storms became more frequent, at first once a week, then every three to five days, until in late February and early March it rained almost every day, often several times a day in the form of showers. The weather of 1900-1901 is being repeated after the long intermediate drought. In all these storms the rain-bearing winds have come from the south, or a little east or west of south, hence from the ocean. Several thousand miles of wind have passed northward.

It does not appear probable that such long-continued winds are wholly connected with passing areas of low barometer. They more nearly resemble persistent monsoons, perhaps the anti-trades. It is generally supposed that the summer movement of Pacific air northward and eastward over Mexico and the adjacent portion of the United States is due to a partial vacuum over the heated land. The winter movement must be due to a *plenum* over the sea, if we use the correlative term.

Several questions arise—

1. What relation do these movements of moist sea air eastward and northward over the lands adjacent to the Gulf of California bear to the anti-trades, the Pacific region of calms, and the area of high barometer of the northern Pacific Ocean?

2. How far north and east do these winds carry their moisture?

3. What connection did the extremely wet, alternating with dry, seasons have with the recent great variations of solar radiation observed by Professor Langley by aid of the bolometer?

4. Did the volcanic eruptions have any effect on these seasons?

Postscript.—Dated March 22, 1905, at Arizpe, on the Sonora River, in Sonora County, Mexico, latitude N. 30° 20′, longitude W. 110°, Greenwich.

It rained every day till it ended in a tremendous downpour on March 8-9. Then it was pleasant for three days; then we had one and one-half days of heavy showers, clearing up by the 15th. The high cirrus streamers on the 15th showed that the upper circulation was from a little north of west. The Sonora River has been so high that it could not be crossed by horses and wagons, and there are no bridges. The storm of March 13-14 was the heaviest of the season and since then no rain, except two little showers. Twice the high cirrus has set in from the southwest, but, in less than 24 hours, veered to the northwest, and during three days there was no sign of cirrus or other cloud.

A HEAVY DEPOSIT OF HOARFROST AND ITS EFFECT IN RETARDING NOCTURNAL COOLING.

By DEWEY ALSDORF SEELEY, B. S., Observer, Weather Bureau, Peoria, Ill.

On the morning of February 26, 1905, there was an unusually heavy deposit of frost and the idea was suggested of attempting to measure the actual amount of precipitation thereof, in the form of water. Accordingly a smooth, horizontal, wooden surface, about one foot above ground, was selected as a place of measurement and the task undertaken. The large galvanized portion of the rain gage was inverted upon this surface, thus marking out a circular area covered with frost, the size of the top of the rain gage. This frost was then carefully collected, by means of a large knife, and placed in the brass portion of the rain gage, the latter having previously been partially filled with water at about 60°. Several measurements of the depth of water in the gage, before and after the frost was placed therein, were very carefully made. The increase in depth resulting from the addition of the melted frost deposit was determined to be very nearly 0.018 inch.

The question was then suggested as to the heating effect of the condensation of so large an amount of vapor into frost. This was roughly determined by means of the formula

$$V = \frac{WH}{10\ W'S},$$

V being the volume of air heated 10° F., W the weight of the frost deposit per square foot, or 0.09284 pounds; H the number of heat units given out by the condensation of vapor into frost, or 1092; W' the weight of a cubic foot of saturated air at 30° F., and under a pressure 30.00 inches, or 0.081 pound; and S the specific heat of air at a constant pressure, or 0.238. From this formula V equals 525 cubic feet. In other words sufficient heat was evolved from the condensation of 0.018 inches of water, from vapor to frost, to raise the temperature of the air for about 525 feet above the surface by an average of 10° F., provided this heat was all consumed in heating the air. It can not be assumed that the heat thus evolved from the condensation of vapor into frost on a clear night is directly effective in warming the air, as it is probably very largely radiated through the atmosphere unimpeded. However, this heat does supply a large amount of the energy which is radiated from the surface of the ground and retards the cooling of the latter, thereby having a tendency to retard the rapid cooling of the atmosphere in contact therewith.

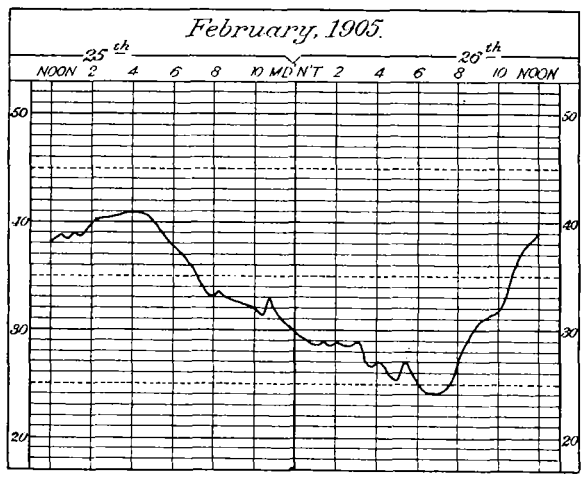

FIG. 1.—Thermograph trace from noon February 25 to noon of the 26th.

A copy of the thermograph trace from noon February 25 to noon February 26 is given in fig. 1, showing that the fall in temperature during the night was retarded. The temperature at 8 p. m., February 25, was 33°, and the dew-point at that time 32°. The temperature fell but 8° below the dew-point as determined at 8 p. m. The night was very favorable for radiation and rapid cooling, the sky being perfectly clear and the wind very light. The temperature would, therefore, undoubtedly have reached a much lower point had it not been for the heat evolved from the condensation of vapor into frost. Had the air continued to cool throughout the night at the same rate as before condensation of moisture began, the temperature would have reached 5°, whereas the minimum on the morning of the 26th was but 24°.

It is reasonably certain that a deposit of dew or frost will prevent the temperature from falling many degrees below the dew-point, as determined in the afternoon or evening preceding. Truck gardeners, cranberry growers, and others who are so greatly affected by the occurrence of frosts, and who can, in a measure, allay the destructive effects by means of flooding, "smudging," etc., might often be able to forecast with reasonable certainty whether a frost is liable to occur at a time when conditions seem favorable for it, by determining the temperature of the dew-point late in the afternoon. If the latter is near the freezing point a frost may be expected, providing other conditions favor it, but if the dew-point is found to be 8° or 10° above 32° the heat of condensation can be depended upon to prevent freezing.