U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU
IN COOPERATION WITH UNIVERSITY OF NEW HAMPSHIRE
CLIMATOGRAPHY OF THE UNITED STATES NO. 20 — 27

LATITUDE 43° 42'
LONGITUDE 72° 17'
ELEV. (GROUND) 603 ft.

CLIMATOLOGICAL SUMMARY

STATION HANOVER, NEW HAMPSHIRE
Shattuck Observatory
Dartmouth College

MEANS AND EXTREMES FOR PERIOD 1931-1960

Month	Temperature (°F) Means: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	** Mean degree days	Precipitation Totals (Inches): Mean	Greatest daily	Year	Snow, Sleet: Mean	Maximum monthly	Year	Greatest daily	Year	Mean number of days: Precip. .10 inch or more	Temperatures: Max. 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Month
(a)	30	30	30	30		30		30	30	30		30	30		30		30	30	30	30	30	
Jan	28.3	9.4	18.9	62	1932	-28	1957+	1430	2.87	1.55	1935	19.5	40.6	1958	15.0	1944	7	0	19	30	9	Jan
Feb	31.5	10.3	20.9	62	1957	-40	1943	1245	2.40	1.62	1952	18.4	49.5	1958	24.5	1958	6	0	14	28	7	Feb
Mar	40.6	20.6	30.6	83	1946	-22	1950+	1065	2.77	1.68	1937	13.6	41.5	1956	13.2	1952	7	0	6	28	2	Mar
Apr	54.7	32.1	43.4	91	1941	8	1954	645	3.13	1.93	1945	4.1	23.0	1953	17.5	1933	7	*	*	16	0	Apr
May	68.1	42.5	55.3	92	1937	22	1956+	305	3.30	1.94	1956	0.4	10.2	1945	8.8	1945	8	*	0	5	0	May
Jun	76.8	52.1	64.5	96	1953+	32	1958+	75	3.24	4.70	1933	0	0		0		7	2	0	*	0	Jun
Jul	81.4	57.0	69.2	99	1953	39	1946	15	4.18	3.53	1941	0	0		0		8	3	0	0	0	Jul
Aug	79.2	55.1	67.2	98	1933	34	1940	50	3.07	2.91	1955	0	0		0		6	2	0	0	0	Aug
Sep	71.0	47.7	59.4	95	1953	22	1947	185	3.38	3.21	1960	0	0		0		6	1	0	1	0	Sep
Oct	59.7	36.9	48.3	86	1947	13	1936	515	2.82	2.27	1937	0.3	3.2	1952	2.5	1952+	6	0	0	11	0	Oct
Nov	45.4	27.6	36.5	79	1950	-12	1938	850	3.36	2.24	1950	5.3	20.8	1943	10.2	1945	6	0	2	22	*	Nov
Dec	31.7	14.1	22.9	65	1934	-34	1933	1300	2.72	2.24	1952	12.9	32.8	1956	13.8	1947+	6	0	15	29	5	Dec
Year	55.7	33.8	44.8	99	July 1953	-40	Feb. 1943	7680	37.24	4.70	June 1953	74.5	49.5	Feb. 1958	24.5	Feb. 1958	80	8	56	170	23	Year

(a) Average length of record, years.

T Trace, an amount too small to measure.

** Base 65°F

+ Also on earlier dates, months, or years.

* Less than one half.

CLIMATE OF HANOVER

Historic Hanover, site of Dartmouth College, lies by the Connecticut River. Dartmouth's Shattuck Observatory is located on a knoll which rises approximately 200 feet above the level of the River and is surrounded by rolling to rough terrain with elevations generally between 400 and 1000 feet above sea level within two miles. Many hills rise to peaks of between 1000 and 1500 feet, with a few higher, within 10 miles of Hanover. White Mountain peaks rise to 4000 feet about 30 miles to the northeast and the main ridge of the Green Mountains is a similar distance to the west. The Atlantic Ocean is about 90 miles to the southeast.

General climatic features include: Changeableness of the weather, a large range of temperature both daily and annual, great differences between the same seasons in different years, and a good monthly distribution of the annual precipitation. Frequent weather changes are shared with other New England communities as the region is a favored path of weather-making low pressure centers. Large daily and annual temperature changes denote a decidedly continental climatic character, though moderating influences from the Atlantic are occasionally noted both in winter and in summer. Also in common with most of New England, Hanover has no "rainy" or "dry" seasons. There is, however, a definite precipitation minimum during the cold season, a continental variation in contrast to small seasonal differences nearer the Atlantic Coast.

The regularity of the annual precipitation fortunately assures a water supply for irrigation and also for important industrial and water power uses. Irrigation may be desirable, especially for high value fruit and truck crops, to cope with the fairly common short dry spells during the growing season, though periods of severe drought are rare. In nearly 80% of the years the annual total precipitation has exceeded 90% of normal. In 94 years of continuous record, the wettest year was 1954, with 46.86 inches, or 128% of normal. The driest year was 1871, with 22.69 inches, or 61% of normal. In the warmer half of the year much of the rainfall comes from showers and thunderstorms which frequently attend frontal passages. During the colder season the area may occasionally be affected by coastal "Northeasters" which can bring strong winds and heavy snowfall, or, less often, sleet or rain. These tend to supplement the otherwise reduced winter precipitation. Days with 0.01 inch or more of precipitation average 140 per year, nearly evenly distributed at about 12 per month. Frequency is slightly greater in spring and slightly less in late summer and early fall. The annual frequency has varied from 116 to 167. Days with 1.0 inch or more average 7 per year also spread fairly evenly in the year excepting a definite maximum in July. The annual frequency of these days has varied from 3 in 1947 to 14 in 1954. Thunderstorms have been recorded on from 10 to 25 days per year, with an average of 17 days. They have occurred even in January but reach a peak average frequency of 5 days in July.

Summer afternoon temperatures normally are in the very comfortable upper 70's while the nighttime minima drop usually into the 50's. Days with 90° temperatures have ranged from none, as in 1950 and 1951, to as many as 20, in 1944. The average annual extreme high temperature is 94°. Though most summers do not reach the 95° mark, the average frequency is nearly once per summer. The one summer in three that does reach 95° or higher usually has several occurrences, with a maximum of 7 days recorded in 1953. Though 100° was not recorded during the 30 year period contained in the above table, prior records going back to 1876 show 100° temperatures in one year, 1911, and then on three successive days, starting on the 3d of July when the maximum was 101°.

Winters are moderately severe, with a Dec.-Feb. 30-year normal mean of 20.9°. The winter of 1933-34 averaged the coldest, at 14.6°. The previous winter, 1932-33, was the mildest, at 27.3°. The maximum frequency of days with zero readings was 45 in the 1947-48 season, while the winter of 1931-32 had only 5. The average annual extreme low temperature is -20°. The coldest daily mean temperature recorded was -23°, Dec. 30, 1933.

Seasonal snowfall varies widely from the 74.5 inch average. Referring to the entire 95 seasons of record, a total of 21 inches in the winter of 1891-92 was the least, while the 1957-58 season had the most, 117.7 inches. Seasonal totals have exceeded 100 inches 8 times out of the 95, with the second largest of record 116.5 inches in 1886-87, and the third largest 109.5 inches in 1947-48. Inspection of the entire snowfall record does not reveal any significant trend toward either snowier or less snowy winters, though great variation from season to season is apparent throughout the record.

The frequency of a daily snowfall of 1 inch or more averages 21 per season, with 1 in April, 2 in November, 4 each in December and March, and 5 each in January and February. One inch falls may occasionally occur also in October and May. A daily snowfall of 2 inches or more averages 13 a season. Falls of 4 inches or more average only 5 per season, 6 inches or more less than 3 times, and 9 inches or more only once. A 10 inch or more snowfall on one day occurrs only about once in two years. Two 10 inch or more falls occur in the same season only once in six years, on the average. The frequency of 1 inch snowfalls has varied from 14 (1948-49) to 29 (1947-48). The frequency of 4 inch falls has varied from 1 to 9 per season. The maximum number with 10 inches or more is 3 in a season. In the 1936-37 season the greatest daily snowfall was only 4.6 inches. Measurable snow lies on the ground continuously through most but not all winters. For those seasons with a long continuous snow cover, numbering 22 out of 30 years, the average date of beginning was December 14 and the ending March 22. The earliest date of a prolonged cover began on November 22 and the latest ending date was April 13th. The average seasonal maximum snow depth for 30 seasons is 22 inches, occurring at an average date of February 19th. However, the greatest depth has come as early as January 1 and as late as April 13.

Based upon the occurrence of the freezing temperature, 32°, Hanover's "growing season" for susceptible tender vegetation averages 131 days, from May 19 to September 27. These dates differ from year to year but about two-thirds of the occurrences fall within 8 days, either way, from the above average dates. The extreme dates for the last spring freeze are May 4 and June 8. For the first in fall the extreme dates are September 12 and October 16, for the 30 years of record studied. The

HANOVER, N. H.

Average Temperature (°F)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	17.6	21.5	33.6	45.2	55.6	63.6	71.8	66.2	62.1	50.0	41.2	25.1	46.1
1932	30.0	22.4	27.4	41.4	55.4	62.8	66.0	68.3	60.2	50.8	33.8	27.2	45.5
1933	29.1	25.6	28.4	43.2	57.1	66.2	69.9	67.0	60.6	46.6	29.6	16.5	45.0
1934	19.4	8.0	27.9	44.6	56.5	65.3	70.0	63.4	63.4	45.0	39.4	20.0	43.6
1935	12.6	18.8	30.8	42.4	51.0	64.2	70.9	67.7	56.2	47.6	40.0	19.1	43.4
1936	16.6	13.2	37.6	41.4	58.2	64.8	66.9	66.0	60.4	47.9	31.6	25.4	44.2
1937	27.7	25.6	25.4	41.4	56.6	64.4	70.2	72.0	58.8	46.7	36.2	21.0	45.5
1938	16.7	23.5	33.0	46.4	53.9	66.2	69.7	70.0	55.8	50.5	36.7	24.8	45.6
1939	17.0	20.8	24.9	38.9	55.4	64.5	69.6	70.9	59.6	47.4	32.8	23.1	43.7
1940	12.2	19.9	27.2	38.8	55.8	62.8	68.8	65.6	57.9	44.2	35.8	22.8	42.6
1941	15.1	21.0	25.8	49.4	55.8	65.8	69.9	63.6	60.0	46.4	39.0	25.2	44.8
1942	19.0	17.8	35.4	46.1	58.6	64.2	67.8	66.3	59.4	49.2	34.0	19.3	44.8
1943	13.2	20.6	27.6	37.0	53.8	66.4	68.3	65.0	56.8	48.3	34.1	17.0	42.3
1944	18.9	18.0	25.5	38.8	59.8	63.8	69.4	70.0	60.8	46.0	35.1	19.6	43.8
1945	12.1	22.0	39.8	48.0	51.4	63.8	68.4	66.8	61.2	45.8	36.5	17.6	44.4
1946	17.5	16.2	40.8	42.2	53.4	63.5	67.6	63.8	61.4	50.6	39.0	24.2	45.0
1947	20.5	19.1	29.6	40.4	53.6	62.2	71.0	70.2	60.2	54.3	32.4	17.8	44.3
1948	12.8	15.6	29.8	44.2	52.5	62.4	68.5	67.8	59.6	46.6	42.0	27.6	44.1
1949	26.3	24.9	33.2	45.8	56.1	69.3	72.1	68.9	57.5	51.8	34.0	26.4	47.2
1950	25.3	17.2	25.0	40.2	55.0	63.9	67.2	65.3	54.3	49.9	36.9	26.3	43.9
1951	22.6	25.4	32.1	45.1	55.7	63.2	69.0	66.1	58.9	48.9	32.1	23.2	45.2
1952	21.7	24.3	31.1	45.7	51.7	65.5	71.9	68.0	61.1	45.1	37.0	26.7	45.8
1953	24.3	25.3	34.1	44.4	57.3	66.5	70.6	66.9	60.1	49.6	40.7	31.1	47.6
1954	15.2	27.5	30.7	44.8	53.0	64.2	66.6	64.2	57.0	52.0	37.6	24.9	44.8
1955	17.0	23.6	30.0	45.8	59.0	64.8	73.0	70.5	58.5	49.0	34.9	16.5	45.2
1956	22.9	24.2	25.3	39.3	50.2	64.5	66.1	65.6	55.5	48.7	38.5	26.8	44.0
1957	12.1	26.1	33.0	46.4	55.0	67.4	67.8	64.1	61.3	48.9	39.7	30.4	46.0
1958	21.2	16.5	35.2	45.4	52.2	58.9	68.4	67.4	59.3	46.5	37.5	14.5	43.6
1959	18.8	15.9	29.8	45.0	59.0	64.0	71.4	70.0	62.8	48.4	37.0	27.8	45.8
1960	20.3	27.1	25.5	44.8	59.6	64.4	67.0	67.5	60.7	46.2	39.3	19.1	45.1

HANOVER, N. H.

Total Precipitation (Inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	1.63	1.16	1.98	2.38	4.26	5.85	7.38	2.47	4.83	2.81	1.41	3.27	39.43
1932	3.96	2.00	3.24	2.46	1.11	2.42	2.78	4.45	3.37	3.13	4.79	1.16	34.87
1933	1.94	2.59	3.40	6.26	1.83	5.90	1.37	4.96	2.81	3.82	1.62	3.13	39.63
1934	2.27	2.04	1.90	4.91	2.37	3.41	3.93	1.31	4.88	1.77	4.20	3.12	36.11
1935	5.11	2.05	1.43	2.58	2.02	4.56	4.40	2.90	4.20	.93	4.49	1.00	35.67
1936	4.74	2.16	5.63	3.98	2.60	2.19	3.74	4.42	1.41	5.01	2.11	4.15	42.14
1937	3.20	2.13	3.49	3.08	6.44	4.20	6.69	1.97	1.08	3.70	3.09	3.02	42.09
1938	3.35	2.04	1.37	2.29	1.87	2.10	5.96	4.91	8.88	2.21	2.82	4.00	41.80
1939	3.04	2.98	2.36	4.03	1.79	2.32	1.92	2.27	2.54	4.48	1.00	2.46	31.19
1940	1.00	2.85	3.90	3.47	4.60	1.82	5.19	1.42	4.65	.84	4.51	3.01	37.26
1941	1.55	1.53	2.03	.49	2.41	2.22	9.17	3.08	1.00	2.98	2.28	2.56	31.30
1942	1.89	1.30	4.16	2.57	3.54	3.72	2.78	.66	4.39	2.05	4.84	2.85	34.75
1943	2.25	1.28	1.75	3.27	4.17	3.60	4.95	5.87	1.88	4.94	5.36	.61	39.93
1944	1.70	2.40	2.94	2.76	2.54	5.19	2.41	.90	4.76	3.05	2.42	1.69	32.76
1945	3.53	2.56	1.59	5.02	4.88	4.17	6.06	.70	4.08	4.37	5.30	3.23	45.49
1946	2.24	2.16	1.26	2.46	4.23	2.96	2.80	4.73	4.68	2.70	1.67	3.81	35.70
1947	3.60	2.17	2.43	1.84	5.05	4.63	3.93	1.50	.78	.45	4.61	2.31	33.30
1948	2.67	1.78	2.41	3.33	4.39	2.79	4.57	2.86	1.31	2.19	5.26	2.96	36.52
1949	3.07	2.02	1.70	2.16	2.39	3.07	4.74	3.08	3.62	2.47	1.85	1.94	32.11
1950	3.81	2.36	3.01	1.95	1.45	2.50	2.94	3.94	1.55	1.77	4.81	2.14	32.23
1951	1.73	4.45	4.07	4.38	2.47	2.58	5.31	3.40	2.92	3.52	4.46	4.24	43.53
1952	2.57	3.69	2.07	3.52	3.20	5.21	3.67	1.28	2.51	2.04	1.20	4.67	35.63
1953	4.21	1.87	4.98	3.87	4.38	.43	1.99	3.16	1.97	3.69	2.18	2.89	35.62
1954	2.77	3.74	3.54	4.36	6.82	4.98	4.34	3.10	4.80	1.51	4.33	2.57	46.86
1955	.99	3.28	2.82	2.45	3.38	3.21	4.41	8.92	1.77	2.98	2.77	.63	37.61
1956	3.15	2.45	4.44	3.05	3.37	2.77	4.03	2.22	4.92	.99	2.17	3.81	37.37
1957	1.66	1.18	1.47	1.45	2.26	3.51	4.89	.91	3.64	1.79	4.91	4.45	32.12
1958	6.62	3.51	2.09	3.24	3.26	1.28	3.54	2.64	2.64	3.45	2.76	1.05	36.08
1959	3.31	2.71	3.16	1.68	1.73	3.22	1.65	6.29	2.78	5.57	5.76	3.22	41.08
1960	2.59	3.61	2.37	4.48	4.23	2.26	3.85	1.64	6.71	3.32	1.94	1.53	38.53

CLIMATE OF HANOVER (continued)

average date of the first occurrence of 0° is December 12 and the last winter occurrence average is March 5. Zero's have come as early as November 16th and the first occurrence also has been delayed as late as January 21st. The last winter occurrence has come as early as February 10 and as late as March 23.

Wind records for a 10 year period show a seasonal variation in prevailing direction. During the winter season the prevailing winds are from the northwest. Gradually during spring the direction backs to west and to west-southwest and southwest in summer. During fall west again prevails as the wind veers back to northwesterly in winter. As Hanover is nestled in the Connecticut Valley and surrounded by numerous small hills which tend to reduce the speed of surface winds, this station reports one of the lowest average wind speeds in New England. Monthly average velocities reach a minimum in August, with 3.5 m.p.h., and a maximum in March and April, with 5.4 m.p.h. Calm winds have been recorded 13% of the time. During the 1938 hurricane the velocity reached a 58 m.p.h. average for one minute.

For 18 years of records, daytime sky conditions have been tallied as an annual average of 108 clear, 125 partly cloudy, and 132 cloudy days. The clearest month is August. November is the cloudiest. While August averaged 12 clear and only 7 cloudy days, November averaged only 6 clear days and 15 cloudy. Records of total hours of bright sunshine show a similar seasonal variation, from a minimum of less than 100 hours in November to 200 hours per month in summer, with the greatest percentage of possible in August.

Through an extraordinarily long period Hanover's observations have suffered a very minimum of environmental change. This is in contrast to the situation of nearly all other long-period U. S. weather observation stations, where moves and man-made changes in surroundings, including growth of urban areas and industrialization, have spoiled the records for consideration of climatic change over the years. Inspection of the Hanover record does not show any significant climatic trend for precipitation. Some slight temperature trend may be evident, however, in the fact that the average for the 30-year period beginning with 1931 is 1.4° warmer than the average for the 46 years ending with 1930. The increase is evident for each of the 12 months, though the amount of warming tends to be greater for winter months than for summer. Thus, warming has been at a minimum during the growing season. The Hanover record is therefore particularly valuable in discounting any claims that large scale changes to warmer weather agricultural crops might be in order.

In summary, Hanover is nearly free of extreme or very uncomfortable summer heat. Winters are cold. The average annual temperature extremes, to be expected once a year, average 94° for the maximum and -20° for the minimum. Prolonged periods of severely cold weather are rare. The frequent variation in day to day conditions is considered stimulating to mental and physical activities.

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HISTORY OF WEATHER OBSERVATIONS AT HANOVER, NEW HAMPSHIRE

The Dartmouth College observations are the longest series of meteorological records in New Hampshire and one of the longest and most valuable in the United States. These were initiated in November 1834 by Prof. Ebenezer Adams. Temperatures at morning, noon, and night and precipitation were recorded. After five years, the observational program was taken over by Prof. Ira Young and expanded to include barometric pressure, clouds, and wind. These earliest observations were made near where McNutt Hall now stands, but in November 1855, Prof. Young moved the station to its present location at the new Shattuck Observatory. No important changes in instrument exposure have occurred in this century-plus period. Eminent astronomers have directed the climatological program. These are, succeeding Prof. Ira Young, the first Director of Shattuck: Prof. Charles A. Young, a world authority and pioneer in solar spectroscopy; Prof. Edwin B. Frost, later Director of the Yerkes Observatory; Prof. John M. Poor, internationally known astronomer; and the renowned present Director, Prof. Richard H. Goddard. Prof. Goddard has served continuously since November 1933, spanning nearly the entire period of record covered in the tables of this bulletin. Except as noted, statistics given in the narrative summary refer only to the 30 years, 1931-1960. During the 1850's and 60's some gaps in the observational program occurred. Any statistics in the narrative based on more than 30 years are confined to the period of continuous record since these gaps nearly a century ago.