MONTHLY CHARTS OF FREQUENCY-RESULTANT WINDS IN THE UNITED STATES

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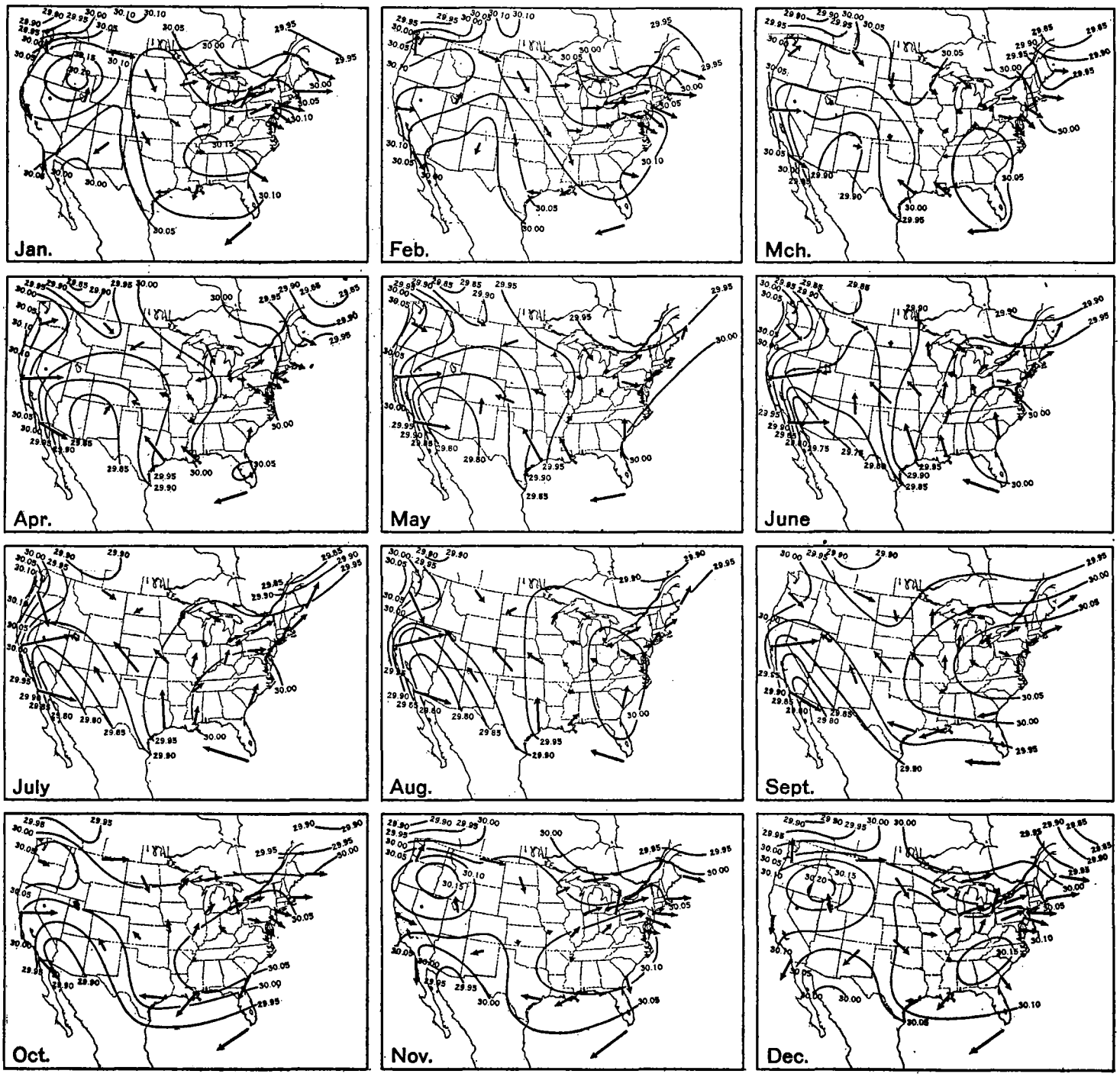
The object of this paper is to present to the readers of the MONTHLY WEATHER REVIEW a set of tables and charts of wind frequency and frequency resultants for the United States.

The data from which these charts and tables were computed were published in the annual reports of the Chief of the Weather Bureau for the 13 years, 1891 to 1902, inclusive. In these reports were given the "number of hours that the wind blew from each of the eight directions, N., NE., etc.," for 28 cities. The data are complete for the 13 years, except at four cities, and at these the record covers more than 12 years.



FIGS. 1-12, INCLUSIVE.—Frequency-resultant winds in the United States for each of the 12 months

It has not appeared possible to apply any corrections to the data. The directions are recorded automatically, all directions within 22½° on either side of N., NE., etc., being recorded as N., NE., etc. This introduces an error that has been discussed by Werenskiold (1). The wind vanes varied in elevation at different stations from 29 feet to 350 feet, and were changed as the stations were moved from building to building with the growth of cities. At the 28 stations no less than 71 different locations were occupied by the anemometers, and only 5 remained in the same location throughout the 13-year period.

Since the average velocity corresponding to each component is not given in the tables, these have been assumed to be equal, and the different directions were weighted only in proportion to their frequency. The frequency resultant has been studied analytically by Terada (2) and empirically by Abbe (3), who has published comparative tables of montly frequency resultants and ordinary resultants for the 13 months from December, 1893, to December, 1894, inclusive.

The method of computing the frequency resultants has been fully illustrated in the MONTHLY WEATHER REVIEW by Davis (4) and is equivalent to Lambert's formula. This was applied to the percentages of time that the wind blew from each direction in each month and in each of the 28 cities. These percentages and the frequency resultants computed from them are given in Table 1. The frequency resultants have been charted and appear in Figures 1 to 12, inclusive, on page 308. To these charts have been added the monthly sea-level isobars from Bigelow (5).

In interpreting these charts it is to be remembered that the computation has retained only the excess of opposing winds. Hence a small resultant does not mean that there is little wind, but that the winds from opposite direction prevail for nearly equal periods. The symmetric components of cyclones and anticyclones have been eliminated, so that the chief effect of this work has been the elimination of the cyclonic and anticyclonic whirls.

The seasonal or annual march of the resultant winds is brought out in Figure 13, in which the annual march of the resultants at 9 of the 28 cities have been graphed by first drawing the successive monthly resultants from the same initial point, then connecting the final points of the resultants in monthly sequence. Finally all of the resultants, except January, were erased. The direction north is shown by an arrow at the initial point.

LITERATURE CITED

(1) WERENSKIOLD, W. Mean monthly air transport over the North Pacific Ocean. Geofy. Pub., vol. 2, No. 9, Kristiania, 1922, p. 5.
(2) TERADA, T. On resultants of wind. Pr. Phys.-Math. Soc. Japan. 3d ser., vol. 4, No. 6, 1922, p. 125.
(3) ABBE, C. A comparison of prevailing and resultant winds. MO. WEA. REV., vol. 21, 1893, p. 365.
(4) DAVIS, T. H. Annual wind resultants. MO. WEA. REV., vol. 30, 1902, p. 519.
(5) BIGELOW, F. H. Rept. on the barometry of the U. S., etc. Rept. Chief of the Weather Bureau, 1900–1901, vol. 2, Chart 28, following page 638.

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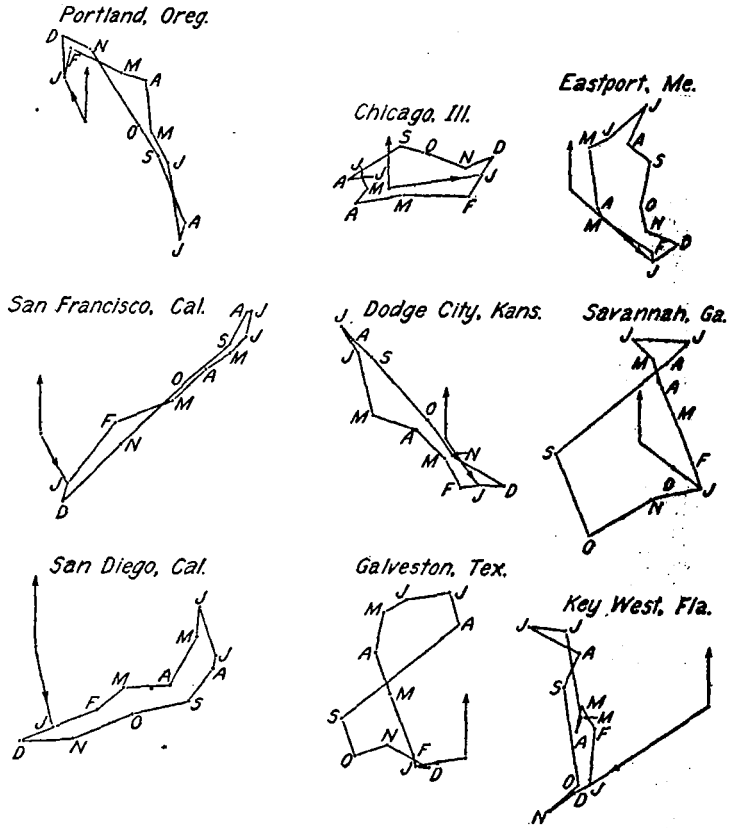

FIG. 13.—The annual march of the frequency resultant at nine cities of the United States, shown by the path of the end of the wind-resultant vectors for the successive months. The base of the vertical arrow is the origin of the resultants. Only the January resultant is drawn. The letters are the initials of the months

Wind direction frequency, and frequency resultant for the 13 years, 1891–1902

BISMARCK, N. DAK.

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Frequency resultant	
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Dir.*	*P. ct.*
January	10	5	11	10	6	3	7	45	4	n 32° w	36
February	9	6	9	11	5	4	8	44	3	n 32° w	36
March	14	10	14	12	6	5	5	31	3	n 2° w	24
April	15	10	16	20	7	4	4	21	2	n 52° e	20
May	12	11	19	19	9	3	5	21	1	n 62° e	21
June	13	8	12	17	11	6	8	23	1	n 8° e	8
July	12	9	14	17	12	5	6	22	2	n 53° e	11
August	14	10	16	16	12	4	6	19	2	n 56° e	14
September	12	6	12	15	10	5	6	32	2	n 21° w	15
October	11	5	12	12	8	6	8	36	3	n 33° w	25
November	10	7	13	13	8	5	5	37	2	n 22° w	22
December	10	4	10	10	6	5	10	42	4	n 41° w	35

BOSTON, MASS.

January	12	4	4	4	6	17	27	25	------	n 79° w	56
February	10	8	6	3	6	13	30	24	------	n 71° w	44
March	8	9	10	5	7	15	24	22	------	n 73° w	31
April	9	14	14	5	7	15	21	16	------	n 57° w	19
May	6	13	16	5	10	20	17	13	------	s 76° w	11
June	6	11	16	4	7	25	21	10	------	s 72° w	20
July	4	7	14	4	8	30	21	11	------	s 81° w	32
August	8	7	16	7	9	22	20	13	------	s 68° w	20
September	8	9	12	5	8	22	20	16	------	s 89° w	26
October	10	11	8	4	8	20	20	19	------	n 76° w	30
November	11	7	5	4	7	19	23	23	------	n 74° w	33
December	11	4	4	4	6	22	28	22	------	n 84° w	50

Wind direction frequency, and frequency resultant for the 13 years, 1891–1902—Continued

BUFFALO, N. Y.

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Frequency resultant	
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Dir.	P. ct.
January	6	7	8	7	9	22	24	16	1	s 76° w	33
February	4	10	7	7	7	21	27	16	------	s 82° w	35
March	8	13	10	6	9	19	20	14	------	n 89° w	20
April	7	12	12	8	8	26	16	11	------	s 62° w	19
May	5	12	10	7	7	30	20	9	------	s 64° w	28
June	6	10	8	7	9	31	21	8	------	s 60° w	33
July	8	8	6	5	10	32	20	11	------	s 65° w	37
August	8	11	9	6	11	25	19	11	1	s 70° w	24
September	8	9	8	7	13	23	18	12	------	s 64° w	26
October	8	10	11	8	12	21	16	16	------	s 72° w	19
November	8	8	7	9	11	19	22	18	------	s 80° w	28
December	6	7	8	6	10	22	24	17	------	s 77° w	35

CHICAGO, ILL.

January	7	7	4	8	14	18	21	20	------	s 80° w	34
February	8	10	5	9	11	14	24	19	------	n 86° w	28
March	11	18	8	11	12	14	13	13	------	n 67° w	6
April	12	25	9	12	12	12	10	8	------	n 65° e	13
May	10	26	7	12	13	16	11	5	------	n 89° e	7
June	8	24	10	13	13	16	10	6	------	s 70° e	11
July	7	24	9	12	10	20	12	6	------	s 55° e	7
August	8	26	11	14	12	16	8	6	------	s 80° e	15
September	8	15	7	12	18	19	11	9	------	s 76° w	15
October	10	13	6	11	19	18	13	11	------	s 42° w	17
November	8	10	3	7	19	18	17	17	------	s 75° w	28
December	7	7	3	6	15	23	21	17	------	s 72° w	39

CINCINNATI, OHIO

January	6	10	9	16	10	19	11	18	1	s 45° w	14
February	7	10	8	14	10	14	14	23	1	n 86° w	15
March	8	10	10	15	11	15	10	19	2	s 1° w	8
April	8	14	10	15	10	13	8	19	4	n 23° w	2
May	8	11	8	17	12	16	8	17	4	s 25° w	8
June	8	12	9	18	11	18	7	12	6	s 10° e	11
July	7	9	9	16	12	21	9	12	6	s 21° w	17
August	9	14	11	17	11	14	7	12	5	s 59° e	10
September	8	12	12	21	8	14	7	12	5	s 47° e	12
October	8	11	11	22	9	13	8	15	3	s 45° e	10
November	6	8	8	11	12	17	10	17	2	s 54° w	15
December	5	8	6	19	13	20	10	15	2	s 26° w	21

CLEVELAND, OHIO

January	5	6	4	20	15	23	15	13	------	s 34° w	34
February	8	8	2	19	11	19	18	15	------	s 60° w	25
March	11	13	4	20	10	13	15	14	------	s 63° w	8
April	14	12	5	18	8	11	16	16	------	n 64° w	10
May	15	13	4	18	12	12	11	15	------	n 64° w	4
June	14	13	5	20	13	11	12	12	------	s 15° w	2
July	16	9	4	18	16	11	11	14	------	s 53° w	6
August	16	12	7	22	12	9	9	14	------	n 82° e	5
September	12	10	5	28	13	11	9	12	------	s 13° e	14
October	8	8	5	29	14	15	9	12	------	s 7° e	24
November	4	6	2	26	17	21	12	12	------	s 18° w	35
December	4	6	2	22	19	26	12	9	------	s 23° w	40

DETROIT, MICH.

January	7	9	5	5	9	32	21	13	------	s 72° w	40
February	7	14	6	5	6	27	22	15	------	s 89° w	32
March	6	21	10	8	5	22	14	13	------	n 69° w	9
April	10	21	11	10	6	18	12	13	------	n 3° w	10
May	8	19	11	8	7	24	12	10	------	s 84° w	6
June	7	17	12	8	8	26	15	8	------	s 53° w	12
July	9	15	10	5	7	29	14	11	------	s 69° w	18
August	10	18	10	12	7	23	11	9	1	s 52° w	4
September	9	13	7	12	9	26	13	10	------	s 51° w	17
October	9	13	8	9	10	24	14	13	------	s 71° w	19
November	8	9	3	7	9	28	19	16	------	s 77° w	36
December	8	8	3	6	8	37	18	12	------	s 57° w	43

DODGE, KANS.

January	16	12	3	15	10	8	9	26	1	n 46° w	20
February	17	14	3	16	10	7	7	25	------	n 16° w	18
March	15	14	4	18	14	8	5	22	------	n 2° w	7
April	12	12	6	26	14	7	3	20	1	s 72° e	11
May	12	19	6	26	18	6	2	10	1	s 72° e	27
June	8	14	6	37	22	6	2	5	------	s 46° e	43
July	5	12	6	42	24	4	1	4	1	s 43° e	55
August	8	12	6	37	25	5	2	4	9	s 43° e	48
September	9	14	5	31	26	5	3	5	1	s 42° e	39
October	13	13	4	22	20	7	6	14	1	s 44° e	10
November	17	12	3	19	14	8	7	20	1	n 16° w	6
December	16	8	2	12	11	9	12	28	1	n 52° w	28

Wind direction frequency, and frequency resultant for the 13 years, 1891–1902—Continued

EASTPORT, ME.

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Frequency resultant	
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Dir.	P. ct.
January	19	11	4	6	3	12	22	23	1	n 49° w	40
February	15	12	5	4	5	12	23	23	1	n 53° w	38
March	15	11	7	6	8	17	18	17	1	n 49° w	16
April	16	14	10	5	12	15	15	10	2	n 52° w	13
May	12	12	9	5	23	19	10	7	3	s 26° w	16
June	10	13	6	4	21	25	11	6	3	s 40° w	22
July	10	6	3	3	28	27	13	7	3	s 43° w	41
August	12	9	5	4	22	22	14	8	5	s 53° w	26
September	13	7	6	4	16	24	17	12	2	s 69° w	31
October	17	9	5	4	11	20	16	15	3	n 77° w	27
November	16	12	4	5	7	17	19	18	1	n 62° w	31
December	16	8	3	4	5	16	24	23	1	n 64° w	44

GALVESTON, TEX.

January	15	15	12	20	12	8	4	14	1	n 81° e	18
February	14	15	11	21	14	8	4	12	------	s 85° e	19
March	10	12	9	31	19	8	2	8	------	s 49° e	36
April	6	8	10	39	22	7	2	6	------	s 40° e	49
May	5	6	5	41	29	8	2	3	------	s 29° e	60
June	3	6	5	36	31	14	3	2	------	s 20° e	61
July	3	4	5	27	33	21	4	3	------	s 5° e	60
August	4	6	6	21	30	21	6	4	------	s 2° e	48
September	9	18	16	32	13	5	2	4	------	s 82° e	44
October	10	21	17	26	8	6	2	8	------	s 89° e	39
November	12	17	14	23	13	8	3	9	------	s 81° e	28
December	15	15	11	18	14	7	6	14	------	n 76° e	13

HAVRE, MONT.

January	5	15	4	0	0	34	24	13	3	n 90° w	42
February	4	19	5	1	1	29	25	13	3	n 82° w	36
March	6	23	10	1	1	24	19	13	3	n 54° w	23
April	7	18	11	4	2	22	19	15	2	n 62° w	21
May	5	15	16	7	3	20	19	13	2	n 71° w	10
June	8	14	9	5	3	22	22	14	2	n 78° w	27
July	9	13	11	4	3	21	21	15	3	n 72° w	24
August	8	20	10	4	4	19	18	15	2	n 52° w	20
September	6	14	8	2	3	25	23	17	2	n 79° w	34
October	6	12	7	3	2	32	24	11	3	s 83° w	38
November	6	15	6	1	1	34	23	13	2	s 90° w	38
December	4	15	5	1	0	39	22	11	3	s 81° w	42

KANSAS CITY, MO.

January	14	8	6	13	14	14	6	26	------	n 75° w	14
February	16	11	8	12	11	10	8	25	------	n 33° w	16
March	13	13	7	16	12	12	4	23	------	n 23° w	6
April	12	11	11	22	13	10	4	16	------	s 72° e	13
May	14	15	7	21	18	9	4	11	------	s 65° e	16
June	10	13	8	25	21	10	2	9	1	s 43° e	28
July	12	14	8	23	22	11	2	7	1	s 45° e	23
August	12	16	9	24	20	9	2	8	1	s 58° e	27
September	12	11	6	26	23	10	3	9	------	s 38° e	26
October	12	8	4	23	18	13	4	16	1	s 8° e	15
November	13	8	5	18	17	12	4	22	------	s 58° w	6
December	14	9	3	12	16	15	6	24	------	n 82° w	15

KEY WEST, FLA.

January	17	33	20	13	4	3	2	7	------	n 56° e	52
February	13	23	19	25	6	3	2	9	------	n 78° e	42
March	10	18	24	28	6	3	2	9	------	n 88° e	46
April	11	18	32	19	5	3	2	10	------	n 72° e	48
May	10	14	34	21	4	4	3	10	------	n 83° e	47
June	4	8	32	34	10	6	2	4	1	s 64° e	58
July	2	6	43	34	8	5	1	2	------	s 67° e	70
August	4	10	33	28	9	7	4	5	------	s 69° e	50
September	5	20	33	22	9	4	4	4	------	s 83° e	53
October	10	40	23	10	3	4	3	6	------	n 58° e	56
November	10	49	23	8	3	2	1	5	------	n 56° e	67
December	12	42	18	13	4	2	1	7	------	n 57° e	59

MARQUETTE, MICH.

January	6	3	2	7	14	13	23	30	2	n 90° w	45
February	10	6	4	7	11	11	20	29	1	n 72° w	36
March	16	11	5	10	11	9	12	26	1	n 44° w	25
April	18	14	6	10	8	6	9	27	2	n 20° w	29
May	18	12	5	9	9	10	7	29	1	n 32° w	28
June	17	10	6	11	12	11	9	22	2	n 42° w	16
July	15	11	6	9	10	16	10	22	2	n 57° w	21
August	16	14	4	8	12	14	12	19	1	n 52° w	19
September	9	8	3	11	16	19	13	21	------	s 73° w	26
October	12	8	3	11	18	14	13	21	------	s 81° w	22
November	8	6	2	8	17	15	20	24	------	s 85° w	36
December	6	4	2	6	16	16	26	24	------	s 80° w	46

Wind direction frequency, and frequency resultant for the 13 years, 1891–1902—Continued

MEMPHIS, TENN.

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Frequency resultant	
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Dir.	P. ct.
January	12	12	7	11	15	15	9	18	------	s 82° w	9
February	17	14	7	11	13	9	9	20	------	n 17° w	14
March	12	12	7	17	16	11	8	17	------	s 7° w	3
April	11	12	9	18	15	12	8	14	------	s 29° e	8
May	10	13	8	13	18	18	7	14	------	s 14° w	11
June	9	10	10	12	18	19	10	11	1	s 21° w	17
July	10	10	8	10	16	21	9	15	2	s 50° w	16
August	14	14	9	8	12	20	7	16	1	n 65° w	9
September	17	15	10	14	14	11	6	13	2	n 55° e	9
October	14	14	8	17	12	11	7	16	1	n 46° e	5
November	12	12	7	16	17	11	7	16	1	s 16° e	4
December	11	13	7	16	17	12	8	16	------	s 2° w	5

NEW ORLEANS, LA.

January	19	17	10	13	10	8	8	14	2	n 25° e	17
February	18	18	9	16	12	10	6	11	1	n 56° e	15
March	13	13	8	22	20	9	5	9	1	s 47° e	21
April	10	12	9	26	21	9	5	8	1	s 37° e	26
May	7	11	5	30	20	14	6	6	2	s 24° e	34
June	6	11	7	24	21	15	8	7	2	s 15° e	31
July	7	8	6	20	18	19	10	9	2	s 11° w	26
August	9	11	5	15	15	20	13	10	2	s 36° w	19
September	13	30	13	22	7	4	3	6	2	n 72° e	41
October	19	34	10	12	5	4	4	10	2	n 40° e	44
November	21	24	10	19	9	5	4	7	1	n 75° e	29
December	23	18	8	16	12	6	6	12	------	n 45° e	24

NEW YORK, N. Y.

January	10	12	5	4	8	18	14	30	------	n 63° w	35
February	7	15	4	5	6	13	16	33	------	n 43° w	37
March	8	14	7	9	8	12	11	31	------	n 46° w	25
April	8	13	7	13	10	12	10	26	------	n 58° w	14
May	6	13	8	15	13	16	10	18	------	s 40° w	10
June	5	10	6	14	16	20	9	19	------	s 45° w	20
July	5	9	5	11	21	24	10	16	------	s 37° w	30
August	8	10	6	12	18	17	10	17	------	s 49° w	16
September	8	12	5	11	17	18	9	19	------	s 63° w	15
October	8	15	7	7	11	18	10	24	------	n 68° w	19
November	7	13	5	7	9	18	14	27	------	n 72° w	29
December	8	10	4	4	9	22	16	27	------	n 76° w	36

PHILADELPHIA, PA.

January	11	15	6	5	5	17	10	30	------	n 44° w	31
February	10	16	5	5	5	13	11	34	------	n 42° w	38
March	12	16	8	7	8	13	7	30	------	n 31° w	26
April	12	13	8	8	9	16	9	25	------	n 49° w	19
May	10	12	10	9	10	22	10	18	------	s 85° w	13
June	10	11	9	7	11	24	10	18	------	s 82° w	19
July	8	8	7	8	14	27	12	16	------	s 61° w	27
August	13	11	9	8	12	22	9	16	------	s 83° w	13
September	12	14	9	8	10	20	10	16	------	n 76° w	11
October	13	16	8	6	8	17	10	22	------	n 42° w	22
November	13	12	5	5	9	18	11	27	------	n 58° w	30
December	11	10	4	4	7	20	13	29	------	n 67° w	36

PITTSBURGH, PA.

January	7	4	5	13	8	23	18	22	------	s 76° w	34
February	8	5	6	14	6	14	15	33	------	n 73° w	29
March	12	6	6	14	10	15	11	26	------	n 75° w	20
April	16	8	7	14	7	12	11	25	2	n 48° w	20
May	15	7	5	11	7	16	14	23	3	n 68° w	27
June	16	8	6	10	8	19	12	18	2	n 73° w	18
July	14	7	5	10	10	19	14	20	2	n 84° w	24
August	18	9	6	8	7	14	13	21	3	n 50° w	26
September	15	7	8	13	9	15	11	20	4	n 67° w	14
October	12	7	8	12	8	14	13	23	2	n 72° w	20
November	8	4	4	14	10	18	16	24	1	n 78° w	29
December	6	4	4	13	11	20	18	24	1	s 75° w	34

PORTLAND, OREG.

January	8	8	10	20	21	9	3	18	1	s 28° e	18
February	7	9	9	18	27	12	4	13	1	s 14° e	28
March	6	6	6	14	24	15	6	22	2	s 33° w	22
April	8	2	3	16	22	14	7	27	1	s 52° w	25
May	13	3	3	14	16	12	7	31	2	n 83° w	23
June	13	3	2	11	13	11	6	38	2	n 63° w	32
July	20	2	2	8	7	6	4	50	3	n 39° w	55
August	15	2	2	8	9	4	3	53	3	n 44° w	50
September	11	3	2	11	17	8	4	41	3	n 67° w	29
October	9	4	4	16	18	9	5	34	3	n 88° w	18
November	6	4	7	20	25	13	5	19	1	s 6° w	27
December	5	5	10	23	27	10	4	14	9	s 15° e	33

Wind direction frevuency, and frequency resultant for the 13 years; 1891–1902—Continued

ST. LOUIS, MO.

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Frequency resultant	
	P. ct.	P. ct.	P. ci.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Dir.	P. ct.
January	9	9	5	13	18	11	16	20	------	s 75° w	19
February	13	9	6	12	13	11	15	21	------	n 74° w	18
March	12	9	9	16	15	11	13	17	------	s 59° w	7
April	12	11	11	18	16	10	10	12	------	s 38° e	9
May	13	11	7	15	23	12	9	11	------	s 1° w	14
June	10	11	8	11	26	17	9	8	------	s 9° w	24
July	11	12	7	10	24	18	9	9	------	s 16° w	19
August	15	17	8	9	21	14	8	8	1	s 28° e	6
September	13	10	7	14	26	14	6	9	1	s 3° e	18
October	13	8	5	13	27	11	10	13	1	s 25° w	18
November	12	5	5	14	25	10	12	17	------	s 42° w	18
December	12	6	4	12	22	14	14	17	------	s 57° w	23

ST. PAUL, MINN.

January	5	3	4	23	8	13	14	29	2	s 72° w	23
February	5	6	4	20	8	14	15	28	2	s 82° w	22
March	8	10	7	19	7	11	11	26	1	n 56° w	10
April	8	12	9	22	8	9	8	22	2	n 66° e	4
May	8	12	7	21	10	12	8	21	2	s 15° w	2
June	5	6	6	30	11	14	10	16	2	s 1° e	20
July	7	5	5	23	13	16	9	19	3	s 27° w	19
August	7	5	6	24	13	12	8	21	4	s 22° w	13
September	6	5	5	28	13	13	10	16	4	s 6° w	23
October	5	4	4	26	11	14	12	21	4	s 33° w	20
November	6	4	4	23	10	12	14	25	2	s 64° w	18
December	5	3	4	22	10	14	14	27	1	s 70° w	23

SALT LAKE CITY, UTAH

January	4	4	9	26	15	9	14	17	2	s 3° w	21
February	6	6	8	24	14	10	12	19	2	s 14° w	14
March	10	7	7	24	13	6	10	22	1	s 4° w	5
April	10	8	8	23	10	7	9	24	2	n 53° w	2
May	9	9	9	23	10	6	7	24	2	n 54° e	3
June	11	11	10	25	10	6	5	23	1	n 71° e	10
July	9	11	11	28	12	5	5	19	------	s 71° e	17
August	6	9	10	32	14	6	5	17	------	s 49° e	24
September	7	10	10	31	10	5	6	21	1	s 55° e	16
October	7	8	10	30	9	4	8	22	2	s 61° e	11
November	6	5	8	33	12	7	9	18	2	s 24° e	20
December	6	5	8	33	12	9	10	16	2	s 18° e	22

SAN DIEGO, CALIF.

January	15	20	8	6	5	8	12	22	6	n 13° w	30
February	11	16	6	5	6	11	18	24	4	n 45° w	32
March	9	12	5	5	6	14	22	24	4	n 66° w	35
April	8	7	3	3	5	16	28	27	4	n 74° w	50
May	5	3	1	3	9	25	28	24	2	s 86° w	37
June	5	2	1	2	10	31	26	19	4	s 76° w	58
July	6	1	0	1	5	26	27	28	4	n 88° w	64
August	6	1	0	1	4	22	30	29	6	n 84° w	64
September	9	3	1	2	5	15	23	36	5	n 71° w	57
October	13	9	3	4	6	11	18	30	6	n 56° w	42
November	16	18	7	5	5	7	12	26	5	n 22° w	36
December	13	26	11	5	6	5	9	21	4	n 9° e	34

SAN FRANCISCO, CALIF.

January	23	7	5	17	7	9	11	20	1	n 29° w	20
February	13	6	3	15	9	16	24	13	1	s 80° w	28
March	8	4	3	9	8	22	35	10	1	s 78° w	48
April	4	2	2	7	7	32	40	7	1	s 68° w	64
May	2	2	1	4	6	38	43	4	------	s 67° w	73
June	1	1	1	3	4	45	44	1	------	s 64° w	81
July	0	1	0	1	5	56	36	0	------	s 59° w	88
August	0	1	0	1	7	53	37	0	------	s 59° w	86
September	2	1	1	4	6	40	42	3	1	s 65° w	75
October	7	3	2	7	8	28	37	7	2	s 71° w	56
November	17	5	4	12	8	15	23	15	2	n 83° w	28
December	28	8	5	15	7	8	10	19	------	n 17° w	25

SANTA FE, N. MEX.

January	14	31	6	13	7	11	4	11	4	n 42° e	27
February	14	22	5	12	7	15	5	16	4	n 13° e	15
March	10	14	5	14	9	20	7	20	3	n 86° w	10
April	8	11	7	20	9	22	6	15	2	s 17° e	12
May	6	11	8	21	10	25	6	11	2	s 2° w	21
June	5	10	9	26	10	26	5	9	2	s 9° e	29
July	7	13	11	23	11	17	5	9	4	s 39° e	22
August	7	13	12	25	10	16	5	9	3	s 45° e	24
September	6	11	9	26	12	18	5	9	4	s 27° e	26
October	8	14	8	25	9	18	4	10	4	s 38° e	18
November	13	22	7	19	6	14	4	12	5	n 63° e	16
December	15	30	5	13	6	10	4	12	4	n 33° e	28

Wind direction frequency, and frequency resultant for the 13 years, 1891–1902—Continued

SAVANNAH, GA.

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Frequency resultant	
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Dir.	P. ct.
January	12	15	6	4	7	15	18	20	------	n 54° w	28
February	10	13	7	7	10	15	17	20	------	n 70° w	21
March	8	10	9	10	18	16	13	16	------	s 45° w	18
April	8	8	9	12	23	14	13	12	------	s 22° w	20
May	6	8	9	15	25	17	12	8	1	s 8° w	30
June	6	8	10	18	25	20	9	4	------	s 4° e	37
July	6	7	6	12	21	30	13	5	1	s 27° w	41
August	7	9	8	12	22	24	12	7	1	s 20° w	31
September	11	26	17	15	11	8	6	4	1	n 83° e	31
October	20	29	11	8	6	5	7	12	------	n 29° e	38
November	17	18	8	8	8	11	12	17	1	n 14° w	20
December	16	16	8	7	9	12	13	18	------	n 29° w	21

Wind direction frequency, and frequency resultant for the 13 years, 1891–1902—Continued

WASHINGTON, D. C.

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Frequency resultant	
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Dir.	P. ct.
January	12	11	5	6	18	7	10	28	3	n 52° w	21
February	14	11	5	6	14	7	10	30	2	n 44° w	28
March	13	13	8	8	17	5	8	27	2	n 29° w	17
April	11	12	7	11	18	6	8	26	2	n 45° w	14
May	10	12	8	10	25	8	8	18	2	s 26° w	7
June	12	11	6	10	24	11	9	16	2	s 47° w	11
July	9	8	5	9	29	12	10	16	3	s 36° w	21
August	14	12	7	9	23	8	8	16	4	s 80° w	3
September	13	13	9	10	21	9	7	15	3	s 61° e	3
October	14	15	6	7	18	6	8	23	4	n 26° w	15
November	13	9	4	6	23	6	9	28	3	n 71° w	20
December	13	7	4	6	22	8	11	26	3	n 89° w	27

THE DEPENDENCE OF COASTAL SEA TEMPERATURES OF CAPE COD ON THE WEATHER

By FRANCES VANDERVOORT TRIPP

The purpose of this study is to ascertain the temperatures of the ocean water surrounding Cape Cod and to discover

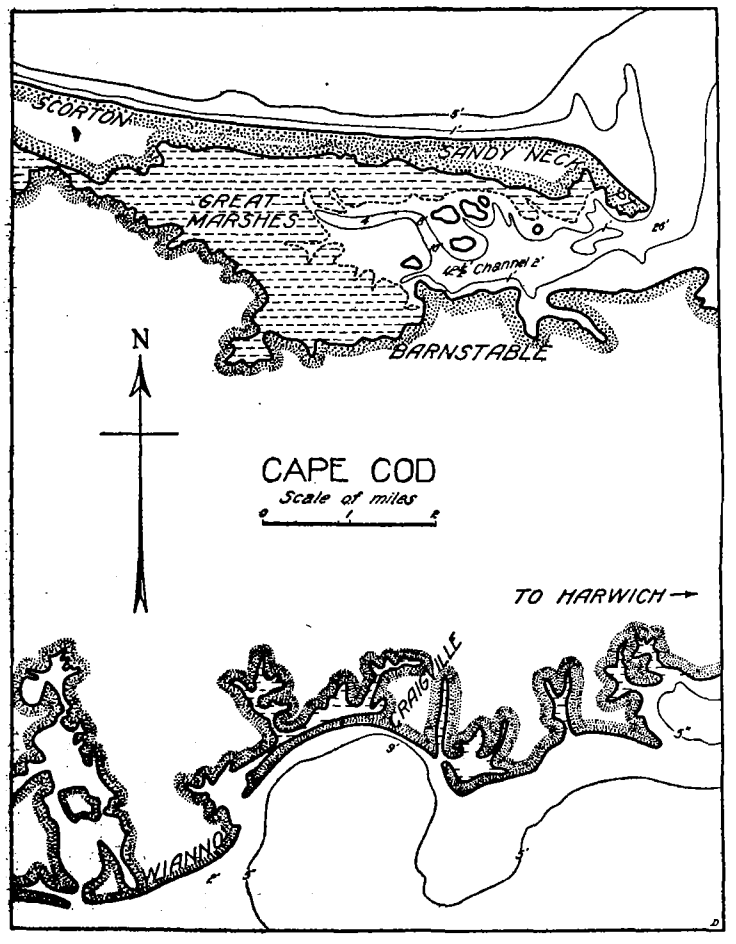

FIG. 1.—Map of Barnstable and vicinity

to what extent the agents, sun, wind and air affect these temperatures. Observations were made at six stations during the summers of 1925 and 1926, three located on the north, three on the south side of the cape. (See map, fig. 1.) Of those on the north side, the first, Barnstable, is situated on Barnstable Harbor, where the tidal rise and fall is between 9 and 10 feet; the second, Sandy Neck Point, forms the entrance to Barnstable Harbor; the third, Scorton Dunes, is located on the outside of Sandy Neck. All three have deep water at high tide, the first two have exposed flats at low tide. At the fourth station, Craigville, on the south shore, the rise and fall of tide is negligible, the water is always deep; while at the fifth and sixth stations, Harwich and Wianno, with the exception of flood tide, the water is never deep. Conditions at Harwich and Wianno being similar, data from these two stations may be grouped together.

To obtain the water temperatures, a Fahrenheit thermometer was placed inside a heavily weighted ginger-ale bottle which was lowered into the water by a 5-foot string attached near its mouth. After it had filled at that depth it was raised and the thermometer read. All temperature readings not made at that depth are so designated. The time required for the bottle to sink was 4 seconds, required to sink and fill, 22 seconds, required to fill just below the surface, also 22 seconds. The bottle was one-sixth full on reaching the bottom. Owing to the great rise and fall of tide and consequent rapidly moving water in Barnstable Harbor, where most of the observations were taken, the difference in temperature between the surface and 5 feet is in a majority of cases negligible.

Because of the contour of the coast line and its relation to the cold drift from the north, the water along the sandy shores of Cape Cod falls naturally into four divisions: (1) North shore, deep; (2) north shore, shallow; (3) south shore, deep; (4) south shore, shallow. The average summer temperature of the north shore deep ranges from 63° to 66° (the higher figure being found where sunned flats have influence); the average summer temperature of the south shore, deep, remains fairly constant at 74°–75°. Shallow-water temperatures vary more, depending on the interrelation of the factors, sun, wind, and air. To determine the sequence in importance of these factors in influencing local shore temperatures, high-tide temperatures at Barnstable (deep water, north shore, influenced somewhat by sunned flats) will be considered in relation to each factor in turn.

INSOLATION

The greatest number of high-water temperatures came on clear or hazy days; 22 examples of water at 70°–75° occurring on such days, against 14 on partly cloudy and cloudy days. The lowest temperatures and the greatest number of temperatures below 65° were recorded on partly cloudy and cloudy days; there were 16 instances of water 59°–65° on such days, against 11 on clear days. Water below 65° on clear days was due in practically all cases either to an exceptionally strong offshore wind or