conditions brought about through the extension of the levee system, which has raised the flood level to a height heretofore unknown, causing a deflection of the water into new channels. From an examination of the records obtained during the flood of 1903, it is seen that after the water had reached the highest stage at New Madrid, the Fulton gage indicated the same sudden increase noted this year, and for about four days the river rose over 1 foot a day. This information is important, as it clearly indicates that the remarkable rise that occurred at Memphis during the three days next preceding the arrival of the crest at that place in both 1903 and 1904 was probably due to the outpouring of water from the Reelfoot basin, and not, as was formerly supposed, to an engorgement produced by the railroad embankments in front of Memphis on Hopefield Point. These embankments may have had some effect on the stage at Memphis, but the main cause must be attributed to deflection of the water into the Tennessee basin, which has the same effect as the St. Francis basin formerly had on the Helena gage when the water was permitted to overflow that section.

The wave crest reached Memphis April 11 with a stage of 39 feet, and Helena on the 15th, the stage at that place being 47.7 feet. Warnings for the above stages were given two days in advance at Memphis and five days at Helena. The water remained above the danger line in this district, as follows: New Madrid 20, Memphis 19, and Helena 22 days. During the week preceding and the one following the arrival of the crest, all of the levees fronting the St. Francis basin were in a very critical condition, and had all the water they could hold. By prompt action on the part of the engineers and the employment of several hundred men the weak places were repaired, and a topping of sand bags placed wherever the height appeared insufficient. Notwithstanding the extreme height of the water, the continued rains, and other unfavorable weather conditions, the levees were held intact throughout the entire system, and marked the first successful resistance to the encroachment of the water on the St. Francis basin.

Compared to the flood of 1903, the stage at Cairo was 1.5 feet lower, New Madrid 0.9 of a foot lower, Memphis 1.1 feet lower, and Helena 2.3 feet lower. All of the island plantations and the lowlands in Arkansas that lie outside the levee were entirely covered, and the extreme southern portion of the St. Francis basin in the counties of Lee and Phillips, where no levee exists, was also flooded as usual. On the Tennessee side a large territory was inundated, causing considerable damage and great inconvenience to the dwellers in that section. In and about Memphis the flood was about as severe as in 1903, but as the people were better prepared, the damage was slight.

During the progress of the flood the Weather Bureau office was hourly besieged by anxious inquirers from far and near, while the telephone calls were more frequent than ever before known. The daily stages at all important points, and the daily forecasts were sent by telephone and telegraph to a large number of places for distribution to the adjacent

country. Maps and river bulletins were furnished all outgoing steamers for distribution along the river, and every possible means was employed to obtain and distribute information. In this way the people throughout the threatened district were at all times in close touch with this Bureau, whose work in this connection has been highly commended by many of those benefited thereby. It is worthy of note that the usual excitement attendant upon severe floods was noticeably absent this year. This was largely due to the conservative tone of the reports issued, and to the fact that newspapers, as a rule, refrained from publishing alarming and exaggerated accounts of the flood. This was very beneficial and prevented many people from incurring the unnecessary expense of moving property and families, and enabled planters to retain their negro workmen, who would have otherwise fled.

The third important rise of the season began about May 1, reaching its maximum at Madrid on the 7th, Memphis on the 9th, and Helena on the 11th. At Helena, only, did the water reach the danger line, Memphis being 0.8 of a foot, and New Madrid 0.5 of a foot below that mark. The crest stages on this rise were accurately predicted from six to eight days in advance, the stages forecast in no case showing a variation of over 0.3 of a foot. The following are the maximum stages recorded during the May rise: New Madrid, 33.5; Memphis, 32.2; and Helena, 42.0 feet. Owing to the lateness of the season and the damaging effect that an overflow would have at this time, especially upon growing crops, those having farming interests at stake were very anxious as to the outcome of the rise. However, as forecast, it did not cause the river to overflow its banks to any great extent, and no material damage resulted.

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Service Division.

The following summaries relating to the general weather and crop conditions during May are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3000 and 14,000, respectively:

Alabama.—Generally too dry and cool for growth; warm weather and fairly general rains during the last week beneficial, though drought continued in southeastern counties. Cotton stands generally inferior; plants small, but improving at close of month, when the crop was mostly chopped. Corn did fairly well; some upland corn laid by, some in tassel during last week, when oats and wheat were being cut; oats light yield; wheat fair to good; minor crops fair.—*F. P. Chaffee.*

Arizona.—Moderate temperatures prevailed during May. The precipitation was above normal, most of it occurring on the 10th and 11th. Crops in the lower Colorado Valley made fine growth. Local showers early in the month revived vegetation elsewhere, but the dry weather which followed largely overcame the beneficial effect of those showers and crops were again in poor condition. The ranges, which were improved by the rain, again deteriorated. Stock generally suffered greatly.—*M. E. Blystone.*

Arkansas.—Cool, with less than the usual amount of rain. Cotton planting completed; early planted fair stand; late planted fair to good; plant small but healthy; chopping well advanced. Corn planting completed; stand fair to good; cultivation general; being laid by in southern portion at close of month; stalk small but healthy. Oats and wheat promising; heading in southern portion at close of month. An average crop of apples and peaches of excellent quality indicated.—*Edward B. Richards.*

California.—Dry northerly winds during the month caused considerable damage to grain and vegetables, and high winds on the 24th and 25th seriously injured cherries and other deciduous fruits in some sections. The grain and fruit crops promise to fall below early estimates in nearly all parts of the State. Barley harvest and haying are progressing. The hay crop is large and of excellent quality. Deciduous fruits are ripening and citrus fruits are in good condition.—*G. H. Willson.*

Colorado.—Month favorable. Planting of corn and early potatoes was finished. Potatoes were a good stand, but the weather was too cool and wet for corn. Fall grain, alfalfa, and range grass improved steadily. Gardens were good and the prospect for fruit was fine, only slight damage resulting from frost. Beet thinning, melon planting, and tomato setting were under way. Floods caused considerable damage in the Poudre Valley during night of 20th.—*F. H. Brandenburg.*

Florida.—The month was dry and mostly cool, conditions favorable for farm work, but not conducive to the germination of seed and the growth of plants. Early planted cotton advanced very well and at the close of the month was fruiting freely; late planting was backward; poor stands were general. Corn suffered for rain and the crop from the early planting will be short. Citrus fruits dropped freely as result of drought. Pineapples were cut off very much. Peaches were plentiful, but small.—*A. J. Mitchell.*

Georgia.—The first half of the month was moderately cool, the latter part abnormally warm. This was the eighth consecutive month with precipitation below average. Crop conditions were serious, drought

There was also a flood in the Colorado River of Texas during the early days of the month, due to heavy general rains. Warnings were issued on the 4th for danger-line stages below Austin, and they were fully verified. In the Brazos River the stages, while quite high, did not reach dangerous proportions.

There is nothing further of special interest to be mentioned, except the somewhat remarkable fact that ice in considerable quantities, the last remnants of the great gorge of the winter of 1903-4, was observed along the Susquehanna River between Harrisburg and York Haven, Pa., after the middle of the month.

The highest and lowest water, mean stage, and monthly range at 188 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. 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.—*H. C. Frankenfield, District Forecaster.*

prevailed until the very last of the month, when beneficial showers occurred and relieved a situation that was viewed with grave apprehension. Cotton made slow growth. Spring oats were almost a failure. Corn was abnormally small. Fruit prospects were bright.—*J. B. Marbury.*

Idaho.—The driest May on record; irrigated crops made satisfactory progress, as a rule, but some unirrigated hay and grain and late sugar beets suffered from drought. There was some damage to fruit by frost, but not sufficient to affect the general yield materially. Range grass made excellent growth and stock made good gains. Streams remained high from melting snow.—*Edward L. Wells.*

Illinois.—The month opened with unseasonable weather, but quite favorable conditions followed, beginning during the first decade and continuing for the most part during the remainder of the month. Considerable advance was made in corn planting; about one-half the crop was in the ground by the 15th, and by the end of the month corn was mostly all planted in the northern portion, and the work was well advanced in the southern. Oats, wheat, and grasses were generally promising.—*Wm. G. Burns.*

Indiana.—Farming operations continued behind throughout the month. On account of poor crop prospects much wheat was plowed up; the remainder promised light crop. Sowing oats was finished during first decade, prospects favorable for good crop. Corn planting began about May 10, and was unfinished at end of month; much replanting necessary on account of cutworms. Old clover thin and weedy, other hay crops promising. Peaches promised light crop; other fruits fair to excellent prospects.—*W. T. Blythe.*

Iowa.—May was about normal as to temperature and rainfall, with generally favorable conditions for planting, germination of seed, and cultivation. Delay in planting was caused in limited areas by excess of rainfall on previously saturated soil. As a whole the month was favorable for field operations, germination of seed, and normal growth of grasses, cereals, potatoes, and garden truck. Fruits were more promising than in recent years.—*John R. Sage.*

Kansas.—Wheat continued in good condition, had headed in the southern counties, and was heading in the central. Spring wheat made good growth. The wet weather retarded corn planting and the cool nights retarded its growth, yet by the end of the month the corn was coming up in the northern counties and was being cultivated in the southern. Oats, barley, and grass made good progress. Alfalfa was ready to cut in several counties by close of month.—*T. B. Jennings.*

Kentucky.—Moderate warmth during the first week was followed by cool weather until about the 20th, checking the growth of crops. The temperature rose afterwards and warm weather continued until the end of the month. The rainfall was a little less than normal and irregularly distributed. Wheat improved decidedly during the month. Corn advanced well during the last ten days. The month closed with tobacco setting in progress. Crops generally in good condition.—*H. B. Hersey.*

Louisiana.—Cotton planting was completed under favorable conditions; prevailing low temperatures caused poor stands in some localities and retarded growth, but warmer weather at close of month proved more favorable; the plant was small but healthy. Corn grew slowly; the crop was well cultivated. Cane grew slowly but was generally promising. Irrigated rice did well; the rainfall was not sufficient for Providence rice. Truck gardens gave good yields.—*I. M. Cline.*

Maryland and Delaware.—Temperature and sunshine were above nor-