

551.5093(73) "1916.4"

SECTION III.—FORECASTS.

FORECASTS AND WARNINGS FOR APRIL, 1916.

By EDWARD H. BOWIE, Supervising Forecaster.

[Dated: Weather Bureau, Washington, May 19, 1916.]

During the first six days of the month the barometric readings were higher than normal over eastern and southern Alaska, and after the 20th readings were again much above the normal over the entire Alaskan area: in the interval from the 7th to the 19th, inclusive, there was a prolonged depression of the barometer. The reports from Honolulu show a steady pressure above the normal from the 1st to the 19th and a period of subnormal pressures from the 19th to the 30th, inclusive. The subpermanent area of high barometer over the Atlantic Ocean, as shown by the barometer readings at the Azores, was well above the seasonal average from the 3d to the 19th, inclusive, and ill-defined before and after these dates. In the vicinity of the Bermudas, the pressure fluctuated frequently but was near or slightly above the normal in this region during the month.

As might be expected from the variations in the great centers of action over the middle latitudes of the Atlantic Ocean and the Alaska and Aleutian Islands area, the migratory low pressure and high pressure systems shown by the daily weather maps of the United States and southern Canada, were not confined to any particular region as to their first appearance on these charts nor did they follow well-defined paths. The lows were 14 in number, 5 of which belonged to the Alberta, 4 to the Colorado, 1 to the South Pacific, 2 to the East Gulf, 1 to the South Atlantic and 1 to the Central Type. The highs were 11 in number and of these 7 first made their appearance off the Pacific coast north of San Francisco, 3 entered the United States from the western Canadian Provinces and 1 formed over the northern Rocky Mountain region.

WASHINGTON FORECAST DISTRICT.

On the 1st of the month a LOW of considerable intensity was central over Texas, whence it moved eastward across the Gulf States to the Carolina coast by the morning of the 4th, and from this region its center traveled north-northeastward off the Atlantic coast to Newfoundland during the following 48 hours. This disturbance caused strong shifting winds on the east Gulf coast during the 2d, warnings of which were ordered the morning of the 1st on the Mississippi, Alabama, and northwest Florida coasts. This was the only storm warning required on the east Gulf coast during the month. On the morning of the 4th when this storm was central off Cape Hatteras, storm warnings were ordered on the Atlantic coast from Delaware Breakwater to Boston, and during the afternoon and night of this day winds of verifying velocity occurred in the region where warnings were displayed. As the storm advanced rapidly, the duration of the storm winds was not prolonged and no damage to shipping occurred.

The next low of importance east of the Mississippi River formed over the central Rocky Mountain region on the 5th, advanced southeastward to Texas on the

6th, moved eastward across the Gulf States during the 7th, and during the 8th advanced rapidly northeastward. On the morning of the 9th, the center of this disturbance was near Cape Cod, where the pressure was as low as 29.34 inches. When this storm was central over the Carolinas storm warnings were ordered for the Atlantic coast from Delaware Breakwater to Eastport, Me., and winds of gale force occurred within the succeeding 36 hours in the region where warnings were displayed. Moreover, strong westerly winds occurred on the east Gulf and south Atlantic coasts in connection with this disturbance, but as they were not of sufficient force to justify storm warnings, special advices for the benefit of small crafts were sent these regions at the time the storm was passing through the Gulf States. This low was followed by an extensive area of high pressure from the Northwestern States, and as it advanced southward over the Gulf and South Atlantic States it was attended by general frosts on the 9th, 10th, and 11th in these regions, excepting the Florida peninsula. Frost warnings were widely disseminated the morning of the 8th in the east Gulf States, Georgia and South Carolina; the morning of the 9th in the east Gulf and South Atlantic States, except the Florida peninsula, and on the same day warnings of frosts and freezing temperature were issued for Tennessee, the Ohio Valley and the Middle Atlantic States; on the morning of the 10th frost warnings were repeated for the Middle Atlantic and South Atlantic States, except the Florida peninsula and the upper Ohio Valley.

During the night of April 13 there was a rapid development of storm conditions within a region of low pressure that prevailed over the Great Lakes, and on the morning of the 14th, when the center of the disturbance was over the lower Lake region, storm warnings were displayed on the Atlantic coast from Norfolk, Va., to Eastport, Me. The storm under consideration moved southeastward from the lower Lakes and the evening of the 14th its center was near Cape Cod, where the pressure was 29.20 inches. Winds of gale force occurred the afternoon and night of the 14th along the Atlantic coast north of Cape Hatteras. The highest velocities, in miles per hour, were as follows: Norfolk, 60 west; Washington, 44 northwest; Delaware Breakwater, 68 northwest; Sandy Hook, 44 northwest; New York, 72 northwest; Block Island, 46 northwest; and Nantucket, 48 northeast.

On the 16th a low of marked intensity was over the Great Lakes, and storm warnings were displayed on the Atlantic coast from Sandy Hook to Cape Cod; but the center of the Great Lakes storm kept well north of the St. Lawrence Valley and the expected storm winds did not occur. The display of warnings was ordered discontinued the morning of the 17th.

With the pressure high over the plains States and the Mississippi Valley and on the Pacific coast and relatively low over the intervening region, conditions were favorable during the 16th and 17th for the development of a storm over the middle Rocky Mountain region. This development took place during the 18th, and the evening of that day a storm center with barometer reading of 29.38 inches was over western Kansas. This storm advanced slowly northeastward to the Great Lakes on

the 21st, remained central in that region for several days and finally passed eastward off the Atlantic coast on the 28th. While moving from western Kansas to the Great Lakes this storm was attended by numerous thunderstorms in the middle Plains States and the Great Central Valleys and local wind storms and tornadoes within these regions. On the morning of the 20th, the day of resumption of storm warnings on the Great Lakes for the season of 1916, storm warnings were ordered for Lake Superior and the morning of the 21st for Lakes Michigan, Huron, Erie, and Ontario. The storm diminished after reaching the Upper Lake region and the storm winds were confined to Lake Superior. On the evening of the 21st, there were signs of the development of a secondary storm center over Virginia, and storm warnings were displayed on the Atlantic coast from Sandy Hook to Boston. The disturbance developed as expected, and the morning of the 22d it was central off the New Jersey coast and the evening of that date off Cape Cod. Strong, shifting winds occurred in the region where warnings were displayed. It is of interest to note that at the time the storm developed over Kansas on the 18th the synoptic cloud chart of that date showed a general flow of upper clouds toward the northeast over a widespread area extending from the Mississippi Valley westward over the Plains States and the Rocky Mountain region. The northeast movement of the upper clouds in advance of lows that form over the southwestern States is commonly observed, but it is uncommon that this movement of the upper clouds not only prevailed in advance of the storm center but as well in the region of the storm center and in its western quadrants.

Warnings of frosts were issued for southern Indiana on the 22d, for the Ohio Valley and the mountain districts of the Middle Atlantic States on the 23d, for the Ohio Valley and the Middle Atlantic States on the 24th, for the Ohio Valley on the 25th, for the region of the Great Lakes, the Ohio Valley and Tennessee on the 27th and for the Ohio Valley on the 28th.

DISTRICT WARNINGS DURING APRIL.

Chicago district.—The month was uneventful as far as the issuing of special warnings is concerned. The period was between what might be termed the cold-wave and the frost-warning season. No frost warnings were issued in the first half of the month, and those issued in the second half were few and of little importance, on account of the lateness of the season.—*H. J. Cox, Professor of Meteorology.*

Denver district.—Warnings of frost or freezing temperature were issued for some part of the district on 19 days during the month. The large number of warnings issued was due to the prevalence of threatening pressure distribution and the fact that the development of fruit and vegetation was unseasonably advanced in parts of the district. The month opened with a disturbance over southern Texas and another forming over southern Nevada. Frost warnings were issued for eastern New Mexico on the morning of the 1st. A heavy frost occurred at Roswell the following morning, with minimum temperature at the freezing point in eastern New Mexico. On the 2d warnings of frost or freezing temperature were issued for northwestern Utah. Freezing temperatures occurred the following morning in the extreme northwest portion of Utah only, as the high pressure moved well to the northward before crossing the Rocky Mountains. The morning weather map of the 3d showed increasing pressure on the eastern slope in Wyoming and freezing

temperature warnings were issued for eastern Colorado. They were fully verified. Warnings of freezing temperature were again issued for eastern Colorado on the morning of the 4th and also for northern New Mexico, and frost warnings for portions of Arizona and Utah. Freezing temperatures occurred in eastern Colorado and a portion of New Mexico; although it cleared and the temperature fell in southern Arizona and southwestern Utah, frosts did not follow in these sections. On the 5th, 6th and 7th frost or freezing temperature warnings were issued for a large part of the district, as the southwestern disturbance was steadily moving southeastward and a ridge of high pressure was developing over the northern parts of the Rocky Mountain and Plateau regions. These warnings were verified over a large portion of the area for which issued, and by the morning of the 7th freezing temperature, with local frosts, had spread over the entire district, excepting the southern portions of Arizona and New Mexico, and on the 8th killing frosts extended as far southward in New Mexico as Roswell. On the 9th the pressure decreased rapidly throughout the district and temperatures were well above the normal on the 10th. Another disturbance developed over Nevada on the 10th and 11th, attended by abnormally high temperature. It moved rapidly eastward to the Plains States and was followed by an anticyclonic area of considerable intensity from the Pacific. Warnings of frost or freezing temperatures were issued on the 12th for Colorado and Utah. They were verified except in southern and western Colorado and southeastern Utah, where a disturbance that developed over northeastern Arizona caused overcast skies and rain. From the 11th to the 19th temperatures were generally above the freezing point in this district. On the 19th, however, an anticyclonic area moved eastward across the North Pacific States in the wake of a disturbance that had formed in the middle Rocky Mountain region and moved eastward to Iowa. Warnings of frost or freezing temperature issued on the 19th for Utah, Colorado, and eastern New Mexico were verified except in southeast New Mexico. The frost or freezing temperature warnings issued on the 20th were only partially verified owing to falling pressure. Another anticyclonic area appeared on the North Pacific coast on the 22d and frost warnings were issued for Utah and western Colorado, but the high moved northward to Montana and, although clear skies prevailed, temperatures were not low enough for frost to form. High pressure overspread the Plains States on the 24th, and frost or freezing temperature warnings were issued for the easternmost portions of the district on the 24th and 25th. These warnings were verified in portions of eastern Colorado on the morning of the 27th only. An area of low pressure was central on the morning of the 29th in northern New Mexico, with an anticyclonic area spreading rapidly eastward over the northern plateau. Frost warnings for Colorado and Utah were distributed and special warnings were issued for the fruit districts in Colorado on the western slope. Frost or freezing temperature warnings were also issued on the 30th for Colorado, including the fruit districts, Utah and eastern New Mexico. These warnings were fully verified in the greater part of the area, a sharp fall in temperature being general. The minimum temperatures in the fruit district on the western slope were well below the freezing point, temperatures as low as 22 degrees being registered. Smudging was resorted to quite extensively and but little damage occurred except where the orchards were not protected by smudging.—*Frederick W. Brist, Assistant Forecaster.*

New Orleans District.—On the 1st storm warnings were ordered for the Galveston section of the Texas coast and for the Louisiana coast as follows:

Hoist southeast storm warnings 8.40 a. m., Velasco, Tex., to Salmen (Slidell), La. Disturbance centered over southwest Texas will move eastward and cause moderate to strong southerly winds on the Louisiana coast and southerly to westerly winds on the Texas coast to-day and to-night.

The storm showed considerable intensity over Texas, where it caused a wind velocity of 42 miles from the southeast at Galveston, but it moved eastward less rapidly than was anticipated, diminished in intensity, and did not give a storm velocity at New Orleans.

Frost warnings were issued on the 1st for western Texas, Oklahoma, the interior of eastern Texas, and northern Arkansas, but on account of the slow movement of the storm area from Texas the high pressure from the Plains States did not move southward and frost occurred only in western Texas and the western portion of Oklahoma. Frost warnings were repeated on the 2d for Arkansas, Oklahoma, northern Texas, and northwestern Louisiana, but the high pressure area did not move southward into the west Gulf States, partly cloudy to cloudy weather prevailed and frost occurred only in Oklahoma and the northwestern portion of Arkansas. During the night of the 6th–7th an area of low pressure moved rapidly eastward from the Rio Grande Valley and gave severe local storms in the vicinity of New Orleans between 2 a. m. and 3 a. m., ninetieth meridian time, on the 7th, but the disturbance did not give a storm wind at the Weather Bureau office. (These local storms have been made the subject of a special report.) This disturbance was attended by general rains, which had been forecast. The rapid eastward movement of this disturbance followed by an area of high pressure from the northwest gave freezing temperatures in the Texas Panhandle and northwestern Oklahoma. Frost warnings were issued on the morning of the 7th for the interior of the district with freezing weather over the Texas Panhandle and northern Oklahoma. The high pressure area from the Rocky Mountain region moved southeastward until the crest on the morning of the 8th was over Nebraska and the warnings were fully verified. Warnings of freezing weather for the northern portion of the district and frost nearly to the coast were issued on the 8th. The crest of the high pressure moved from Nebraska southward into Texas and the warnings were fully verified. Frost warnings were repeated on the 9th for the west Gulf district, except the western coast of Texas. The high pressure area moved rapidly eastward until its crest rested over the South Atlantic States on the morning of the 10th, and while frost temperatures occurred over the interior of the district no general frost was reported. A storm area centered over Kansas on the morning of the 19th with an area of high pressure moving eastward from the north Pacific region, were the occasion of frost warnings for the Texas Panhandle and northwestern Oklahoma for the 20th, and frost temperature prevailed. On the morning of the 20th frost warnings were issued for the northern portion of western Texas, Oklahoma, except the southeastern portion, and the extreme northwestern portion of eastern Texas. The high pressure area did not move southeastward with the intensity anticipated and the warning was only partly verified. An area of high pressure which was over the eastern Rocky Mountain region and the Plains States on the morning of the 26th indicated frost for the northern portion of western Texas, Oklahoma, Arkansas, and the extreme northern portion of eastern Texas. While no general frost was reported, conditions

showed that the warnings was justified, except in Arkansas, where the temperatures remained too high for frost. The crest of high pressure being over South Dakota on the 27th, frost warnings were repeated for Oklahoma and northern Arkansas, and frosts occurred on the 28th. Frost warnings were issued on the 30th for the Texas Panhandle and for Oklahoma, except the southeastern portion. The temperature fell to the frost point, but general cloudiness prevailed and no frost was reported. The long-range forecasts issued from the central office are given a wide distribution and are proving very valuable to agricultural and shipping interests.—*I. M. Cline, District Forecaster.*

Portland (Oreg.) District.—April was an unusual month in this district, largely because of the abnormal tracks taken by four high-pressure areas during the middle decade. Under normal conditions this month, which covers a large part of the transition period between the wet and the dry seasons, requires more than ordinary attention on the part of the forecaster, as in many localities the diurnal range in temperature is sufficient to cause the formation of frost on clear nights under almost any type of pressure distribution. Highs at the beginning and near the end of the month pursued their usual path from the California coast north to western Washington, and thence east across the Rocky Mountains, but those during the middle decade only went as far north as Oregon, when they advanced either eastward or northeastward, with the result that unsettled conditions prevailed a good portion of the time in the northwestern portion of this district in consequence of the proximity of lows over the Alaskan bight of the Pacific Ocean. Seven frost warnings for the entire district and 9 for local sections were issued, of which number 3 for general frosts were fully verified and 4 were partly verified. Of those partly verified, temperatures sufficiently low for the formation of frost occurred in practically every instance, but no frost formed in some of the localities because of cloudiness. In the case of the 9 forecasts of frosts for local areas, 5 were fully verified, 1 was a failure, and 4 were partly verified. The failures were due to cloudiness which either prevailed all night when it was expected to clear up or it clouded up in the early morning after having been previously clear. No frosts occurred without warnings, and they were of value only in places where protective measures are taken. Not so much protective work is being done as formerly on account of the expense, as well as owing to a difference of opinion existing among horticulturists as to the effectiveness of orchard-heating methods now in general use.

One storm warning was issued to stations at the mouth of the Columbia River only, which was fully verified. Small-craft warnings were issued on 4 occasions for exposed localities in the district, but it is not known whether they were verified or not. No maximum wind velocities were reported by stations at or in the neighborhood of places where the small-craft warnings were displayed. During the night of the 16th–17th and the afternoon of the 21st, velocities slightly exceeding those necessary to verify a warning were reported at Seattle, Wash., but it is believed they were in the nature of squalls and of short duration. No warnings were displayed at the time of their occurrence. The wind also attained a maximum velocity of 64 miles per hour from the southeast at North Head during the evening of the 26th, without warnings being displayed. This was a sudden squall and lasted only a few minutes.

Four "sets" of warnings were issued for cold, wet, and windy weather for the benefit of the live stock industry. The first was on the 3d, followed by another on the 4th,

and the final one was sent on the 5th. These warnings announce (1) when the bad spell of weather will begin; (2) any changes to better or worse that are anticipated during its prevalence; and (3) when the bad spell will break and be followed by fair and warmer weather. The second "set" of warnings for the live stock people was sent on the 10th-11th and 14th, the third on the 17th-19th and 21st, and the last on the 26th and 29th. They were all fully verified and were greatly appreciated by the stock men. The Prosser State Bank of Washington wrote on April 29, 1916, as follows:

As far as I am advised, the shearing season is about closed in this vicinity. Your weather reports have assisted us very much in the past, but I do not believe they would be of any particular value now, unless, of course, something very severe should appear on your chart.

—*E. A. Beals, District Forecaster.*

San Francisco District.—There were no forecasts or warnings of marked importance issued during the month,

except the "fire-weather" forecast issued to the district forester on the 29th. The forecasts of weather were generally satisfactory, except the light rain in northern California on the 11th was predicted for only the extreme north with doubtful period, and indefinite forecast for showers for the district on the 17th was a failure except in the extreme northwest and in the mountains from which no regular reports are received. The temperature forecasts were in general satisfactory, although the rapid shifting of the disturbances caused some failures. The cooler weather in Nevada on the night of the 17th-18th and in the southern portion on the 29th were not predicted.

The first warning of warm weather with north wind and conditions favorable for forest fires was issued to the district forester on the 29th and was timely, as several small fires were reported during the day of the 30th in the forests —*G. H. Willson, District Forecaster.*