of about 4 miles per hour measured at the evaporation station anemometer 2 feet above ground. The sky was partly overcast with clouds at medium height. At 4:35 p. m., clock time, the wind was heard rushing through the woods at some distance, the sky became suddenly overcast with low uniform clouds, there was a sudden gust of strong wind from the west accompanied and followed by dense smoke with a strong smell of burning wood. The temperature dropped from 62° to 51° and the rainfall measured by the Friez recording gage was 0.05 inch between 4:49 and 5:02 p. m. The appearance and odor of smoke was so strong and came so suddenly that one instinctively looked about for a fire in the woods.

The conditions apparently were produced by a layer of cool air underrunning the sluggish, warm and humid surface air which had prevailed throughout the afternoon, forcing it upward with extreme suddenness and producing the light rain. Being interested in the question of the origin of the smoke I made inquiries at Little Falls, located 73 miles west from Albany in the Mohawk Valley, and learned that substantially the same phenomenon as regards wind conditions and the appearance and odor of wood smoke were observed there at very nearly 4 p. m., clock time. * * * In view of the prevailing forest fires of Minnesota the question arises as to the possibility of a connection between this smoke-bearing wind gust and these fires. The air in the Mohawk Valley had been remarkably clear for this season of the year prior to the smoke storm of October 13.—*R. E. Horton.*

Brockport, N. Y.—Sunday, October 13, the light was a curious greenish-yellow until after 2 p. m.

Ithaca, N. Y.—Atmospheric conditions of Sunday, October 13, presented a heavy, smoky appearance in the northern and western sections of the State. The sun and sunlight took a curious greenish-yellow appearance which, in some respects, was not unlike full moon and moonlight in some localities, while in other parts the atmosphere seemed to have been filled completely with a dismal contour of hazy yellow clouds, causing the day to be termed by some as a "yellow" day. In still other places the sun appeared like a bright ball of fire peering through the hazy sheen. Unquestionably the peculiar appearance was due to a heavy pall of smoke, which is believed to have been wafted eastward and southeastward over the Great Lakes by high winds of a strong anticyclonic area of atmospheric pressure from the northeastern sections of Minnesota, where disastrous forest fires that destroyed several towns and cost many lives, raged for some days previous to the "yellow" day of the 13th.

Raquette Lake, N. Y.—From 4 to 5 p. m. unusual sun and sunlight, more like full moon and moonlight.

Wedgwood, N. Y.—A dense smoke with smell of burning leaves observed in the p. m. The sun appeared like a ball of fire.

Burlington, Vt.—Atmosphere very smoky in the afternoon, clearing away shortly after sunset.

New Haven, Conn.—Light smoke was observed during the evening.

Pittsburgh, Pa.—On the 13th dense smoke having a woody odor was observed in the afternoon during a 20-mile wind. The sky was almost copper-colored and the pungent, acrid odor was noted throughout the Pittsburgh district, causing difficulty in breathing, a smarting and burning of the eyes.

Elkins, W. Va.—The smoke of the 13th is believed to have been due to the great Minnesota fires.

Smithfield, W. Va.—On Sunday evening, October 13, for some hours the town was filled with smoke from forest fires in west.

Baltimore, Md.—Light smoke set in at 9:50 p. m. and became dense at 10:15 p. m.

Washington, D. C.—A beautifully clear evening until about 10 p. m., when light smoke, with a strong odor of burning wood, was noticeable. By 10.30 p. m. the smoke cloud became denser, and was distinctly visible over the face of the moon. By 11 p. m. the moon and stars had disappeared, and street-lights half a block distant were appreciably dimmed.

OCTOBER 14.

Madison, Wis.—Dense smoke from some time in the night to 9 a. m. Light smoke from 9 a. m. to some time during the night.

Wausau, Wis.—Smoke from the forest fires in northern Minnesota and Wisconsin was observed.

Portland, Me.—Light smoke observed.

Elkins, W. Va.—Smoke on the 14th believed to have been due to the great Minnesota forest fires.

Greenville, S. C.—Light smoke from early morning until about 10 a. m., which merged into a light haze during the following night.

OCTOBER 15.

Washington, D. C.—Dark layer of haze or smoke on the western horizon in the morning increased in elevation and became lighter in color as the day advanced.

Macon, Ga.—Sky covered most of the day with Ci. St. clouds moving from the west and northwest. With these there was a generally hazy or smoky condition of the air strata.

Thomasville, Ga.—Light smoke was observed to-day.

College Station, Tex.—At 8.20 a. m. there was an unusual amount of haze; and at 10:40 there was a well-defined smell of forest fire smoke and the haze had become dense. Evidently, this was smoke from the Minnesota fires having come in the lower air around the front of the large north-south high pressure area.—*C. F. Brooks.*

Devils Lake, N. Dak.—Mention is made of the smoky condition of the atmosphere. Easterly winds on the 15th and 16th drifted the smoke from the large forest fires of northern Minnesota over this district.

Ellendale, N. Dak.—Light smoke occurred on the 15th and 16th. It was no doubt due to the great forest fires raging in northeastern Minnesota.

OCTOBER 16.

Ludington, Mich.—Considerable smoke on th 16th and on several days previous, due mostly, it is thought, to forest fires in Minnesota.

Columbus, Ohio.—Light smoke noted in the upper air from 1:30 p. m. to 5 p. m. Aviators at a height of 3,500 feet were not visible.

Portland, Me.—Light smoke recorded.

College Station, Tex.—Smoke limited visibility to 3 km., odor still apparent.—*C. F. B.*

Williston, N. Dak.—Light smoke, presumably from forest fires in the northeast during the day.

OCTOBER 17.

Portland, Me.—Light smoke recorded.

College Station, Tex.—Most of smoke gone.—*C. F. B.*

Lodge Pole, Nebr.—Smoke so dense can not see sun.

Valentine, Nebr.—A pall of smoke hung over this station from the 17th to the 19th, inclusive. This smoke came from northeastern Minnesota, where disastrous forest fires had raged several days before.

SUMMARY.

From the foregoing the following facts stand out. On the 12th of October great forest fires raged in northeastern Minnesota and adjoining portions of Wisconsin. At Duluth the smoke became dense about the middle of the afternoon. By the following morning (13th) the smoke cloud had overspread the Michigan Peninsula and central Indiana. In the next 12 hours strong northwest winds had extended this cloud across Ohio into New York, Pennsylvania, West Virginia, Maryland, and the District of Columbia, the two latter being reached shortly after 10 p. m. On the morning of the 14th, the smoke had spread as far south as Charleston, S. C. and Little Rock, Ark., and in another day more than 300 miles farther. On the 15th, easterly winds set in in western Minnesota. The smoke cloud was carried across North Dakota on the 16th and into Nebraska on the following day.

EFFECTS OF HURRICANES ON THE UPPER-AIR CURRENTS.

By Prof. WILLIAM H. PICKERING.

[Dated: Harvard College Observatory, Mandeville, Jamaica, B. W. I., Dec. 10, 1918.]

A short note under the above heading appeared in the MONTHLY WEATHER REVIEW for October, 1915, **43**, 496–497.[1] A piece of negative testimony on the same subject has just been obtained here. It was there shown that if we pointed a telescope to a bright star near the zenith, and then drew out the eyepiece 2 or 3 millimeters, so as to throw the image out of focus, a round disk of light would be obtained from which we could draw conclusions as to the condition of the upper air currents. In the temperate zone parallel lines crossing this image are not infrequently seen. They never appear in the tropics, however, unless some serious disturbance is at hand. They then lie in a direction parallel to the motion of the disturbance. In September, 1915, we were in this manner able to foretell a hurricane

[1] There is a longer, illustrated article by A. E. Douglass on "The study of atmospheric currents by the aid of large telescopes, and the effect of such currents on the quality of the seeing," in Am. Meterological Jour. 1895, 11:395-409.—*Ed.*

whose center was at a distance of 750 miles, some 20 hours before we received the Government notice of its presence, and two days before the center reached us.

On Thursday, August 22, of the present year we received our first notice from the United States Weather Bureau of a disturbance located to the southeast of Barbados. On August 23 we were warned by the local bureau to take all possible precautions as the disturbance would probably reach us on Saturday morning. Friday night was clear, and we hastened to the telescope, but to our surprise not a trace of any hurricane lines could be found. The star image was "moulding," however—that is to say, it looked as if it were being moulded by the fingers first in one place and then in another. This indicates local atmospheric disturbances. The seeing was poor, 6, later dropping to 5 on a scale of 12, but was not extremely bad, such as is the case in the vicinity of a hurricane. We therefore retired considerably relieved, in spite of the warnings. The next day the sky was heavily overcast, but with no rain and only moderate winds, and we were informed by the United States Weather Bureau that there was no definite information as to the location of the disturbance. As it turned out the hurricane either had not developed or had taken a more northerly course.

From this we conclude that telescopic observations of the kind described are of value in the local forecasting of tropical storms, not only to foretell their approach and the direction of their motion, but also sometimes to inform us that other indications are not to be trusted.

OCEAN TEMPERATURES IN LONG-RANGE FORECASTING.

By CHARLES F. BROOKS.

[Paper presented at the Baltimore meeting of the Association of American Geographers, Dec. 28, 1918.]

"Besides trying to predict the extremely variable state of the fickle atmosphere one should give more attention to the conservative element of meteorology, viz, the surface sheet of the ocean where changes may be observed months before their effect on our weather becomes manifest. [For example] a sensible departure from the average value of the vast amount of stored heat carried through the [Florida] Straits might have profound effects on the weather of the following months on the European and North American Continents."

These two sentences by Dr. Hans Petterson[1] led me to compare monthly departures of air temperature at stations in the eastern United States with those in the Gulf Stream. Encouraged by the results, I extended the investigation backward into the make-up of the Gulf Stream and Antilles Current, forward into the movement of the Gulf Stream Drift, and the effects of the Labrador Current, and upward into the influence of water temperatures on the overlying air. A report on the preliminary results just a year ago led to the active cooperation of the Weather Bureau in mapping more data, and later the Signal Corps offered additional help.

Let me outline the general basis which seems to make worth while the contemplated extensive investigation of ocean temperatures in long-range forecasting. If it is possible (1) to forecast the distribution of surface water temperature a few weeks in advance, it may prove possible (2) to forecast the general paths which will be followed by cyclones and anticyclones; and then (3), from the winds which will result, to make long-range forecasts of the general weather to be expected in any period. Let us consider each of these points more in detail.

1. *How do water surface temperature departures originate and move?*

Insolation and radiation are the most important factors in the general heating and cooling of the ocean surface. The temperature of the air is of little consequence in the heating, and still less in the cooling, of the ocean surface, for the specific heat of water per unit volume is about 3,300 times that of air under ordinary conditions.

Departures of the temperatures of the sea surface from the normal are almost wholly the result of variations in wind direction and velocity. Helland-Hansen and Nansen have shown in their recent book[2] that in middle latitudes of the Atlantic the wind direction is largely responsible for the occurrence of plus and minus temperature departures. Following a winter month with the prevailing wind north of the normal over any region, the water temperatures are almost invariably below normal, while a month with prevailing winds south of normal is followed in the next by water temperatures above normal. The air temperature, of course, shows similar, though greater and more immediate, departures. The coldness or warmness of the water is probably dependent more on transportation of water from colder or warmer latitudes than on the cooling or warming by the wind which is driving it. At any rate the evaluation of each factor is of little consequence for both act to produce the same result.

The effect of changes in wind velocity is most noticeable in the Tropics, where changes in direction are of little or no effect. When the trade winds are unusually strong for a period, the warm layer of surface water is driven forward and concentrated in the Equatorial Current, where it forms a plus departure in temperature. The place of this warm surface sheet is taken by cooler subsurface water, making a minus departure. Under the influence of the wind the area of plus departure followed by that of minus moves slowly westward. Using Hepworth's data,[3] I found that most months of unusually strong northeast trade winds in the eastern Atlantic are followed in 4 to 6 months by plus departures in the temperature of the surface water passing through the Straits of Florida, and in 8 to 11 months by minus departures. The southeast trade in the eastern Atlantic, acting through the South Equatorial Current, part of which feeds the Gulf Stream, produces a similar plus and then minus departure in the Straits of Florida, 6 to 9 and 10 to 14 months, respectively, after the month of unusually strong southeast trade.

What happens to these waters of varying temperature as they debouch into the Atlantic? The strength of the Gulf Stream carries them forward to the region south of Nantucket within a month; but their identities are not lost for several months more in the case of water markedly warmer or colder than usual. In fact, in spite of the obliterating effects of shifting winds of varying strengths, many of the water temperature departures observed in the Gulf Stream, Antilles Current, or Labrador Current are discernible many months later on the coast of Europe, especially when the water has made most of the transit in the quieter months of the year. From the Straits of

[1] Meteorological Aspects of Oceanography, M. W. R., June, 1916, 44: 338-341, 2 figs.

[2] Temperatur-Schwankungen des Nordatlantischen Ozeans und in der Atmosphäre Christiania, 1917. See author's abstract, M. W. R., April, 1918, 46: 177-178.

[3] M. C. W. Hepworth, The Trade Winds of the Atlantic Ocean. Metl. Office, London, No. 203, 1910.