FORECASTING SANTA ANA WINDS

Thesis by

Elmer J. Fox

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No definite irrefutable conclusions can be set forth for the absolutely infallable forecasting of Santa Ana winds from the results of the rather meager investigation conducted by the author. To set forth adequate inflexible rules to cover every case would require an analysis of many such winds over a long period of time. But from a perusal of the accompanying 37 charts, covering the 3-hourly temperatures, dewpoints, wind directions and wind velocities for two such occurrences, and the raobs for two nearby stations for one period, we may arrive at a few facts which seemingly would apply in every case. From these few conclusions, by studying the accompanying charts, and by extending the investigation to other incidents of like nature, undoubtedly an accurate basis can be established for forecasting within a matter of hours or even minutes the approach and occurrence of Santa Ana winds.

As everyone knows, Santa Ana winds are caused primarily by a buildup of atmospheric pressure over the Great Basin, and when this pressure is great enough the air is naturally forced through the mountain passes into the valleys to the westward--provided of course that there is the necessary negative pressure gradient in those valleys. The Los Angeles Basin bears the brunt of this onslaught of high pressure winds because, while normally the center of the Thermal Low is in southern Nevada, a buildup of pressure in the Great Basin, forces the center of that Low to migrate westward. In this way the pattern is arranged for the outflow of air from the Basin into a space which now has lower atmospheric pressure, though ordinarily it would show considerably higher pressure.

As a usual occurrence, the pressure gradient between Burbank or Mines Field and Las Vegas ranges between two and six millibars, with the lower pressure being of course at Las Vegas. During May and June in the periods of foggy weather this differential may even reach ten millibars or more. However, when Santa Ana winds occur it is noted that a very slight rise of pressure at Las Vegas or Kingston above that at Burbank or Mines Field is enough to start the air pouring through the mountain passes into the Los Angeles Basin. A pressure differential in this direction of only one to two millibars is all that is required to bring winds of Beaufort Force six to nine in the valleys.

As was stated above, the Thermal Low is centered over the Los Angeles Basin at this time instead of close to the Arizona-Nevada-California boundary. As a result, it is observed that on the afternoon of the day preceding the strong winds, abnormally high temperatures prevail throughout the Los Angeles Basin. The dew point continues fairly steady and relatively high through the period of maximum temperature. Then it is observed that from two to six hours after the highest temperature is reached the dew point begins to drop sharply, and continues a downward trend until six to nine hours before the high winds subside, from which the trend is gradually upward, with a surge upward as soon as lighter winds prevail. The strong winds arrive from six to nine hours after the dew point begins to fall, placing their appearance approximately twelve hours after the time of maximum temperature.

East of the passes, however, it is noted that the great wind increase is begun shortly after the maximum temperature is reached. At Kingston the wind force becomes high from one to three hours after the maximum temperature is reached, and at Las Vegas the winds rise from three to six hours after the temperature begins to decline.

It appears that the high winds reach the lower parts of the Los Angeles Basin about twelve hours after they begin blowing at Kingston, and about nine hours after their increase at Las Vegas. They seem to reach their highest velocities in the lower portion of the San Fernando Valley. Bakersfield and San Diego appear to be situated at the northern and southern perimeter of the high wind area, being less affected by extremes of temperature and dew point, as well as by high winds.

During the passage of the high winds, higher than normal temperatures prevail, but without extreme maximums or minimums occurring.

To conclude, the following basic requirements are necessary for the occurrence of Santa Ana Winds, and their presence should first be ascertained in the preparation of a forecast of these winds:

1. High atmospheric buildup over the Great Basin.
2. Thermal Low over the Los Angeles Basin area.
3. Pressure gradient of one to two millibars from Las Vegas or Kingston to Burbank or Mines Field.
4. Extremely high maximum temperatures in the Los Angeles Basin on the afternoon before the high winds begin.
5. Falling dew points from two to six hours after time of maximum temperatures and from six to nine hours before high winds begin.
6. Extremely low W-values in raob at North Island for twentyfour hours before high winds begin and during the passage of the strong winds; also relatively low W-values and subsidence indicated in raobs at Oakland.

LQ - Las Vegas

°F

Temperature

80 70 60 50 40 30 20

60 50 40 30 20 10 0 -10

Dew Point

Wind

0030 0330 0630 0930 1230 1530 1830 2130 0030 0330 0630 0930 1230 1530 1830 2130 0030 0330 0630 0930 1230 1530 1830 2130 2230

Feb. 14, 1939 Feb. 15, 1939 Feb. 16, 1939 Feb. 17, 1939

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°F

KI- Kingston

Temperature

80 70 60 50 40 30 20

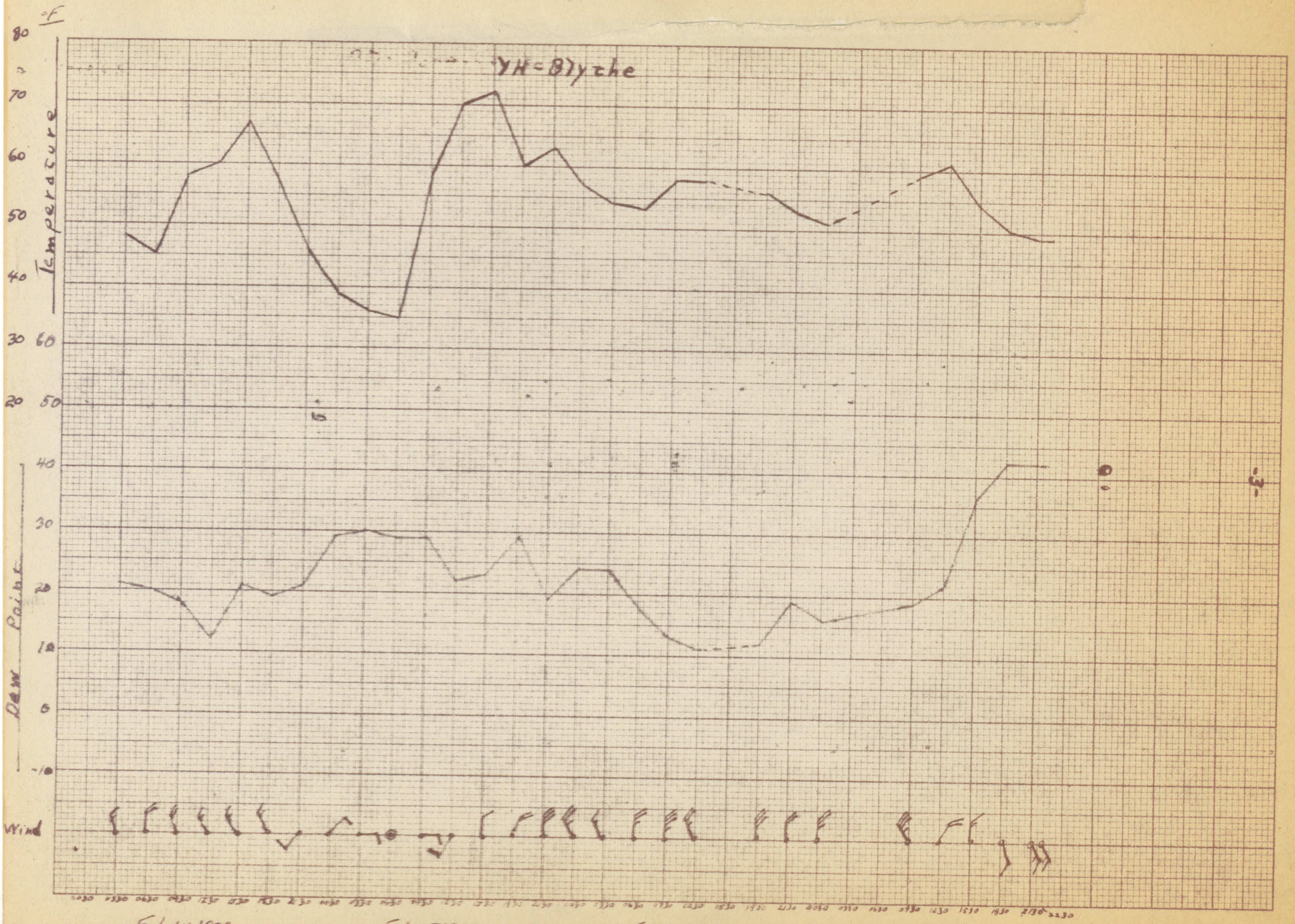
Dew Point

60 50 40 30 20 10 0 -10

Wind

0030 0330 0630 0930 1230 1530 1830 2130 0030 0330 0630 0930 1230 1530 1830 2130 0030 0330 0630 0930 1230 1530 1830 2130 2230

Feb. 14, 1939 Feb. 15, 1939 Feb. 16, 1939 Feb. 17, 1939



2 of 2

DB - Daggett

Temperature

80 70 60 50 40 30 20

Dew Point

60 50 40 30 20 10 0 -10

Wind

9:30 03:30 06:30 09:30 12:30 15:30 18:30 21:30 00:30 03:30 06:30 09:30 12:30 15:30 18:30 21:30 00:30 03:30 06:30 09:30 12:30 15:30 18:30 21:30 00:30 03:30 06:30 09:30 12:30 15:30 18:30 21:30

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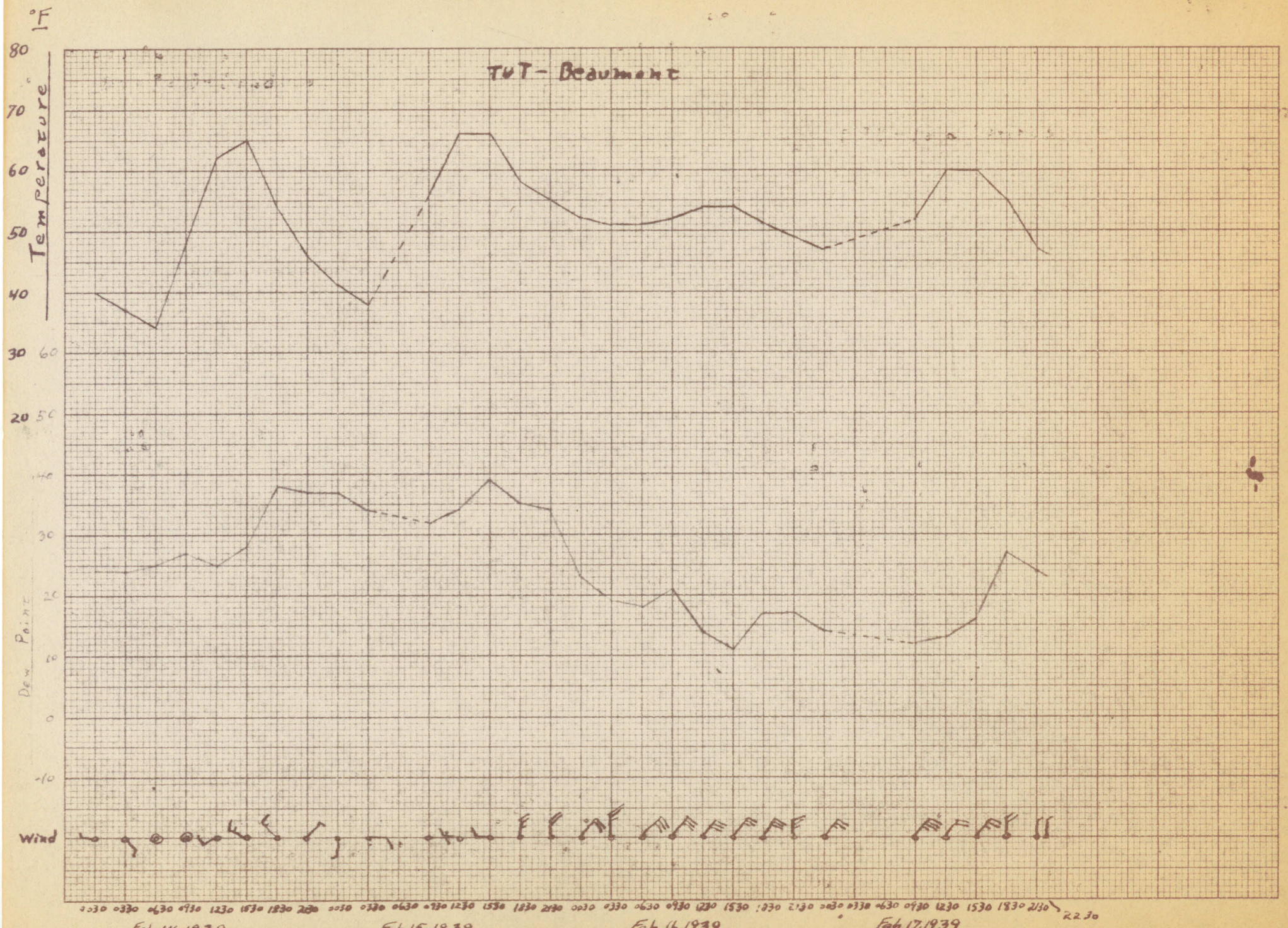

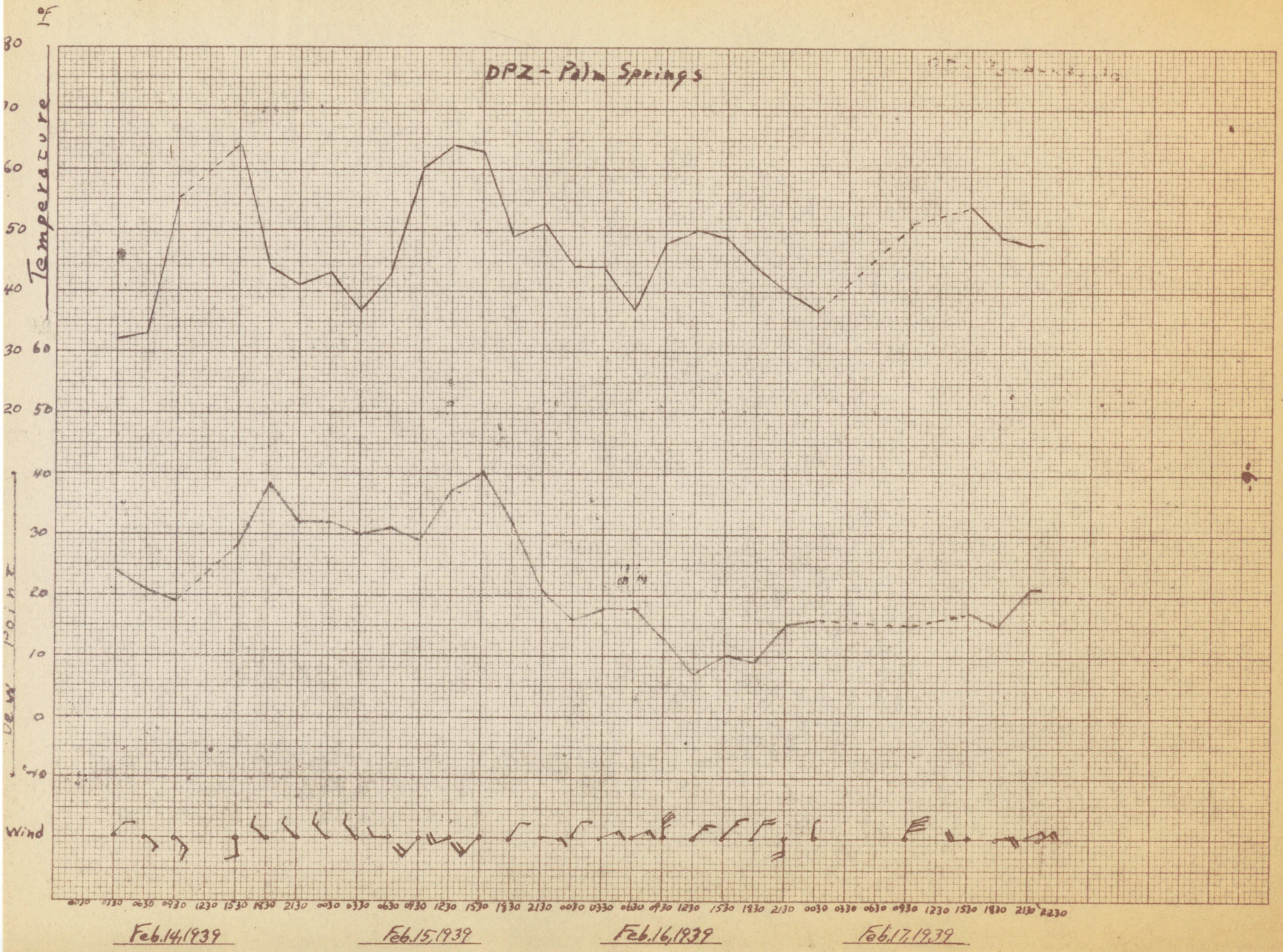

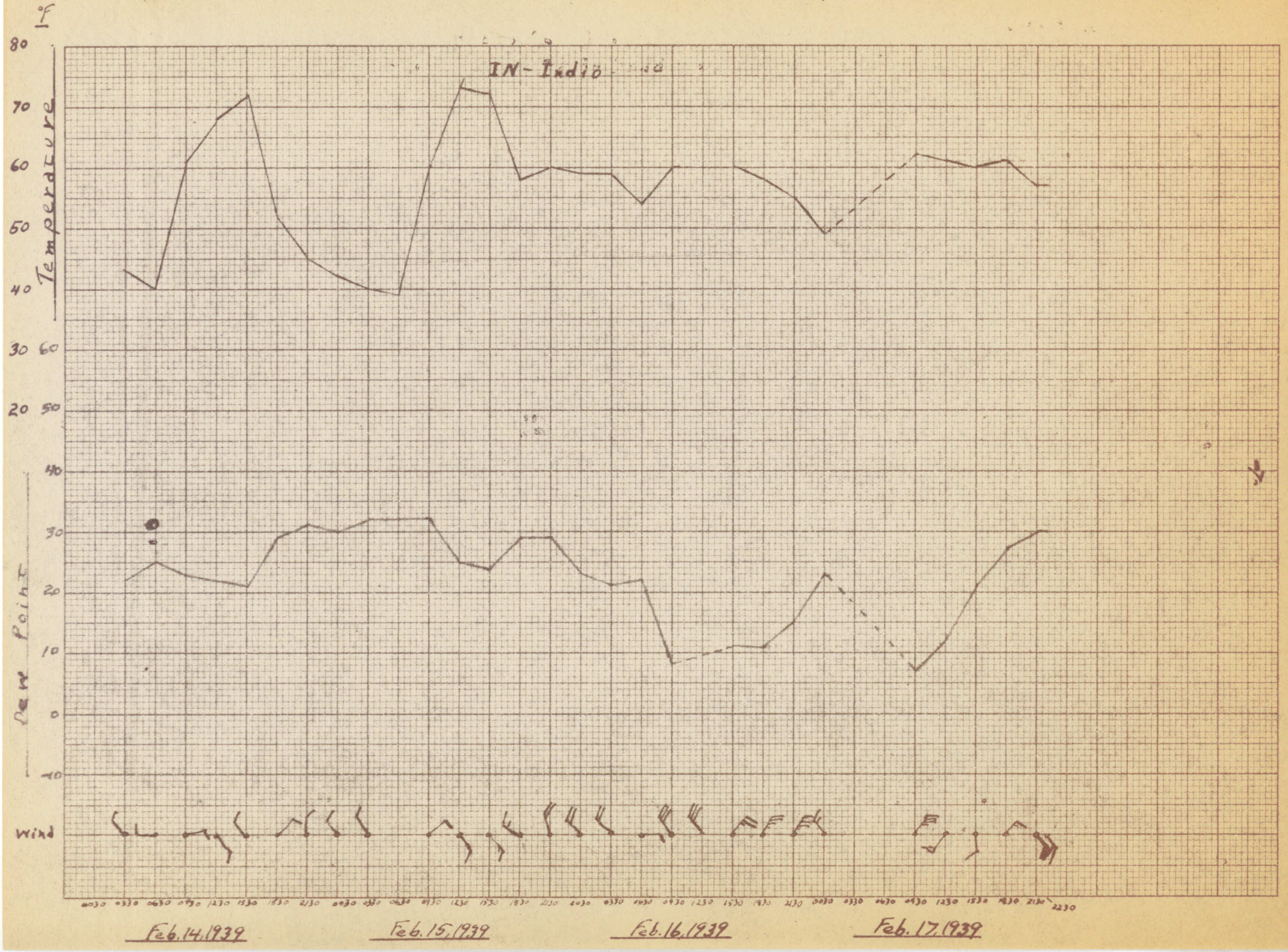

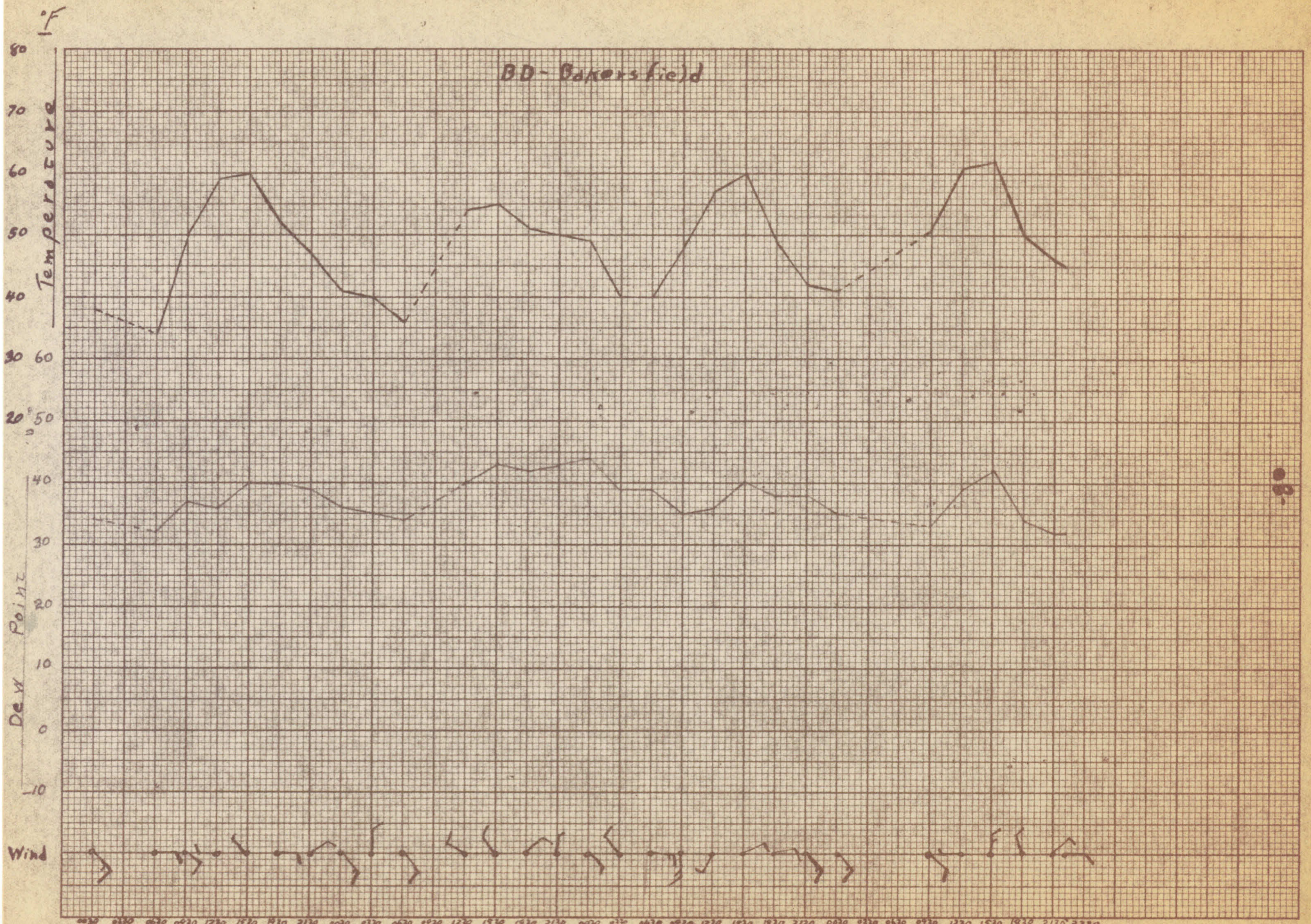

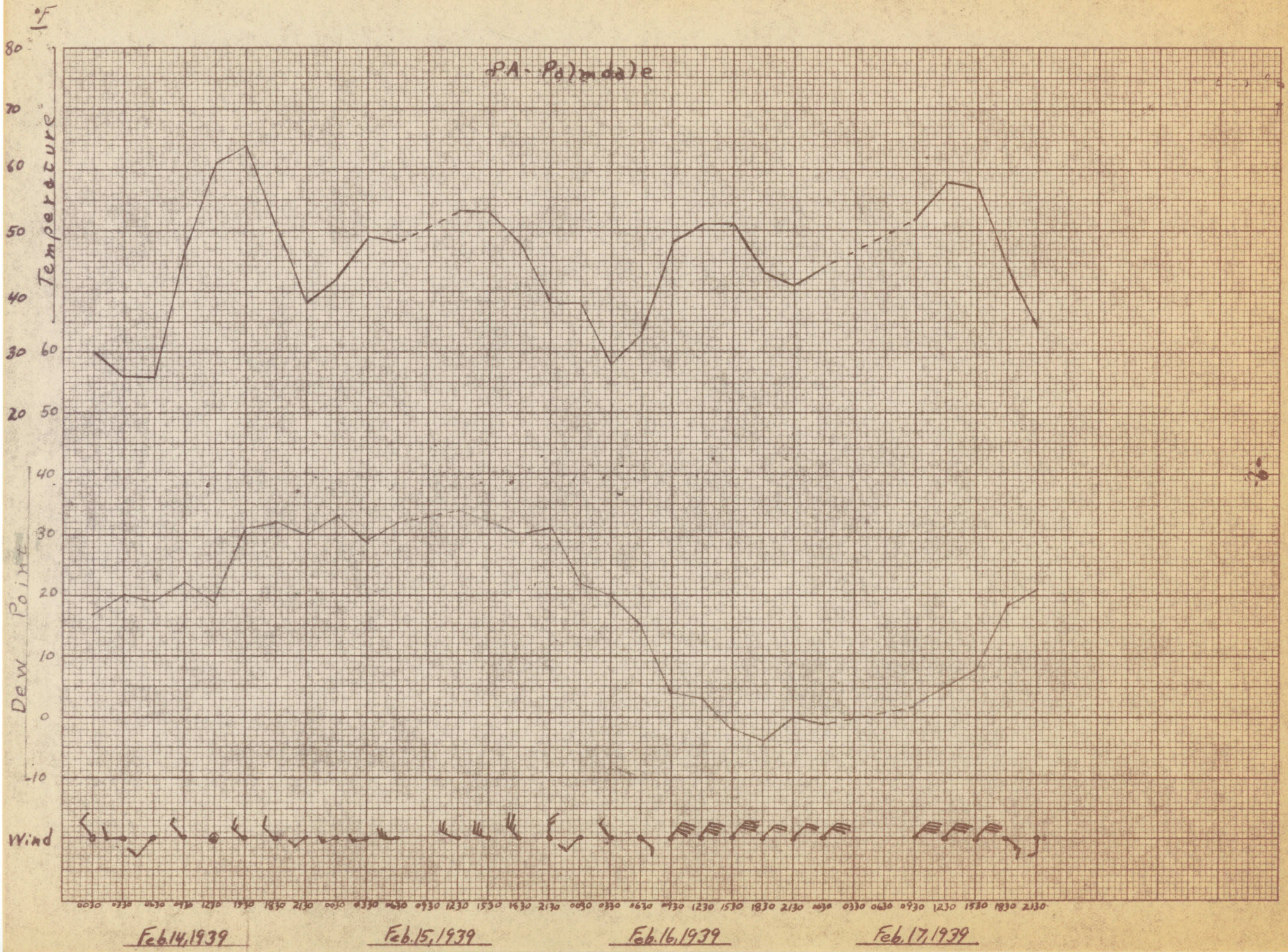

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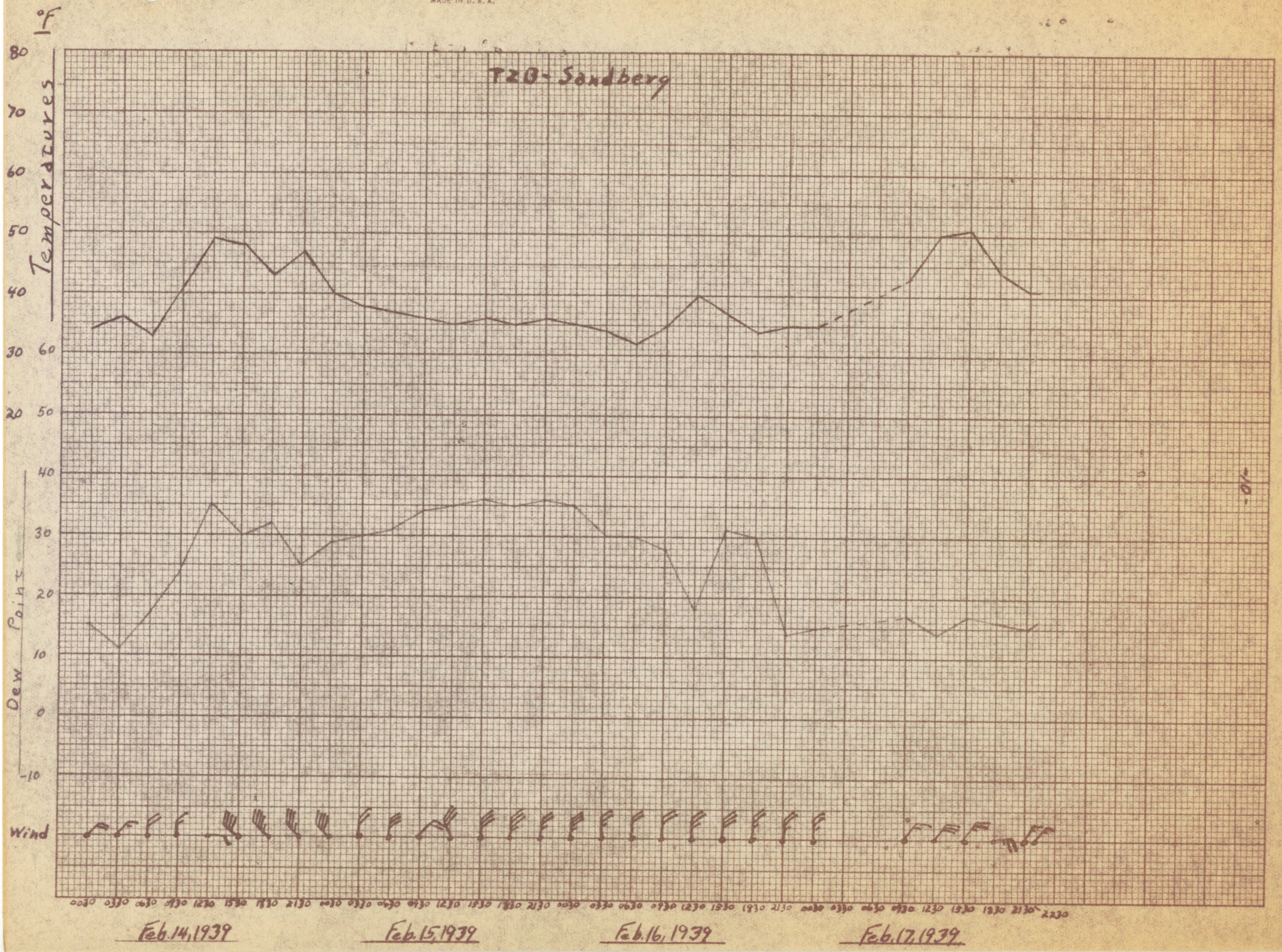

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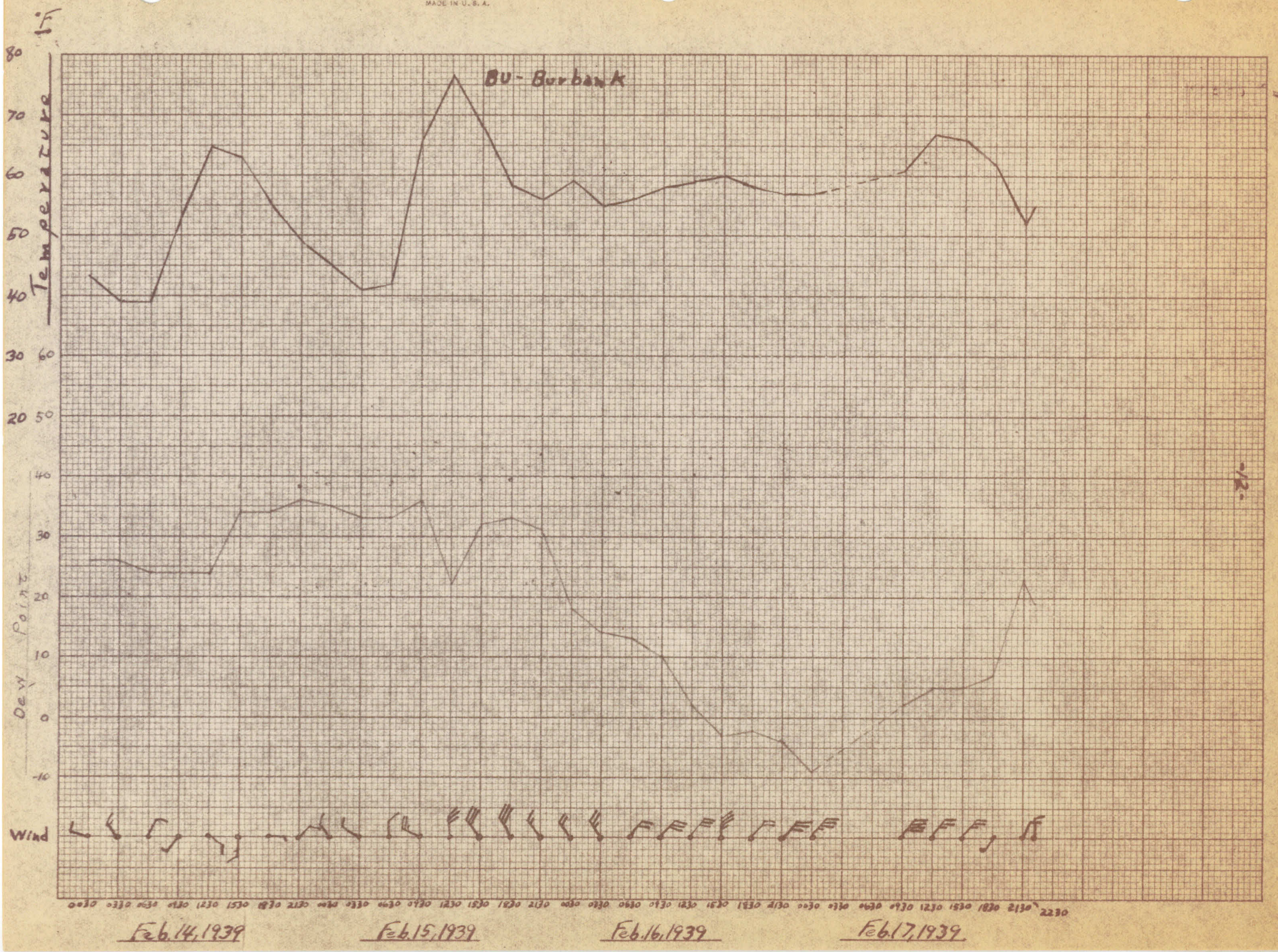


°F

80
70
60
50
40
30
20

Temperature

60
50
40
30
20
10
0
-10

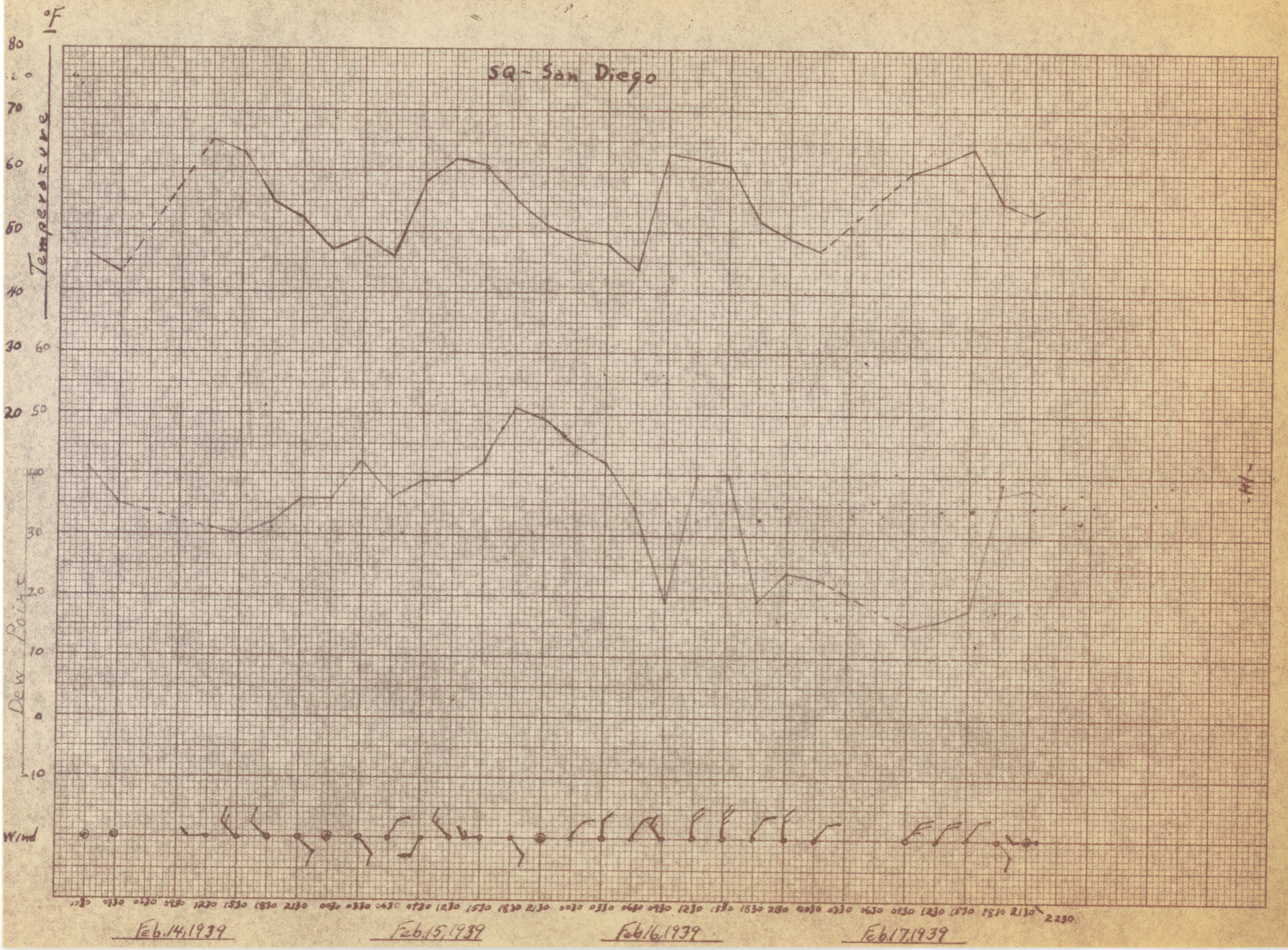
Dew Point

Wind

LA - Los Angeles

0030 0330 0630 0930 1230 1530 1830 2130 0030 0330 0630 0930 1230 1530 1830 2130 0030 0330 0630 0930 1230 1530 1830 2130 0030 0330 0630 0930 1230 1530 1830 2130 2230

Feb. 14, 1939 | Feb. 15, 1939 | Feb. 16, 1939 | Feb. 17, 1939



°F

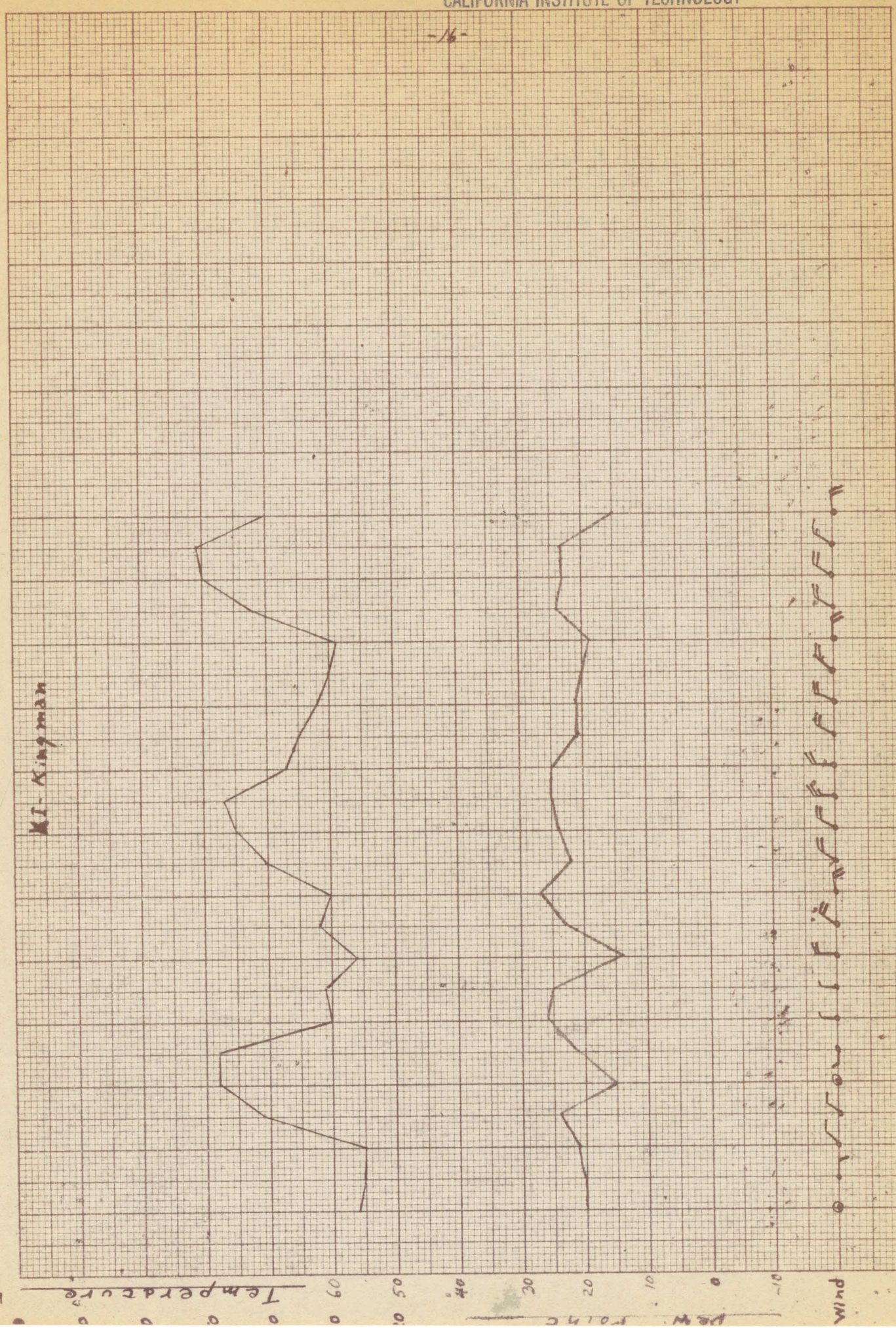
LQ - Las Vegas

Temperature

Dew Point

Wind

Nov. 19, 1941 Nov. 20, 1941 Nov. 21, 1941



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°F

Temperature

NJ - Needles

80
70
60
50
40
30
20
10
0
-10

Wind

Nov. 19, 1941 Nov. 20, 1941 Nov. 21, 1941

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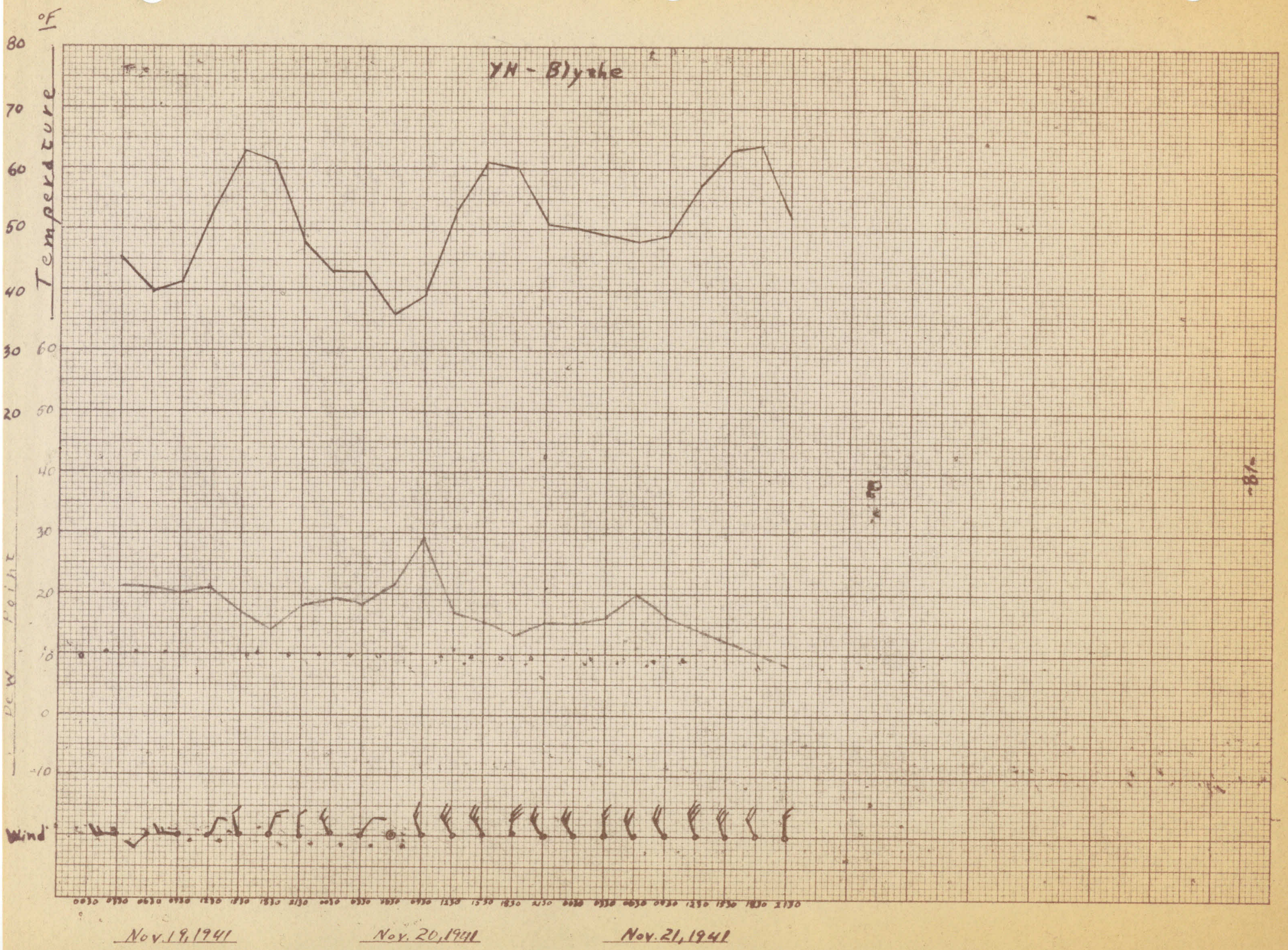

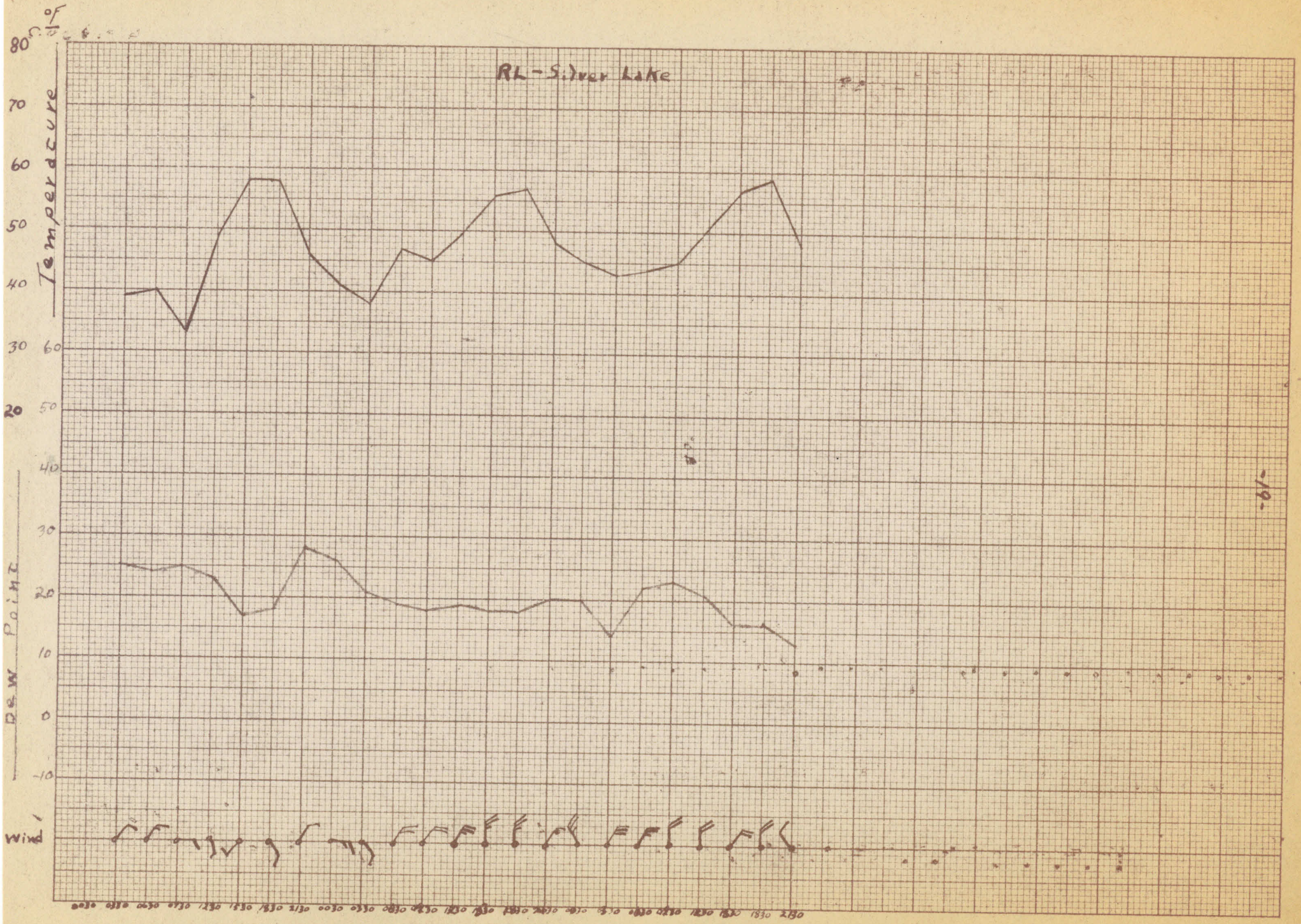

Nov. 19, 1941 Nov. 20, 1941 Nov. 21, 1941

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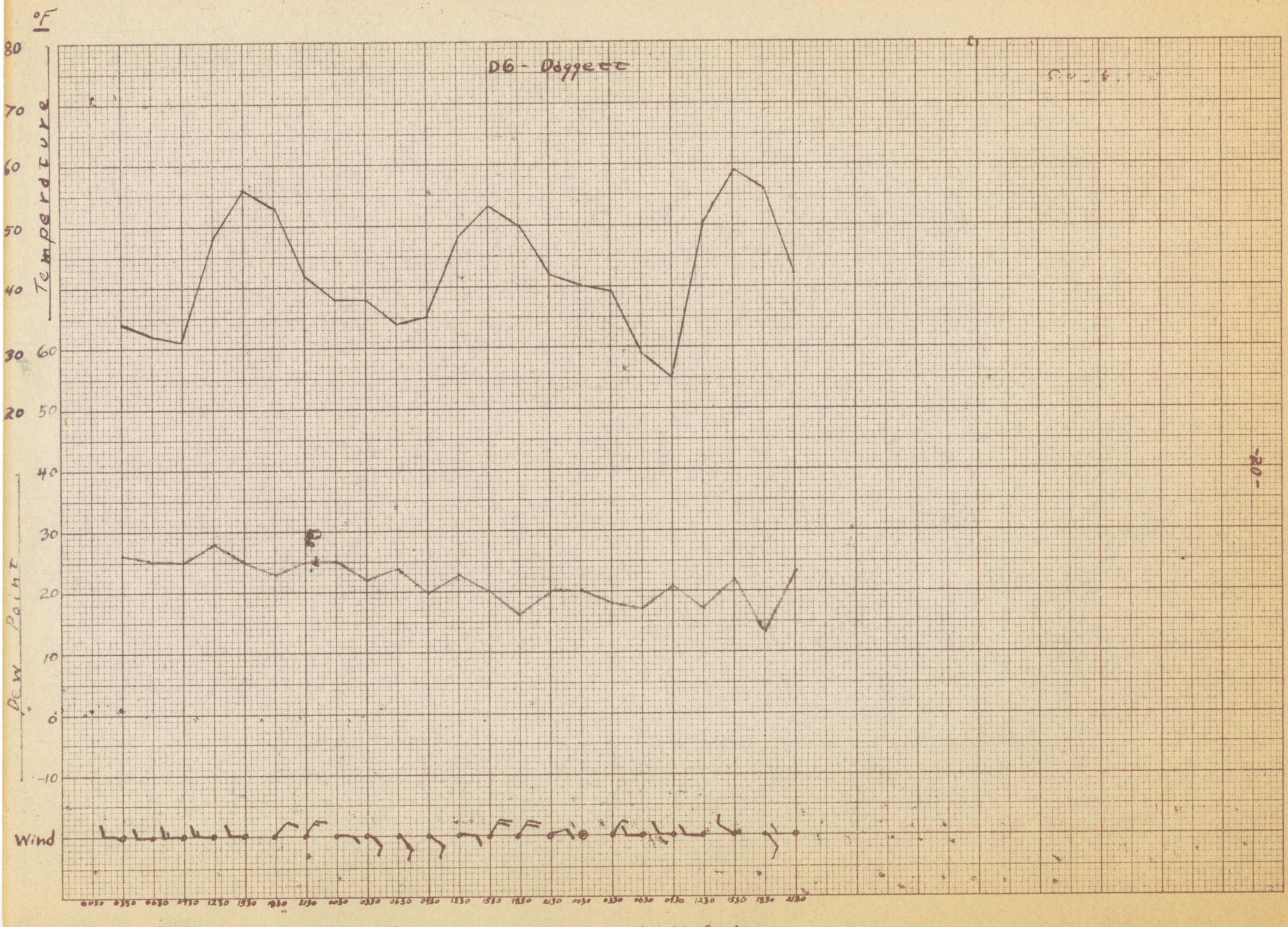

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°F

Temperature

DEQ - Victorville

60
50
40
30
20
10
0
-10

Dew Point

Wind

-21-

Nov. 19, 1941 Nov. 20, 1941 Nov. 21, 1941

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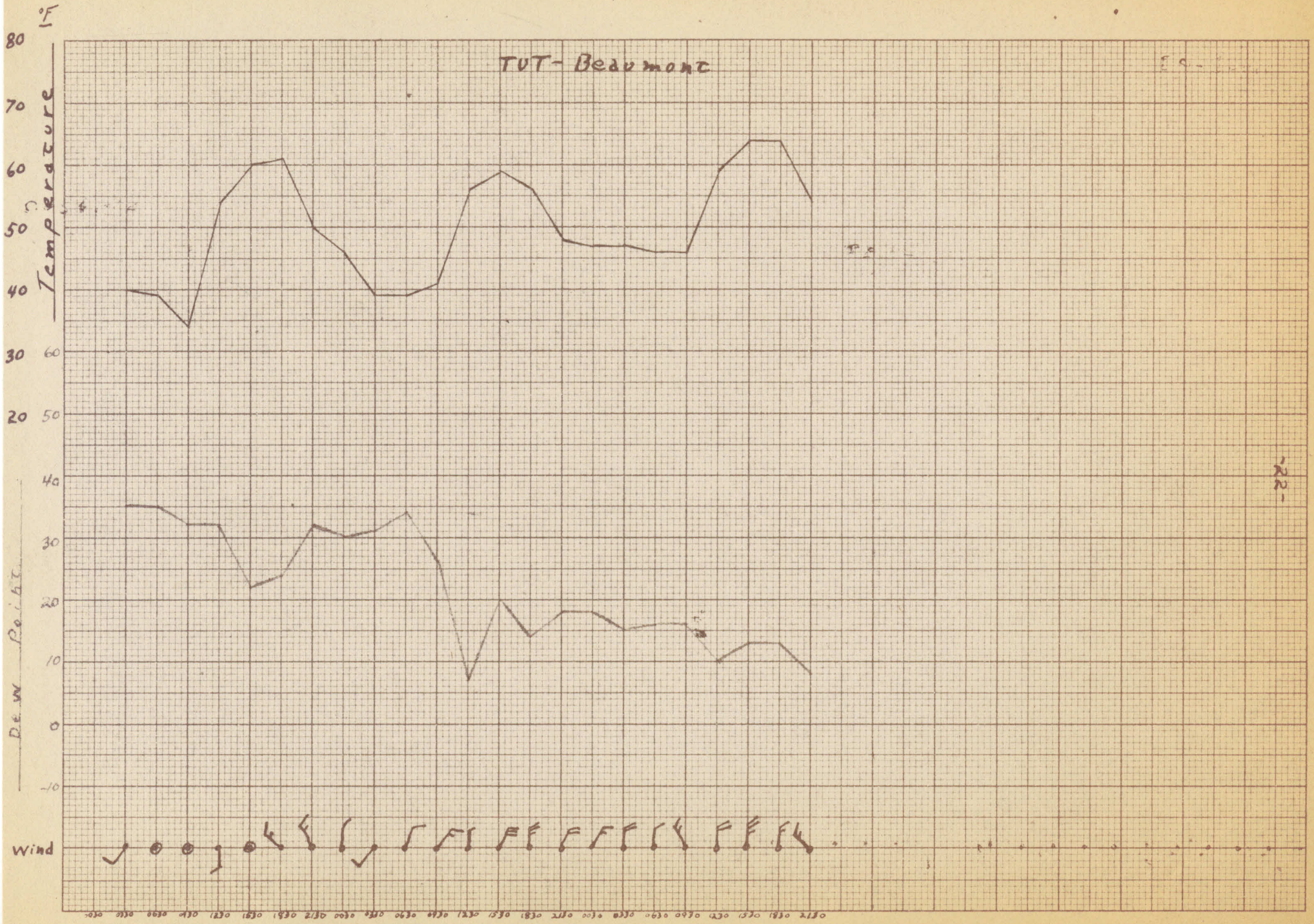

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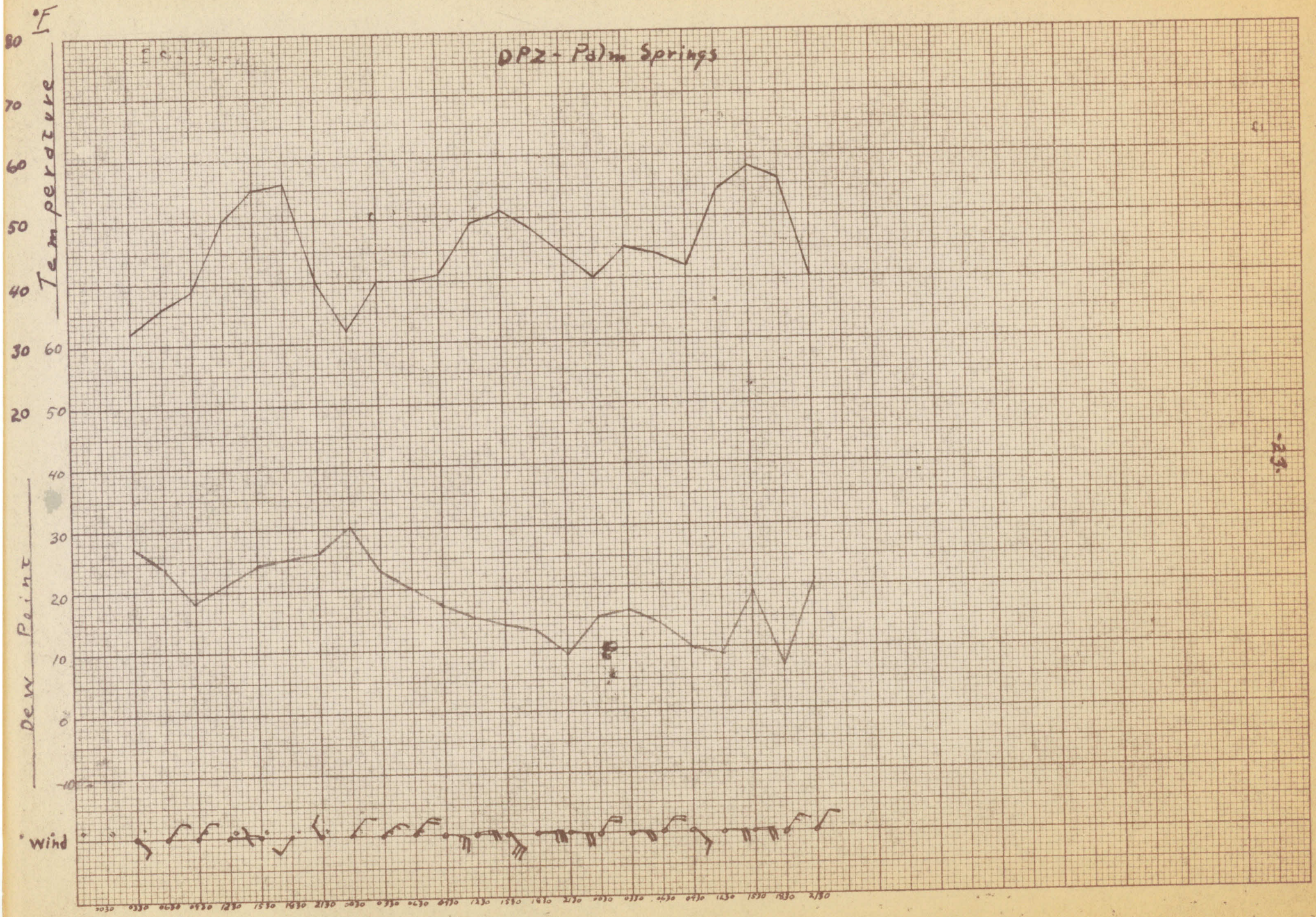

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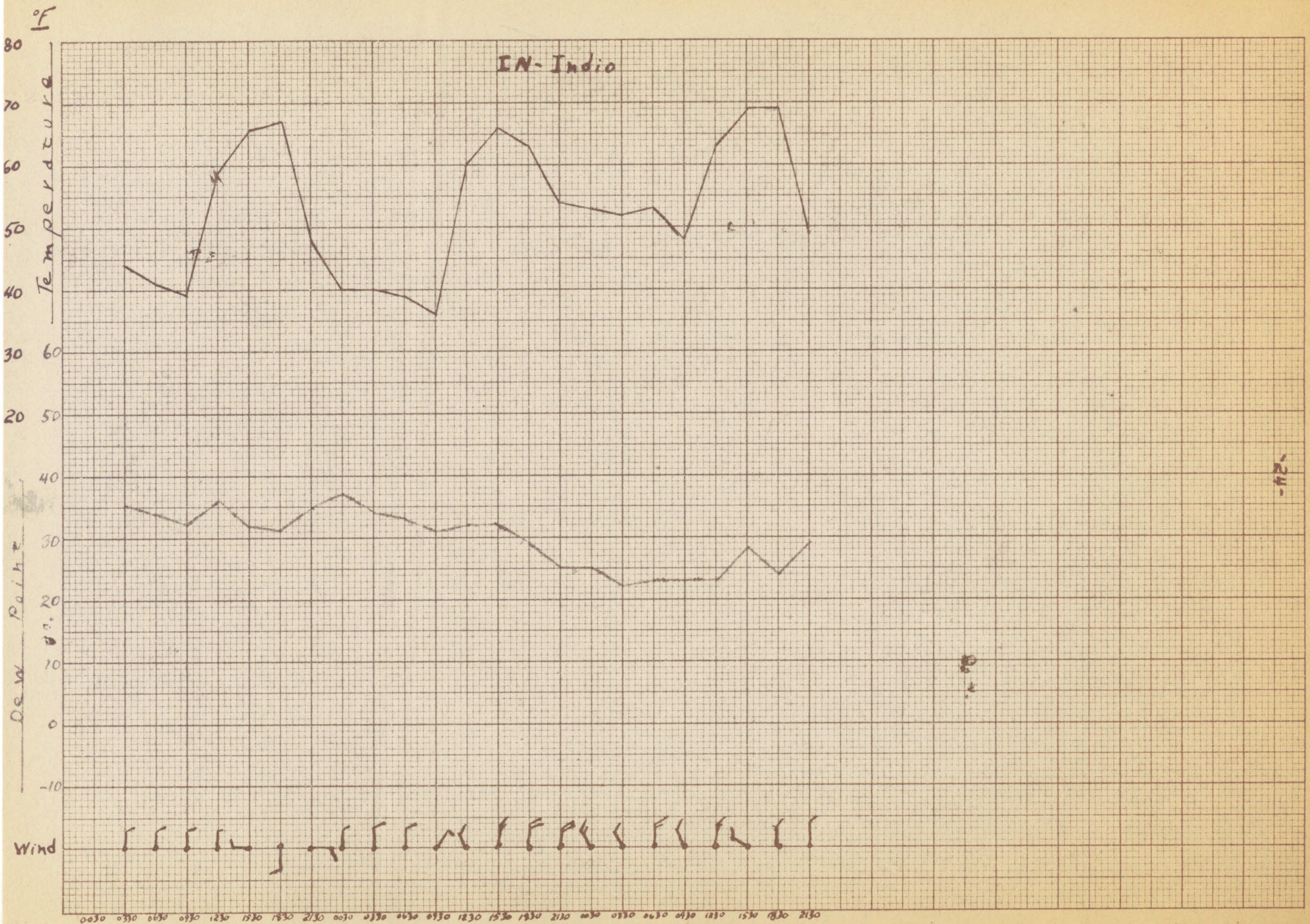

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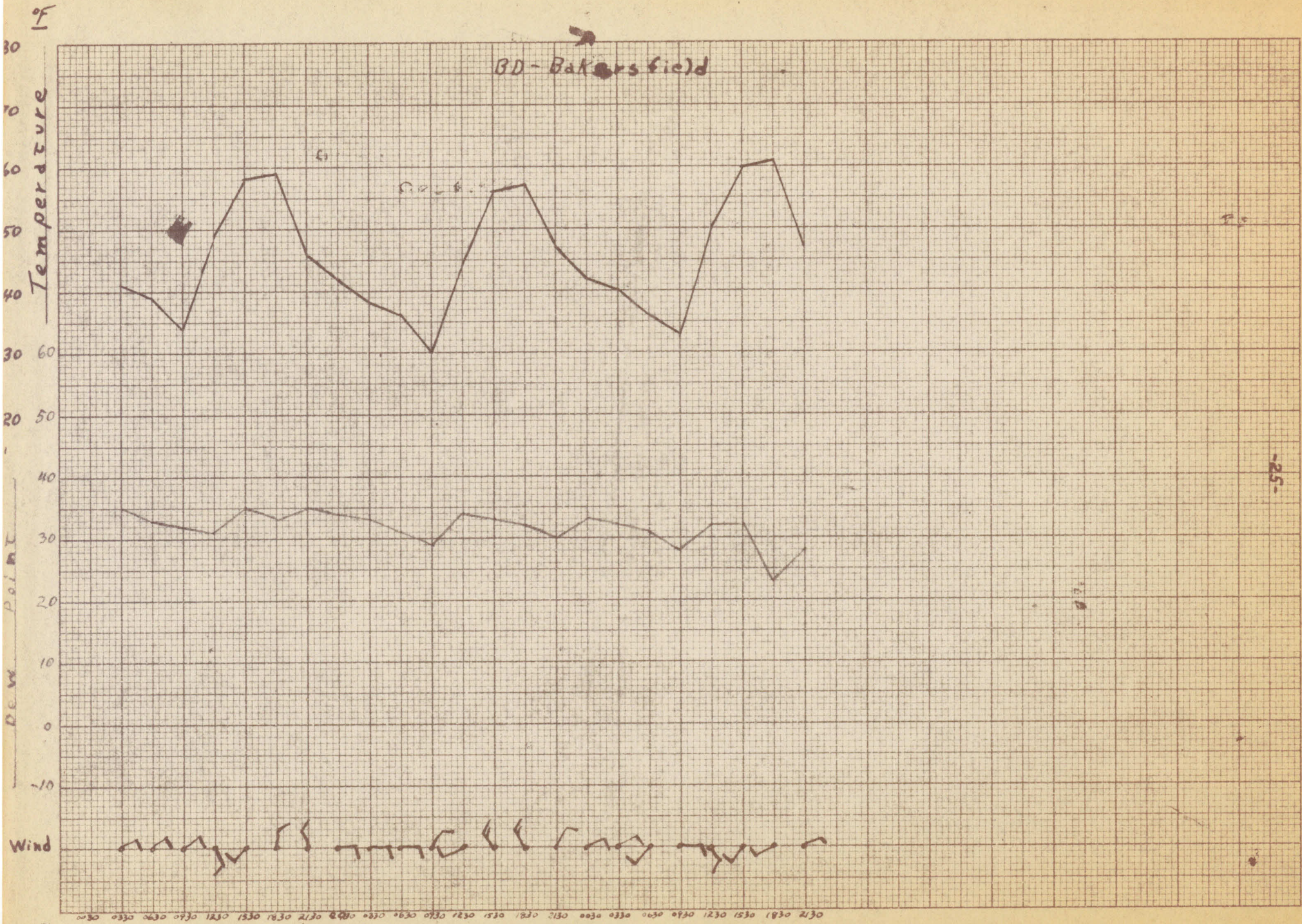

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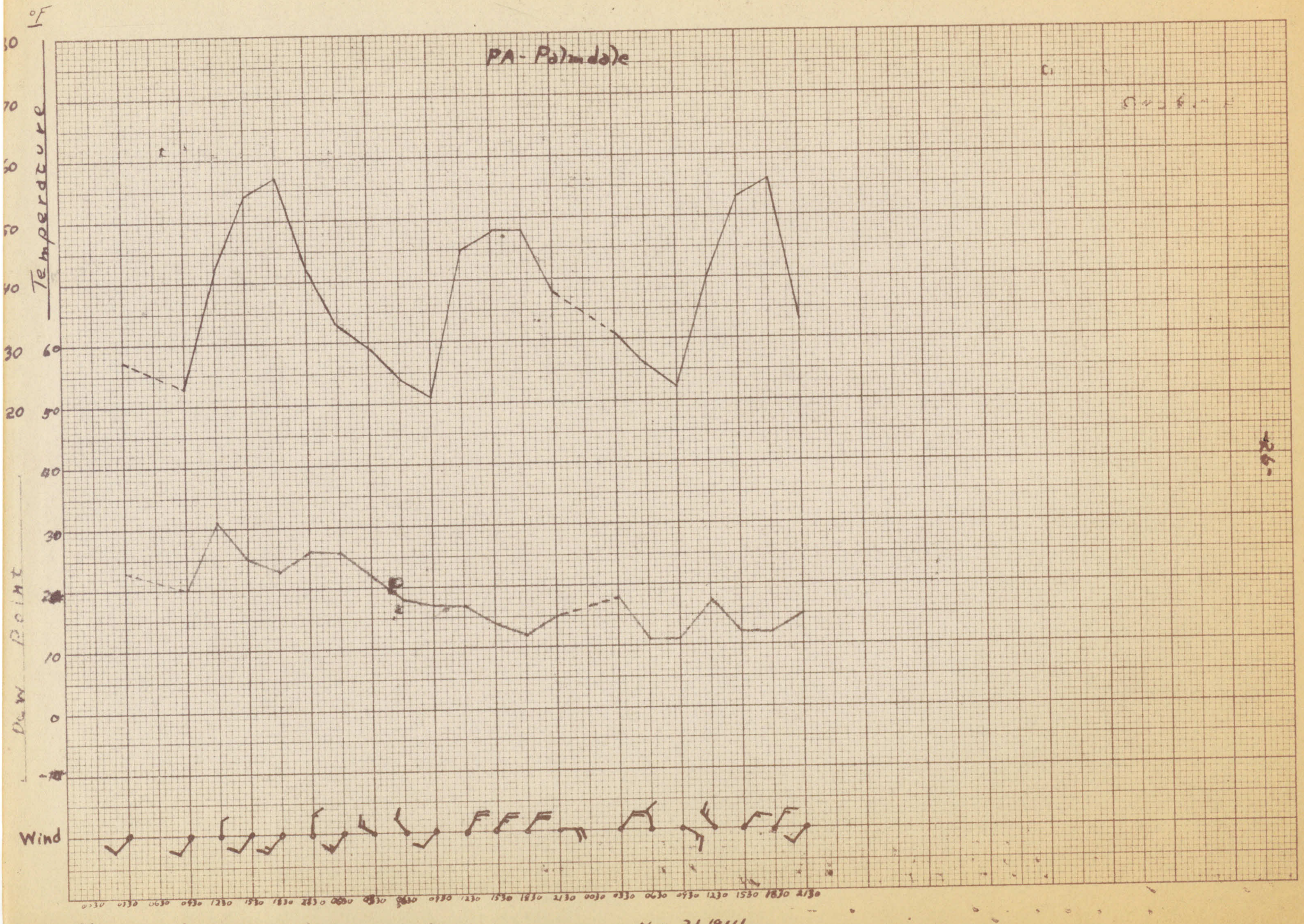

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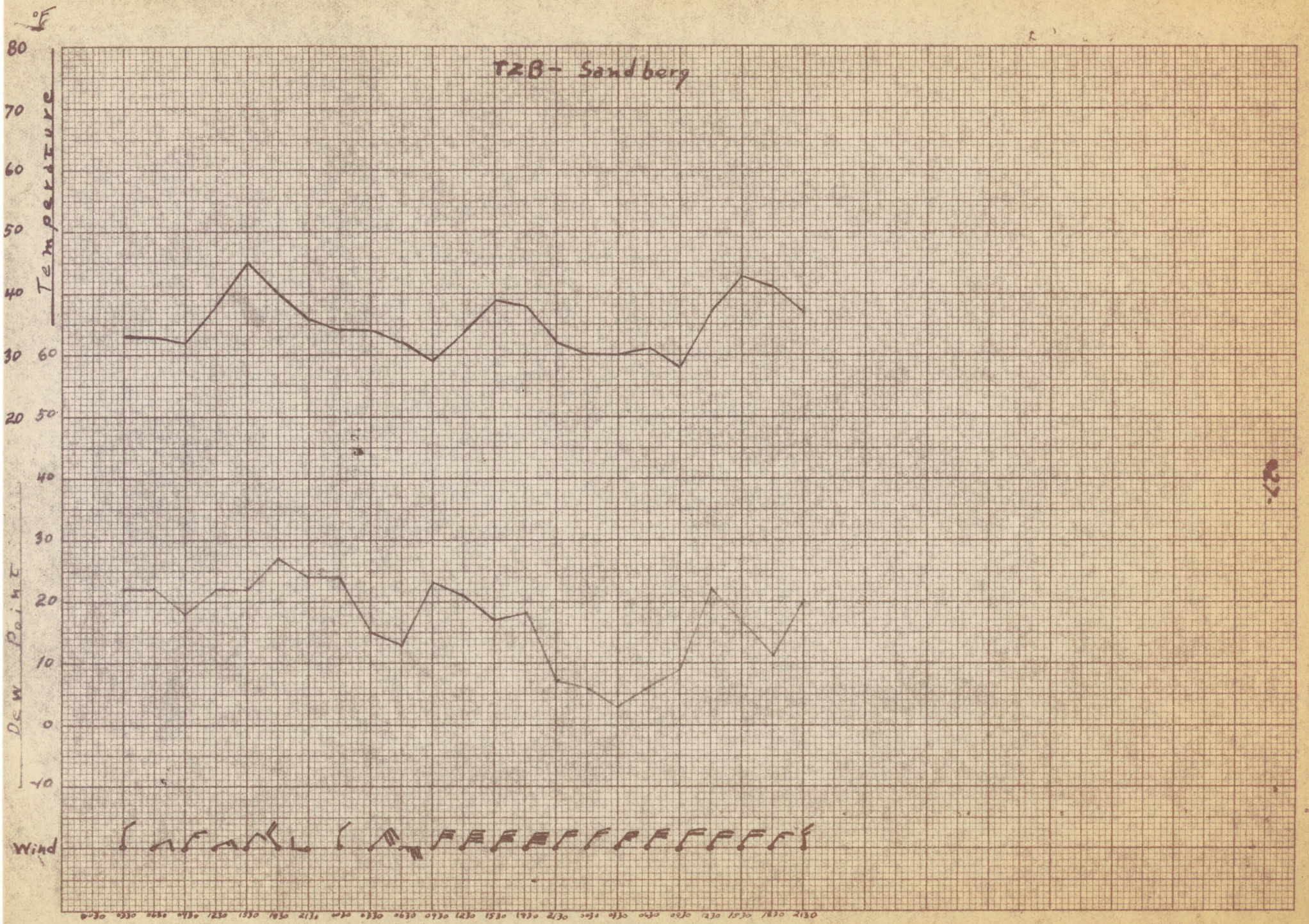

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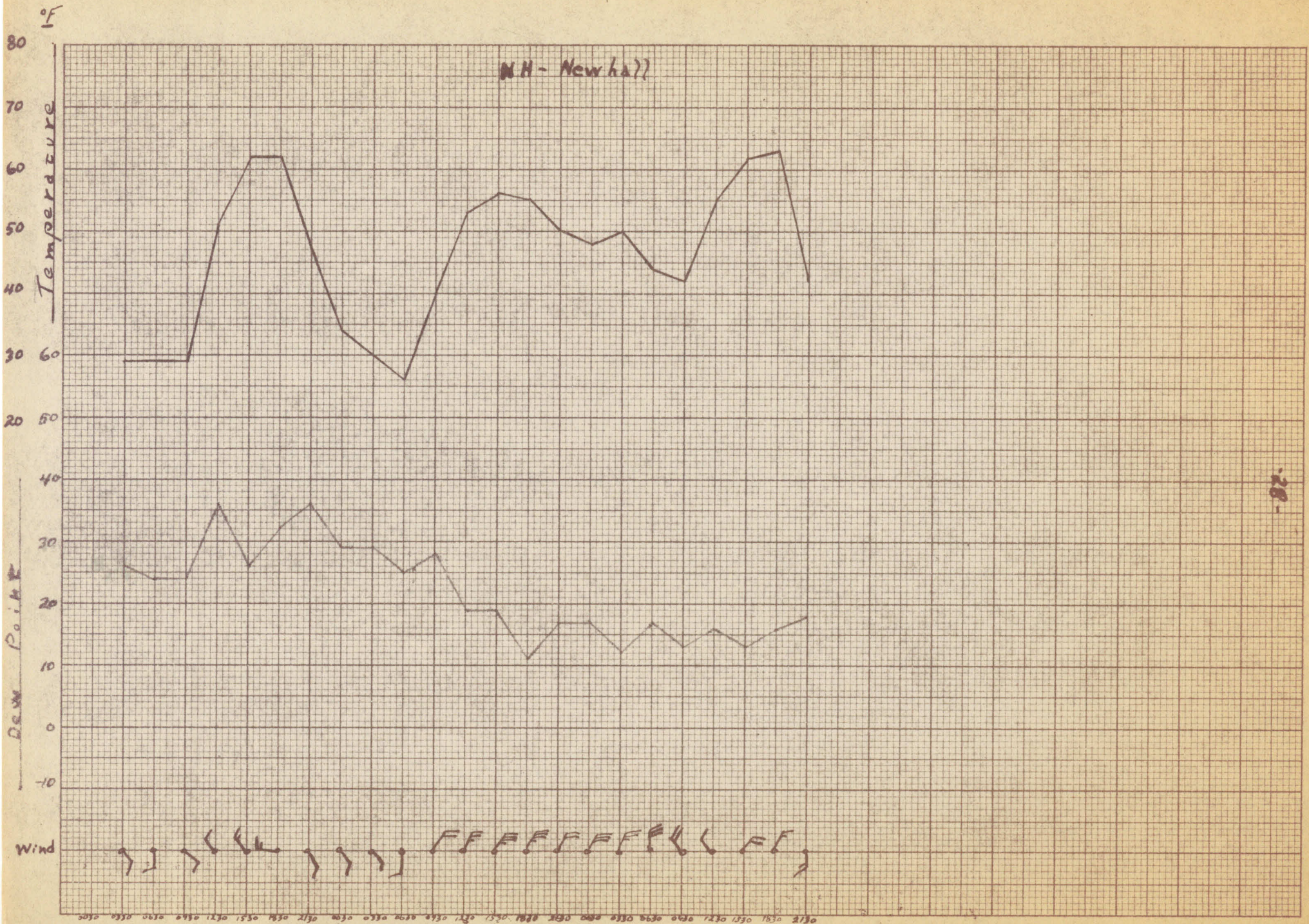

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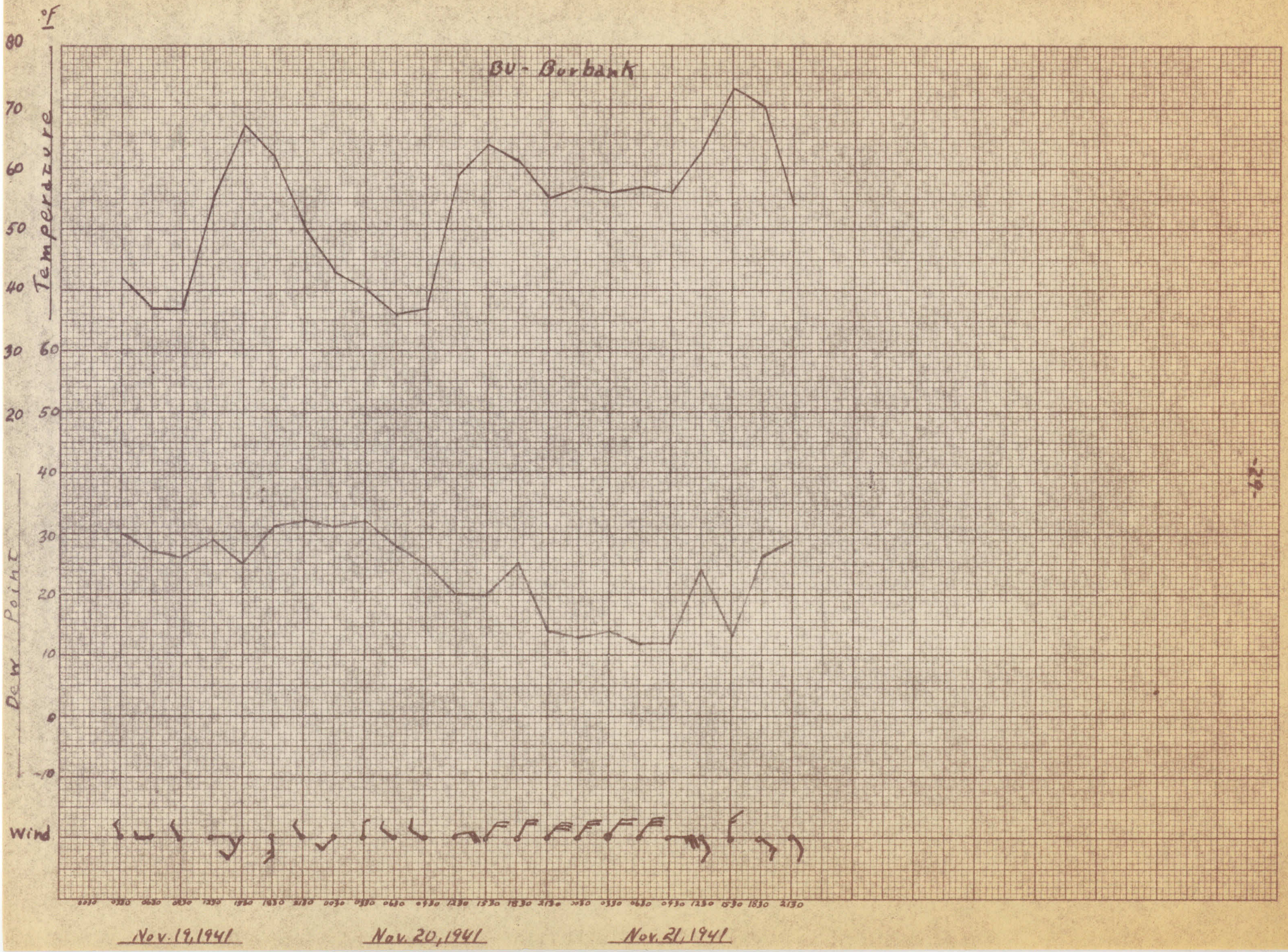

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Engraving, 7 × 10 in.
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°F

Temperature

80 70 60 50 40 30 20

Dew Point

60 50 40 30 20 10 0 -10

-20-

LA - Los Angeles

Wind

0030 0330 0630 0930 1230 1530 1830 2130 0030 0330 0630 0930 1230 1530 1830 2130 0030 0330 0630 0930 1230 1530 1830 2130

Nov. 19, 1941 Nov. 20, 1941 Nov. 21, 1941

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