POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1939	*h. m.*		°	°	°	°				
Dec. 21	10 50	6716	−74	242	−11	75	97	2	VG	Mt. Wilson.
		6715	−61	255	−9	62	73	2		
		6715	−59	257	−11	60	194	7		
		6712	−28	288	−18	33	48	7		
		6704	+52	8	+22	56	73	3		
		6704	+60	16	+21	63	242	9		
		6702	+62	18	+29	67	194	4		
				(316)	(−2)		921	34		
22	11 6	6716	−60	242	−11	60	194	3	G	U. S. Naval.
		6715	−48	254	−9	49	73	1		
		6715	−45	257	−11	46	194	2		
		6712	−14	288	−19	23	24	1		
		6704	+75	17	+22	78	145	2		
		6702	+76	18	+29	80	145	1		
				(302)	(−2)		775	10		
23	11 53	6716	−46	243	−11	47	194	2	F	Do.
		6715	−35	254	−10	36	97	3		
		6715	−31	258	−12	33	170	8		
		6712	−1	288	−19	18	24	1		
				(289)	(−2)		485	14		
24	11 32	6718	−48	228	−21	51	24	4	G	Do.
		6716	−31	245	−11	32	194	1		
		6715	−21	255	−10	23	97	6		
		6715	−19	257	−11	21	145	9		
		6717	−12	264	−10	14	24	5		
		6712	+12	288	−19	21	24	1		
				(276)	(−2)		508	26		
25	13 3	6718	−35	227	−21	40	6	2	F	Mt. Wilson
		6716	−18	244	−11	22	170	4		
		6715	−7	255	−10	11	73	8		
		6715	−5	257	−11	11	97	7		
		6717	+8	270	−8	10	6	1		
		6719	+25	287	+12	27	6	1		
				(262)	(−2)		358	23		
26	11 39	6718	−20	229	−21	28	36	4	VG	U. S. Naval
		6716	−3	246	−11	10	170	1		
		6715	+4	253	−10	10	24	5		
		6715	+9	258	−11	13	145	9		
				(249)	(−2)		375	19		
27	11 31	6718	−7	229	−21	19	6	1	G	Mt. Wilson
		6716	+9	245	−11	12	109	6		
		6715	+22	258	−11	23	97	13		
		6719	+52	288	+12	53	18	4		
				(236)	(−2)		230	24		
28	13 56	6721	−66	156	−16	67	6	2	F	Do.
		6720	−20	202	+19	29	48	6		
		6716	+24	246	−11	26	109	5		
		6715	+35	257	−10	35	97	11		
		6719	+66	288	+13	67	12	5		
				(222)	(−3)		272	29		
29	13 15	6723	−83	126	+16	82	97	1	G	Do.
		6720	−6	203	+19	22	36	7		
		6716	+37	246	−11	36	109	4		

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1939	*h. m.*		°	°	°	°				
Dec. 29	13 15	6715	+48	257	−10	48	48	9		
		6722	+55	264	+6	56	12	1		
		6719	+78	287	+12	78	12	1		
				(209)	(−3)		314	23		
30	11 54	6723	−69	128	+16	70	194	6	VG	U. S. Naval.
		6721	−65	132	+9	65	48	4		
		6720	+6	203	+19	22	24	4		
		6716	+49	246	−11	49	109	4		
		6715	+60	257	−10	60	12	2		
				(197)	(−3)		387	20		
31	12 4	6725	−66	117	+12	67	12	1	G	Do.
		6723	−54	129	+17	56	194	2		
		6724	−50	133	+9	51	36	4		
		(*)	+22	205	−11	22	6	1		
		6716	+63	246	−12	62	97	4		
		6715	+75	258	−10	75	12	1		
				(183)	(−3)		357	13		

Mean daily area for 30 days=585.

*=not numbered.
VG=very good; G=good; F=fair; P=poor.

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR DECEMBER 1939

[Dependent alone on observations at Zurich]

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

December 1939	Relative numbers	December 1939	Relative numbers	December 1939	Relative numbers
1	*d* 54	11	----------	21	*d* 46
2	40	12	----------	22	47
3	43	13	*a* --	23	* 35
4	----------	14	----------	24	----------
5	----------	15	----------	25	**a* 32
6	*Mc* --	16	*a* 53	26	**a* 37
7	*a* 23	17	*ad* 52	27	----------
8	*d* 47	18	* 61	28	----------
9	----------	19	*d* 44	29	----------
10	*d* --	20	----------	30	*d* 46
				31	34

Mean, 16 days=43.4.

*Observed at Chur.
a=Passage of an average-sized group through the central meridian.
b=Passage of a large group through the central meridian.
c=New formation of a group developing into a middle-sized or large center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central-circle zone.
d=Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE in charge]

By B. FRANCIS DASHIELL

Observations of pressures, temperatures and humidities made in the upper air by radiosondes, airplanes and pilot balloons during December are given in tables 1, 2, and 3. The pressures and temperatures, as well as resultant-wind directions and velocities, for 1.5, 3, 4, and 5 kilometers, are shown on charts VIII, IX, X and XI, respectively. Table 4 indicates the average heights of the tropauses, and chart XII presents the December isentropic data. Effective December 1, the United States Navy discontinued airplane observations at Pensacola, Fla., and substituted the use of radiosondes.

The distribution of mean pressure at 5,000 feet was such that the lowest pressure prevailed over the northeastern portion of the United States and the highest over Florida. Pressures reduced to this level showed the lowest to be at Mount Washington, N. H. (828.0 millibars), while the highest occurred in the southern Rocky Mountain region (Durango, Colo., 852.6 millibars). In the upper levels low mean pressure persisted over Sault Ste. Marie, Mich., with the highest over Pensacola and Miami, Fla. Outside the United States proper, the lowest pressures at all levels prevailed over Alaska, with Fairbanks consist-

ently about 10 millibars lower than Juneau at each corresponding level.

The mean barometric pressures during the current month were lower than those for November. Such was the case over all stations at every level, and, in many instances, December pressures were lower than any noted since radiosonde observations were inaugurated. It was also found that the current month showed pressures lower than in December 1938 at all levels over Washington, D. C., and in all but the higher altitudes over Nashville, Tenn., and Sault Ste. Marie, Mich. At Omaha, Nebr., however, the current month showed higher mean pressures for all levels than during the corresponding month of 1938.

Pressure differences between the high and low pressure areas, indicated by Miami, Fla., and Sault Ste. Marie, Mich., were greatest at 7 and 8 kilometers by as much as 30 millibars. This gradient, although associated with moderately high winds at identical levels, failed to coincide with the region of highest resultant winds and maximum individual velocities occurring at 9, 10, and 11 kilometers as shown in tables 2 and 3, respectively.

Mean free-air temperatures for the month were lowest over Sault Ste. Marie, Mich., and highest over the South, and particularly Miami, Fla., at 1.5, 3, 4, and 5 kilometers, as shown on charts VIII, IX, X, and XI, respectively. At these levels, as well as those up to 8 kilometers, the temperature difference between the points of extreme means (Miami, Fla., and Sault Ste. Marie, Mich.), remained uniform at approximately 18° C. Then the difference decreased with additional altitude until, at 11.4 kilometers, temperatures over both stations were equal. But above this level mean temperatures over Sault Ste. Marie, Mich., became warmer than those over Miami, Fla., with the difference increasing with altitude to 18° C. at 16 kilometers.

December temperatures were lower than those noted during the preceding month up to 10 kilometers, and then warmer above. In Alaska, however, the means at Juneau and Fairbanks showed the current month to be warmer at all levels. All stations having 1 year of radiosonde records showed that the current December was warmer than in December 1938 at all levels below 10 kilometers. At Omaha, Nebr., however, the current month was warmer at all levels, while Washington, D. C., showed means lower than in December 1938 above 2 kilometers.

The lowest individual temperature recorded during December was −78.1° C. at 15 kilometers over Miami, Fla. Other outstanding low readings were made at 17 kilometers in the Southwest. Mean and individual minimum temperatures were highest over Fairbanks, Alaska.

Resultant winds are shown on charts VIII, IX, X, and XI, for 1.5, 3, 4, and 5 kilometers, respectively. At 1.5 kilometers, winds from the northwest quadrant predominated east of the Rocky Mountains, while southwesterly and southeasterly directions occurred over the far West. This circulation, about the high pressure area in the Rocky Mountain region, still persisted to a slight extent at 3 and 4 kilometers. However, northwesterly directions practically covered the entire country, and at 8 and 10 kilometers (see table 2) northwesterly winds existed everywhere, with the exception of Miami, Fla.

Resultant velocities were high over most of the United States, except in the far Southwest at 1.5 and 3 kilometers. While a similar distribution was maintained at all higher levels, there was an increase in velocity with altitude. Outstanding resultant velocities occurred over the lower Great Lakes region, the Ohio Valley, and the Middle Atlantic States, with the highest for the country at 1.5 kilometers being recorded at Kylertown, Pa. (12.7 meters per second); at 3 kilometers over Cincinnati, Ohio (16.2 meters per second); at 4 kilometers over Chicago, Ill. (22.5 meters per second); at 5 and 8 kilometers over Richmond, Va. (25.2 and 35.8 meters per second); and at 10 kilometers over Huron, S. Dak. (28.8 meters per second).

Except in the far Northwest, at 3 and 5 kilometers, and west of the Rocky Mountains at 4 kilometers, the resultant wind directions departed from normal by turning in clockwise rotations. However, these departures were not large, except for a few scattered instances where velocities were comparatively low. Resultant velocities were greater than normal at each level over practically every station, but departures were not excessive below 5 kilometers. At the latter level, however, large positive departures from normal were noted at Billings, Mont., Cheyenne, Wyo., and Atlanta, Ga. (+11.1, +7.7 and +7.2 meters per second, repectively.).

Table 2 shows resultant winds based on 5 p. m. (seventy-fifth meridian time) observations. These directions, when compared with those for 1.5 and 3 kilometers based on 5 a. m. observations, showed a decided diurnal tendency to become more northerly over all but the southern and western portions of the United States. Elsewhere, the directions were more southerly in the afternoon. The 5 p. m. velocities were less than in the early morning over all of the country except along the northern border at 1.5 kilometers, and over the entire Rocky Mountain region at 3 kilometers.

The maximum wind velocities for December are given in table 3. The velocity of 87.5 meters per second (195.8 miles per hour) over Omaha, Nebr., at 12 kilometers on the 22d, is the highest of record in that section of the country, and is the fourth highest ever to be recorded by means of pilot balloons.

MONTHLY MEAN ISENTROPIC CHART [1]

The monthly mean isentropic chart, $\theta=300°$, for December 1939 (chart XII) shows that the westerlies had pushed southward over the eastern part of the country practically to the Gulf Coast, while an anticyclonic eddy is suggested in the moisture pattern over the Southwest, although not in the resultant wind circulation. With no knowledge of the normal isentropic pattern for December, no correlation with the departure of precipitation from normal can be undertaken. However, it may be remarked that over the eastern half of the country, where there is a marked deficiency of precipitation, the resultant winds are along slope or slightly down slope.

[1] Prepared by Division of Research and Education.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during December 1939*

Stations and elevations in meters above sea level

Altitude (meters) mean sea level	Albuquerque, N. Mex. (1620 m.)				Atlanta, Ga. (300 m.)				Barksdale Field, Shreveport, La.[1] (51 m.)				Billings, Mont. (1,089 m.)				Bismarck, N. Dak. (505 m.)				Boise, Ida. (824 m.)				Buffalo, N. Y. (220 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	840	3.2	55	31	982	5.3	74	21	1,011	7.6	82	31	891	2.4	53	31	955	−3.9	75	30	923	2.7	83	31	985	−0.7	83
500	----	----	----	----	31	959	7.0	70	21	957	9.7	74	----	----	----	----	----	----	----	----	----	----	----	----	31	951	−2.3	82
1,000	----	----	----	----	31	902	6.0	64	21	902	7.8	71	----	----	----	----	31	898	0.3	68	30	905	4.6	77	31	892	−4.6	84
1,500	----	----	----	----	31	848	4.3	58	21	849	5.4	69	31	847	4.2	50	31	844	−0.4	63	30	852	3.8	69	31	837	−6.0	78
2,000	31	802	4.9	49	31	798	3.2	48	21	799	3.5	64	31	796	1.5	51	31	792	−1.6	59	30	800	1.1	70	30	785	−7.4	75
2,500	31	754	2.9	47	31	750	1.7	39	21	750	1.7	61	31	748	−1.7	53	31	744	−3.8	57	30	752	−2.2	70	30	736	−9.3	73
3,000	31	708	0.6	45	31	704	−0.9	37	20	704	−0.2	56	31	702	−5.0	55	31	698	−6.8	56	30	705	−5.1	68	30	690	−11.5	72
4,000	31	625	−4.2	38	31	620	−6.3	36	17	621	−5.0	49	31	617	−11.5	56	31	613	−12.4	55	29	621	−10.4	68	28	604	−16.6	70
5,000	31	550	−10.7	34	31	546	−12.1	39	17	546	−10.9	47	30	541	−18.1	55	29	537	−19.4	56	27	544	−16.2	64	28	528	−22.4	67
6,000	31	481	−17.7	33	31	478	−18.7	39	14	479	−17.1	50	30	472	−25.1	54	28	469	−26.2	55	27	476	−22.7	62	28	460	−28.9	65
7,000	31	420	−25.3	32	31	417	−26.5	38	10	417	−23.6	46	30	411	−32.2	52	26	407	−34.2	53	27	414	−30.4	61	28	399	−36.0	64
8,000	31	366	−33.3	32	31	362	−34.7	38	7	361	−31.0	45	30	356	−38.7	52	25	352	−41.9	----	27	359	−37.2	58	28	345	−42.7	----
9,000	30	316	−40.5	31	31	313	−42.3	----	7	313	−39.4	47	30	307	−45.1	----	24	303	−48.8	----	27	310	−44.4	56	26	296	−48.1	----
10,000	30	273	−47.5	----	30	270	−49.8	----	----	----	----	----	30	264	−50.5	----	24	260	−53.2	----	27	267	−50.5	----	26	254	−51.3	----
11,000	30	234	−52.8	----	30	231	−56.0	----	----	----	----	----	28	226	−54.3	----	23	223	−54.6	----	24	229	−54.8	----	24	218	−52.6	----
12,000	30	200	−57.2	----	30	197	−59.7	----	----	----	----	----	27	193	−55.6	----	21	190	−53.9	----	23	195	−57.3	----	21	186	−51.9	----
13,000	30	170	−59.8	----	30	168	−62.0	----	----	----	----	----	27	165	−56.0	----	19	162	−54.0	----	22	166	−57.5	----	20	159	−52.9	----
14,000	29	145	−62.1	----	29	143	−64.1	----	----	----	----	----	27	141	−56.4	----	14	138	−54.7	----	22	142	−57.4	----	20	136	−54.0	----
15,000	26	123	−65.0	----	29	121	−65.9	----	----	----	----	----	26	120	−57.5	----	12	118	−54.8	----	19	121	−59.0	----	18	116	−55.0	----
16,000	25	104	−66.7	----	27	102	−67.1	----	----	----	----	----	26	103	−58.6	----	8	101	−55.2	----	16	103	−59.6	----	14	99	−56.0	----
17,000	19	88	−67.1	----	25	87	−66.4	----	----	----	----	----	21	87	−57.5	----	7	85	−54.9	----	12	87	−59.3	----	6	84	−56.4	----
18,000	9	74	−64.4	----	17	74	−65.1	----	----	----	----	----	11	74	−55.9	----	5	72	−53.3	----	5	73	−57.6	----	----	----	----	----

Stations and elevations in meters above sea level

Altitude (meters) mean sea level	Charleston, S. C. (14 m.)				Denver, Colo. (1,616 m.)				El Paso, Tex. (1,193 m.)				Ely, Nev. (1,908 m.)				Fairbanks, Alaska (153 m.)				Joliet, Ill. (178 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	30	1,016	6.4	82	30	838	−0.5	52	31	885	5.5	63	31	812	−1.9	68	30	977	−14.6	65	31	992	−0.5	83
500	30	959	9.7	60	----	----	----	----	----	----	----	----	----	----	----	----	30	934	−9.3	69	31	953	+0.6	75
1,000	30	902	7.4	51	----	----	----	----	----	----	----	----	----	----	----	----	30	876	−7.7	67	31	896	−0.4	66
1,500	30	849	5.8	47	----	----	----	----	31	853	10.0	49	----	----	----	----	30	822	−8.0	64	31	841	−1.4	58
2,000	30	798	4.3	40	30	800	5.0	49	31	802	7.6	45	31	803	0.6	64	30	770	−10.4	62	31	790	−3.1	54
2,500	30	751	2.6	36	30	752	3.2	46	31	755	5.1	42	31	754	0.8	59	30	721	−13.9	62	30	742	−5.1	51
3,000	30	705	0.4	33	30	706	−0.1	44	31	710	2.3	40	31	708	−1.7	58	30	675	−17.3	63	30	695	−7.3	51
4,000	30	622	−5.5	31	30	622	−6.7	42	31	627	−2.8	34	30	624	−6.4	49	30	590	−24.4	60	30	611	−12.3	53
5,000	29	547	−11.8	31	30	547	−13.1	42	31	552	−9.4	31	30	548	−12.7	44	30	513	−31.4	57	30	535	−18.8	51
6,000	29	480	−18.4	32	30	479	−20.2	43	31	484	−16.7	31	30	480	−19.5	42	29	444	−38.7	56	30	467	−26.1	51
7,000	29	419	−25.3	31	30	418	−27.8	43	31	422	−24.5	30	30	419	−27.1	43	29	384	−45.9	----	30	406	−33.7	50
8,000	27	363	−32.9	32	30	362	−35.6	43	31	368	−32.6	30	29	364	−34.6	42	29	329	−52.2	----	27	351	−40.8	----
9,000	25	315	−41.1	----	29	313	−43.4	----	30	318	−40.1	----	29	314	−41.8	----	28	282	−55.9	----	26	302	−46.8	----
10,000	22	271	−48.2	----	28	270	−50.4	----	30	274	−47.2	----	29	270	−48.6	----	27	241	−54.7	----	25	259	−51.9	----
11,000	20	232	−53.9	----	28	231	−54.9	----	29	235	−53.6	----	29	232	−54.1	----	26	207	−52.5	----	23	222	−53.9	----
12,000	18	198	−58.1	----	24	197	−58.0	----	29	201	−58.4	----	29	198	−57.2	----	25	177	−50.9	----	18	190	−54.1	----
13,000	16	169	−60.9	----	21	168	−59.4	----	29	171	−61.4	----	29	169	−59.1	----	21	152	−50.0	----	18	162	−54.7	----
14,000	15	143	−62.6	----	19	143	−61.3	----	29	145	−64.6	----	27	143	−60.0	----	19	131	−49.1	----	17	138	−55.9	----
15,000	13	121	−65.3	----	18	122	−62.7	----	29	123	−67.7	----	24	122	−62.0	----	17	112	−48.5	----	13	118	−56.9	----
16,000	12	103	−66.3	----	17	104	−64.2	----	29	104	−68.7	----	24	104	−63.7	----	14	96	−48.3	----	10	101	−57.1	----
17,000	10	87	−65.3	----	13	88	−63.7	----	19	88	−68.0	----	20	88	−62.4	----	10	83	−47.3	----	7	86	−57.5	----
18,000	7	74	−64.1	----	6	74	−61.1	----	6	75	−65.4	----	11	74	−61.8	----	----	----	----	----	----	----	----	----

See footnotes at end of table.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during December 1939*—Continued

Stations and elevations in meters above sea level

Altitude (meters) mean sea level	Juneau, Alaska (49 m.)				Lakehurst, N. J.[2] (39 m.)				Medford, Oreg. (401 m.)				Miami, Fla. (4 m.)				Minneapolis, Minn. (263 m.)				Nashville, Tenn. (180 m.)				Norfolk, Va.[2] (10 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	29	997	4.4	82	29	1,008	−0.2	76	30	971	5.2	89	31	1,018	15.0	92	31	982	−3.2	77	31	995	4.4	74	25	1,016	4.5	76
500	29	943	1.8	83	29	952	−0.9	68	30	959	5.5	87	31	960	16.4	77	31	954	−1.8	74	31	957	4.9	71	25	957	5.8	61
1,000	29	886	−1.6	88	29	894	−2.0	66	30	903	5.9	75	31	906	13.5	75	31	896	−1.8	67	31	900	3.3	65	25	900	3.3	55
1,500	29	831	−4.5	92	29	839	−3.4	63	30	849	4.7	68	31	854	12.1	59	31	841	−1.8	56	31	846	1.7	58	25	846	1.3	52
2,000	29	780	−7.1	93	29	788	−4.8	61	30	798	2.2	63	31	804	10.7	45	31	789	−3.2	52	31	796	0.4	54	24	794	−1.1	49
2,500	26	731	−9.7	91	29	739	−6.5	62	30	750	−0.1	58	31	757	8.8	36	31	741	−5.4	52	31	748	−1.2	49	24	746	−3.5	47
3,000	22	685	−12.4	88	29	693	−9.0	63	30	704	−2.6	57	31	712	6.1	33	31	695	−8.0	51	31	702	−3.4	46	24	700	−5.7	46
4,000	18	600	−18.8	84	29	608	−14.2	62	29	620	−8.0	59	31	630	0.4	27	31	610	−13.2	50	29	618	−8.3	44	23	616	−10.8	41
5,000	15	523	−26.0	82	27	532	−20.2	63	29	545	−14.2	61	31	555	−5.5	24	31	534	−19.4	50	29	542	−13.8	43	17	541	−16.7	40
6,000	9	455	−33.7	79	27	464	−27.1	63	29	477	−21.1	63	31	488	−12.6	24	31	466	−26.8	50	27	474	−20.5	41				
7,000	7	393	−40.6		25	403	−33.9	66	28	415	−28.2	61	31	427	−19.4	25	31	405	−34.4	50	26	414	−28.0	39				
8,000	7	338	−46.6		23	349	−40.4		27	360	−36.4	58	31	373	−27.0	25	31	350	−41.9	51	24	359	−35.6	38				
9,000	7	290	−51.7		21	300	−46.6		26	311	−44.0	62	31	324	−34.8	25	31	302	−48.2		23	311	−42.7	38				
10,000					19	258	−51.3		23	267	−50.6		31	280	−42.7		31	259	−52.3		23	267	−48.9					
11,000					16	221	−54.2		23	228	−56.7		31	241	−50.2		31	222	−53.6		22	229	−53.9					
12,000					15	190	−55.2		21	195	−60.1		31	206	−57.2		31	190	−53.9		19	196	−57.0					
13,000					13	162	−56.1		20	166	−60.0		31	176	−62.7		31	162	−54.0		18	166	−59.9					
14,000					12	138	−57.3		17	141	−60.6		30	149	−66.9		30	139	−54.5		18	141	−61.7					
15,000					9	118	−58.6		14	120	−61.9		30	126	−69.9		26	119	−55.4		17	120	−62.8					
16,000					7	100	−59.6		11	102	−63.7		28	106	−71.1		21	102	−55.7		14	101	−63.3					
17,000									8	86	−62.5		25	90	−71.1		11	87	−55.4		11	86	−63.7					
18,000									7	72	−60.4		20	76	−70.1		6	74	−55.7		6	72	−62.7					
19,000													11	64	−68.3													
20,000													5	54	−65.6													

Stations and elevations in meters above sea level

Altitude (meters) mean sea level	Oakland, Calif. (2 m.)				Oklahoma City, Okla. (391 m.)				Omaha, Nebr. (301 m.)				Pearl Harbor, T. H.[2] (6 m.)				Pensacola, Fla.[2] (24 m.)				Phoenix, Ariz. (339 m.)				St. Louis, Mo. (171 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	1,020	9.0	84	31	972	4.6	63	31	981	−0.9	75	31	1,015	20.4	85	30	1,018	12.2	73	31	977	9.3	68	31	996	1.7	77
500	31	961	10.5	72	31	959	7.2	58	31	957	1.9	59	31	959	19.5	76	30	961	11.5	61	31	959	13.7	63	31	956	2.9	71
1,000	31	905	8.9	65	31	902	8.0	47	31	899	2.6	58	31	905	15.6	83	30	905	9.1	58	31	904	14.8	52	31	898	2.1	66
1,500	31	852	7.7	57	31	849	6.2	43	31	845	1.4	54	31	854	12.6	81	30	852	8.0	48	31	852	12.1	47	31	844	0.8	60
2,000	31	801	5.8	50	31	798	4.3	38	31	794	−0.5	53	31	804	13.2	51	30	802	6.6	38	31	802	9.4	45	31	794	−0.9	55
2,500	31	754	3.4	44	31	751	2.2	36	31	746	−2.6	53	31	757	12.5	33	30	754	4.7	32	31	755	6.6	42	31	745	−2.9	51
3,000	31	708	0.8	40	31	705	−0.4	35	31	700	−4.8	50	31	713	10.5	21	30	709	2.8	30	31	710	3.9	40	31	699	−5.5	50
4,000	31	625	−5.0	39	31	622	−6.2	33	30	616	−10.6	49	31	632	4.7	15	30	626	−2.5	30	30	627	−2.5	38	31	614	−11.2	45
5,000	31	550	−11.4	42	30	546	−12.7	31	30	540	−17.0	49					29	551	−8.6	32	30	552	−9.1	36	31	539	−17.2	43
6,000	31	481	−18.4	40	29	479	−19.4	27	30	472	−24.3	48					29	484	−15.5	35	30	484	−16.7	34	30	471	−24.3	44
7,000	31	420	−26.0	39	29	418	−27.1	27	30	410	−32.2	47					29	423	−22.1	37	30	423	−24.5	33	30	409	−31.9	44
8,000	29	365	−34.1	39	27	363	−34.7	27	30	355	−40.0	47					29	368	−29.3	44	30	368	−32.7	32	29	355	−38.9	44
9,000	29	316	−42.0	39	27	314	−41.4		30	306	−46.7						29	319	−36.7	45	30	318	−40.6	32	28	306	−45.6	
10,000	29	272	−49.5		25	270	−48.0		29	263	−51.9						29	276	−44.0		29	274	−48.3		27	263	−51.3	
11,000	29	233	−55.8		23	231	−54.3		29	225	−54.7						29	238	−51.0		28	235	−54.3		25	225	−55.4	
12,000	29	199	−59.8		22	197	−58.1		28	192	−55.8						29	203	−56.6		28	201	−58.1		22	192	−57.0	
13,000	29	169	−61.0		22	168	−59.1		28	164	−56.6						26	173	−60.2		27	171	−61.0		20	165	−57.7	
14,000	29	144	−62.6		21	143	−61.3		28	140	−57.5						25	147	−62.9		27	145	−64.0		19	140	−59.0	
15,000	29	122	−65.1		18	121	−63.8		25	120	−59.0						23	125	−65.0		25	123	−66.9		19	120	−60.7	
16,000	24	104	−66.6		14	103	−64.9		23	102	−60.1						20	106	−66.9		24	104	−69.8		15	102	−61.8	
17,000	21	88	−66.7		10	86	−64.9		10	87	−59.4						14	90	−67.8		23	88	−69.6		10	87	−61.6	
18,000	16	74	−65.0		5	73	−63.6										11	76	−68.4		18	74	−67.6					
19,000	8	63	−63.2														7	64	−68.0		11	63	−65.0					
20,000																	5	54	−67.3									

See footnotes at end of table.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during December 1939*—Continued

Altitude (meters) mean sea level	Stations and elevations in meters above sea level																			
	San Antonio, Tex. (174 m.)				San Diego, Calif.[2] (10 m.)				S. Ste. Marie, Mich. (221 m.)				Spokane, Wash. (598 m.)				Washington, D. C.[2] (7 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	999	10.7	75	29	1,016	12.3	80	31	983	−3.4	84	31	948	1.8	89	27	1,013	2.5	76
500	31	961	14.3	66	29	958	16.1	57	31	919	−4.7	88					27	953	1.6	66
1,000	31	906	12.5	58	29	904	15.0	48	31	890	−6.2	87	31	902	1.9	83	27	897	0.2	67
1,500	31	853	10.6	55	29	852	12.9	41	31	835	−6.5	80	30	847	0.1	78	27	842	−1.5	62
2,000	31	803	8.9	48	29	802	10.6	35	31	784	−7.8	75	30	795	−2.5	73	27	790	−3.3	61
2,500	31	756	6.6	42	29	755	8.0	31	31	734	−9.8	74	30	747	−5.2	70	27	741	−5.4	60
3,000	31	711	4.0	40	29	710	5.0	28	31	688	−12.2	72	29	700	−8.0	69	27	696	−7.6	58
4,000	31	628	−1.6	39	27	627	−2.0	26	31	603	−17.9	70	29	615	−12.9	62	27	611	−12.4	59
5,000	31	553	−7.7	39	9	553	−9.2	32	31	527	−24.0	68	28	539	−19.2	62	27	535	−18.3	57
6,000	29	486	−14.8	39					31	459	−31.1	65	28	470	−25.6	64	26	468	−25.3	56
7,000	29	425	−22.8	39					31	397	−37.9	65	28	409	−32.6	64	26	407	−32.6	56
8,000	29	370	−30.0	38					30	343	−44.7		28	354	−39.7	62	23	352	−39.2	55
9,000	29	320	−37.4	39					30	295	−50.0		28	305	−46.1		23	304	−45.0	
10,000	29	276	−44.7						30	252	−53.1		27	262	−51.8		20	261	−49.5	
11,000	29	237	−51.0						30	216	−52.9		27	225	−54.8		17	224	−54.3	
12,000	29	203	−56.0						25	185	−52.5		24	192	−55.5		12	191	−57.2	
13,000	29	174	−59.5						22	158	−52.8		23	164	−54.8		8	163	−58.5	
14,000	28	148	−62.1						16	135	−53.8		21	140	−55.4					
15,000	26	125	−64.8						10	116	−53.7		21	120	−56.4					
16,000	23	106	−66.9						5	98	−52.5		20	102	−56.6					
17,000	23	90	−67.5										11	88	−56.8					
18,000	17	76	−66.1										5	75	−55.6					
19,000	12	64	−64.8										5	64	−53.5					
20,000	6	54	−63.4																	

[1] Army. Taken at approximately 2 a. m., 75th meridian time.
[2] Navy. Taken at 4 a. m., 75th meridian time, except San Diego, Calif., and Pearl Harbor, T. H., where they are made at dawn.

Observations taken at 1 a. m., 75th meridian time.
Number of observation refers to pressure only as temperature and humidity data are missing for some observations at certain levels; also, the humidity data are not used in daily observations when the temperature is below −40.0 ° C.
None of the means included in this table are based on less than 15 surface and 5 standard-level observations.

LATE REPORT FOR FAIRBANKS, ALASKA, SEPTEMBER 1939

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level: Fairbanks, Alaska (152 m.)				Altitude (meters) m. s. l.	Stations and elevations in meters above sea level: Fairbanks, Alaska (152 m.)				Altitude (meters) m. s. l.	Stations and elevations in meters above sea level: Fairbanks, Alaska (152 m.)			
	Number of observations	Pressure	Temperature	Relative humidity		Number of observations	Pressure	Temperature	Relative humidity		Number of observations	Pressure	Temperature	Relative humidity
Surface	19	994	4.6	74	3,000	19	694	−9.8	78	10,000	12	257	−52.7	
500	19	952	4.7	74	4,000	17	609	−15.7	76	11,000	11	220	−52.9	
1,000	19	895	1.7	78	5,000	17	532	−22.2	73	12,000	9	188	−52.6	
1,500	19	841	−1.5	81	6,000	16	464	−29.3	70	13,000	8	161	−53.0	
2,000	19	790	−4.4	81	7,000	15	402	−36.7	68	14,000	8	138	−53.3	
2,500	19	740	−7.1	80	8,000	14	348	−43.7		15,000	7	117	−53.8	
					9,000	12	299	−49.1		16,000	6	100	−53.8	

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during December 1939*—Continued

LATE REPORT FOR SAN ANTONIO, TEX., FOR AUGUST, SEPTEMBER AND OCTOBER 1939

Altitude (meters) mean sea level	Stations and elevations in meters above sea level											
	August (174 m.)				September (174 m.)				October (174 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	994	24.2	85	29	995	22.7	84	31	998	18.8	71
500	31	958	23.5	82	29	959	22.4	78	31	960	19.9	68
1,000	31	905	22.5	70	29	905	20.5	69	31	906	17.9	61
1,500	31	855	19.7	67	29	854	18.2	65	31	855	15.5	60
2,000	31	806	16.8	68	29	805	15.2	64	31	805	13.5	53
2,500	31	760	13.9	67	29	759	12.7	62	31	759	11.0	51
3,000	31	716	11.0	65	29	715	9.9	60	31	714	8.6	51
4,000	30	635	5.3	64	28	633	4.7	53	31	632	3.4	50
5,000	30	561	−0.3	63	28	560	−0.7	50	31	558	−2.1	47
6,000	30	495	−5.8	59	27	494	−6.6	41	31	492	−8.4	43
7,000	29	435	−12.4	56	27	434	−13.1	36	31	431	−15.2	40
8,000	29	380	−19.1	51	27	379	−20.5	35	31	378	−22.1	38
9,000	29	332	−26.5	48	26	330	−27.8	34	31	328	−29.6	37
10,000	29	289	−34.0	48	26	286	−35.5	33	31	285	−36.9	36
11,000	29	249	−41.8	----	26	246	−43.2	----	30	246	−44.2	----
12,000	26	215	−49.3	----	26	212	−50.6	----	30	211	−50.7	----
13,000	25	184	−56.3	----	26	182	−57.5	----	29	181	−56.3	----
14,000	25	157	−62.3	----	26	154	−63.3	----	29	154	−61.9	----
15,000	24	133	−66.7	----	26	131	−67.9	----	28	131	−66.8	----
16,000	24	113	−69.4	----	26	111	−70.6	----	28	111	−70.1	----
17,000	23	95	−68.8	----	26	93	−71.5	----	26	94	−70.3	----
18,000	21	81	−66.7	----	24	79	−70.2	----	21	79	−68.9	----
19,000	16	68	−64.0	----	21	66	−67.1	----	16	67	−66.1	----
20,000	13	58	−61.6	----	14	56	−63.5	----	14	56	−62.5	----
21,000	11	49	−60.1	----	6	47	−60.5	----	10	47	−60.2	----
22,000	7	42	−58.4	----	----	----	----	----	5	40	−57.8	----

LATE REPORT SWAN ISLAND, WEST INDIES, AUGUST 1939

Altitude (meters) mean sea level	Swan Island, West Indies (10 m.)				Altitude (meters) mean sea level	Swan Island, West Indies (10 m.)				Altitude (meters) mean sea level	Swan Island, West Indies (10 m.)			
	Number of observations	Pressure	Temperature	Relative humidity		Number of observations	Pressure	Temperature	Relative humidity		Number of observations	Pressure	Temperature	Relative humidity
Surface	31	1,010	26.7	85	6,000	31	490	−9.2	48	15,000	31	129	−71.8	----
500	31	957	22.5	88	7,000	31	430	−15.2	47	16,000	31	109	−73.9	----
1,000	31	904	19.4	82	8,000	31	376	−21.7	46	17,000	30	92	−73.8	----
1,500	31	853	16.5	75	9,000	31	328	−28.9	45	18,000	26	78	−72.5	----
2,000	31	804	13.8	68	10,000	31	284	−36.6	45	19,000	25	65	−70.5	----
2,500	31	757	10.9	63	11,000	31	246	−44.6	----	20,000	22	55	−68.2	----
3,000	31	713	8.2	56	12,000	31	211	−52.6	----	21,000	9	46	−66.5	----
4,000	31	631	2.7	52	13,000	31	180	−60.5	----	22,000	7	39	−65.0	----
5,000	31	557	−3.3	51	14,000	31	153	−67.4	----					

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during December 1939*

[Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second (superior figures indicate number of observations)]

Altitude (meters) m. s. l.	Abilene, Tex. (537 m.)		Albuquerque, N. Mex. (1,554 m.)		Atlanta, Ga. (302 m.)		Billings, Mont. (1,095 m.)		Boise, Idaho (850 m.)		New York, N. Y. (15 m.)		Brownsville, Tex. (7 m.)		Buffalo, N. Y. (220 m.)		Burlington, Vt. (132 m.)		Charleston, S. C. (18 m.)		Cheyenne, Wyo. (1,873 m.)		Chicago, Ill. (192 m.)		Cincinnati, Ohio (157 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	271^{30}	2.5	309^{31}	0.8	272^{28}	3.9	259^{31}	4.2	193^{27}	0.7	297^{30}	5.6	122^{29}	2.8	253^{29}	4.0	264^{29}	1.4	254^{31}	1.9	281^{29}	6.5	270^{30}	2.9	259^{31}	2.8
500	----	----	----	----	277^{28}	4.6	----	----	----	----	294^{29}	8.6	149^{29}	3.2	251^{29}	6.5	263^{29}	4.1	256^{31}	4.7	----	----	276^{30}	5.2	252^{31}	5.7
1,000	276^{30}	3.0	----	----	277^{27}	6.0	----	----	150^{27}	1.6	287^{28}	9.7	215^{28}	2.0	261^{24}	10.3	276^{24}	5.9	250^{29}	7.9	----	----	290^{28}	7.9	259^{24}	7.6
1,500	292^{28}	4.5	----	----	288^{27}	8.2	267^{31}	8.2	154^{27}	2.8	293^{26}	11.0	276^{24}	3.4	277^{14}	9.9	283^{13}	6.7	260^{27}	11.0	----	----	296^{26}	10.1	282^{21}	9.7
2,000	290^{26}	6.1	306^{31}	1.9	294^{21}	10.9	276^{23}	10.2	211^{26}	2.8	297^{23}	12.7	283^{23}	4.4	293^{10}	9.2	----	----	267^{24}	13.3	281^{26}	7.4	297^{18}	12.3	286^{30}	13.0
2,500	290^{26}	6.6	313^{31}	4.8	291^{21}	12.6	278^{23}	10.9	239^{26}	6.1	295^{13}	9.4	282^{22}	5.7	----	----	----	----	268^{22}	16.1	291^{26}	9.8	301^{14}	12.8	300^{16}	13.9
3,000	283^{26}	7.8	307^{31}	8.1	291^{21}	14.3	284^{26}	11.1	245^{24}	7.8	289^{10}	9.4	277^{20}	5.7	----	----	----	----	270^{16}	14.2	298^{26}	10.4	309^{14}	14.9	319^{13}	16.1
4,000	289^{25}	9.6	307^{29}	10.7	289^{20}	17.7	296^{21}	17.4	263^{18}	9.2	----	----	283^{18}	7.6	----	----	----	----	271^{10}	15.7	302^{27}	13.2	----	----	----	----
5,000	292^{25}	12.2	309^{27}	13.7	290^{18}	19.8	298^{20}	19.0	----	----	----	----	296^{13}	9.5	----	----	----	----	----	----	297^{25}	14.9	----	----	----	----
6,000	296^{24}	11.9	305^{27}	14.9	291^{16}	20.6	308^{17}	21.2	----	----	----	----	----	----	----	----	----	----	----	----	296^{24}	17.1	----	----	----	----
8,000	299^{22}	12.4	277^{22}	13.7	302^{10}	19.3	312^{10}	23.8	----	----	----	----	----	----	----	----	----	----	----	----	315^{13}	21.7	----	----	----	----
10,000	282^{17}	13.0	296^{13}	16.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
12,000	291^{15}	12.6	309^{11}	18.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
14,000	287^{11}	14.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
16,000	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
18,000	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during December 1939*—Continued

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.)		Fargo, N. Dak. (283 m.)		Greensboro, N. C. (271 m.)		Havre, Mont. (766 m.)		Houston, Tex. (21 m.)		Huron, S. Dak. (393 m.)		Las Vegas, Nev. (570 m.)		Little Rock, Ark. (79 m.)		Medford, Oreg. (410 m.)		Miami, Fla. (10 m.)		Minneapolis, Minn. (261 m.)		Nashville, Tenn. (194 m.)		New Orleans, La. (19 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	317^{21}	0.6	294^{27}	2.3	252^{26}	2.5	256^{30}	3.9	246^{30}	1.4	306^{31}	3.7	87^{31}	0.7	223^{29}	1.3	349^{22}	1.4	334^{31}	0.4	283^{28}	2.4	263^{28}	2.4	345^{27}	2.1
500	-----	-----	293^{27}	4.2	251^{26}	4.6	-----	-----	239^{30}	2.5	306^{31}	4.4	-----	-----	236^{29}	3.8	16^{22}	1.0	308^{31}	0.4	272^{28}	3.4	257^{28}	3.9	266^{27}	2.2
1,000	-----	-----	290^{19}	8.5	260^{26}	7.5	252^{30}	8.4	282^{29}	4.0	305^{28}	6.6	51^{21}	2.1	249^{28}	6.3	155^{20}	3.3	272^{31}	1.7	292^{26}	6.5	266^{27}	5.5	268^{26}	4.0
1,500	280^{31}	1.1	297^{19}	10.2	281^{26}	9.3	267^{30}	11.9	288^{27}	5.7	312^{26}	10.0	30^{31}	1.2	276^{24}	8.1	204^{19}	5.3	266^{31}	4.0	303^{24}	8.1	280^{28}	8.0	288^{28}	6.0
2,000	271^{31}	2.4	303^{16}	11.5	292^{22}	13.0	273^{30}	12.1	286^{21}	7.1	313^{24}	10.9	270^{31}	1.0	290^{23}	10.2	220^{18}	7.8	277^{28}	5.3	313^{22}	10.6	289^{22}	10.4	288^{24}	7.7
2,500	290^{31}	4.3	297^{18}	13.1	286^{20}	15.7	280^{30}	13.1	282^{23}	7.9	315^{23}	13.0	264^{31}	2.6	298^{22}	11.4	228^{13}	10.6	274^{26}	7.0	314^{22}	11.8	291^{21}	11.9	288^{22}	8.4
3,000	292^{31}	5.3	297^{17}	13.8	289^{19}	17.6	283^{23}	12.1	289^{23}	8.5	312^{22}	15.3	267^{31}	4.0	294^{22}	13.1	-----	-----	274^{24}	7.2	311^{19}	12.9	300^{19}	14.7	287^{22}	9.9
4,000	295^{29}	7.1	300^{16}	16.3	286^{19}	22.5	295^{18}	10.2	280^{23}	11.1	305^{22}	18.7	279^{30}	6.8	297^{18}	13.7	-----	-----	264^{24}	9.3	298^{11}	15.5	298^{16}	18.5	292^{17}	11.4
5,000	292^{28}	6.6	-----	-----	293^{19}	25.2	289^{10}	15.4	282^{21}	12.2	307^{22}	22.3	282^{30}	8.6	304^{15}	16.5	-----	-----	266^{19}	11.9	-----	-----	296^{10}	21.8	-----	-----
6,000	293^{25}	8.3	-----	-----	290^{19}	30.8	-----	-----	281^{21}	13.7	306^{19}	23.2	287^{30}	11.0	295^{12}	16.5	-----	-----	265^{18}	15.4	-----	-----	-----	-----	-----	-----
8,000	305^{12}	6.3	-----	-----	290^{18}	35.8	-----	-----	295^{18}	15.2	311^{16}	27.0	288^{28}	12.8	-----	-----	-----	-----	264^{14}	21.7	-----	-----	-----	-----	-----	-----
10,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	317^{11}	28.8	301^{26}	16.3	-----	-----	-----	-----	262^{11}	26.3	-----	-----	-----	-----	-----	-----
12,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	297^{11}	18.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
14,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	307^{16}	14.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
16,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	311^{13}	12.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
18,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)		Oklahoma City, Okla. (402 m.)		Omaha, Nebr. (306 m.)		Reno, Nev. (1,346 m.)		St. Louis, Mo. (170 m.)		Salt Lake City, Utah (1,294 m.)		San Diego, Calif. (15 m.)		San Juan, P. R. (16 m.)		Sault Ste. Marie, Mich. (198 m.)		Seattle, Wash. (14 m.)		Spokane, Wash. (603 m.)		Washington, D. C. (10 m.)		Winslow, Ariz. (1,488 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	218^{30}	1.6	320^{25}	2.2	296^{28}	2.2	151^{31}	1.1	276^{28}	2.1	237^{29}	1.2	283^{31}	3.6	84^{31}	5.2	316^{26}	2.4	182^{25}	2.0	205^{28}	1.4	276^{30}	2.7	331^{21}	0.5
500	219^{30}	0.3	319^{25}	2.2	287^{28}	3.3	-----	-----	262^{28}	4.3	-----	-----	305^{31}	2.8	97^{31}	6.4	307^{26}	3.2	188^{25}	4.8	-----	-----	277^{30}	5.9	-----	-----
1,000	259^{28}	2.0	305^{28}	2.2	298^{27}	5.8	-----	-----	266^{27}	6.0	-----	-----	324^{31}	1.0	109^{30}	5.0	318^{26}	6.3	299^{24}	7.8	195^{28}	3.4	280^{29}	9.4	-----	-----
1,500	251^{26}	2.9	303^{28}	5.5	305^{28}	7.9	163^{31}	1.1	297^{22}	6.8	215^{29}	1.5	359^{30}	0.8	118^{30}	4.0	333^{13}	10.4	208^{22}	8.1	210^{23}	7.6	282^{27}	11.1	-----	-----
2,000	276^{22}	3.5	301^{28}	7.5	300^{23}	8.6	190^{31}	2.8	298^{21}	9.1	213^{29}	2.8	337^{29}	1.1	115^{24}	3.4	333^{12}	13.3	220^{16}	7.4	230^{26}	8.7	288^{22}	13.5	337^{31}	0.8
2,500	266^{21}	4.3	304^{28}	8.3	299^{23}	11.3	229^{31}	4.3	292^{20}	11.4	234^{29}	2.7	318^{29}	2.0	108^{22}	3.4	331^{11}	15.7	231^{18}	7.9	233^{16}	9.7	292^{21}	14.9	294^{31}	2.9
3,000	286^{19}	4.7	301^{26}	9.8	303^{21}	13.1	258^{30}	6.8	297^{16}	13.6	259^{27}	4.5	316^{29}	3.0	101^{18}	3.2	-----	-----	235^{11}	8.3	232^{17}	10.5	288^{16}	15.8	290^{31}	3.9
4,000	299^{18}	7.8	311^{23}	12.4	310^{19}	17.4	264^{24}	11.0	311^{12}	14.5	287^{26}	8.7	302^{28}	4.2	98^{16}	2.0	-----	-----	-----	-----	249^{13}	10.5	295^{13}	18.2	304^{29}	6.6
5,000	288^{11}	7.7	307^{23}	13.3	310^{18}	20.3	281^{21}	12.5	-----	-----	298^{20}	12.7	302^{23}	4.2	126^{15}	1.5	-----	-----	-----	-----	272^{10}	14.0	-----	-----	301^{27}	7.6
6,000	-----	-----	304^{21}	14.3	310^{16}	21.7	278^{17}	12.2	-----	-----	301^{13}	12.6	265^{20}	3.8	308^{12}	0.6	-----	-----	-----	-----	-----	-----	-----	-----	289^{27}	9.6
8,000	-----	-----	298^{17}	16.2	313^{12}	24.7	258^{11}	19.0	-----	-----	-----	-----	-----	-----	258^{10}	6.7	-----	-----	-----	-----	-----	-----	-----	-----	283^{22}	11.2
10,000	-----	-----	293^{13}	15.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	283^{21}	12.2
12,000	-----	-----	290^{10}	21.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	300^{18}	14.0
14,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	305^{16}	15.4
16,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	289^{13}	10.9

TABLE 3.—*Maximum free-air velocity, (M. P. S.), for different sections of the United States based on pilot balloon observations during December 1939*

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station
Northeast [1]	51.6	WNW	2,360	31	Harrisburg, Pa.	54.6	WNW	3,880	9	Hartford, Conn.	45.0	NNW	5,650	24	Kylertown, Pa.
East-Central [2]	56.6	W	2,480	31	Richmond, Va.	52.9	WNW	5,000	31	Knoxville, Tenn.	76.0	WNW	9,400	5	Greensboro, N. C.
Southeast [3]	37.4	WNW	2,500	21	Spartanburg, S. C.	43.5	W	4,980	20	Atlanta, Ga.	58.5	WSW	13,900	31	Miami, Fla.
North-Central [4]	40.0	WNW	1,990	16	Fargo, N. Dak.	54.4	NW	4,260	7	Milwaukee, Wis.	75.0	NW	10,080	13	Huron, S. Dak.
Central [5]	35.6	NNW	1,280	2	Kansas City, Mo.	46.0	W	3,040	9	Indianapolis, Ind.	87.5	WSW	11,960	22	Omaha, Nebr.
South-Central [6]	32.1	WNW	2,070	23	Abilene, Tex.	42.0	NNW	4,270	2	Oklahoma City, Okla.	62.0	W	11,770	21	Oklahoma City, Okla.
Northwest [7]	39.0	W	1,570	2	Havre, Mont.	46.4	WNW	3,380	11	Havre, Mont.	50.0	NNW	9,440	1	Billings, Mont.
West-Central [8]	39.6	SSW	2,440	10	Sacramento, Calif.	61.8	WSW	4,210	16	Redding, Calif.	73.6	NNW	10,200	26	Reno, Nev.
Southwest [9]	30.9	WNW	2,190	23	El Paso, Tex.	47.0	NNW	4,880	20	Albuquerque, N. Mex.	69.4	NNW	9,980	22	Las Vegas, Nev.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania and northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.
[3] South Carolina, Georgia, Florida, and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.
[7] Montana, Idaho, Washington, and Oregon.
[8] Wyoming, Colorado, Utah, northern Nevada, and northern California.
[9] Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

TABLE 4.—*Mean altitude and temperatures of significant points identifiable as tropopauses during December 1939, classified according to the potential temperatures (10-degree intervals between 290° and 409° A.) with which they are identified. (Based on radiosonde observations)*

Potential temperatures, °A	Albuquerque, N. Mex.			Atlanta, Ga.			Billings, Mont.			Bismarck, N. Dak.			Boise, Idaho			Buffalo, N. Y.			Charleston, S. C.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.
290–299							7	6.5	−41.3	3	6.0	−34.7	4	6.9	−43.2	2	6.3	−42.0			
300–309	1	8.0	−46.0				8	7.8	−47.2	14	7.9	−48.0	3	7.9	−46.7	18	7.4	−43.6	2	9.3	−53.5
310–319	7	8.7	−47.6	9	9.1	−48.2	13	9.0	−48.1	23	9.4	−54.6	11	9.0	−48.9	22	9.0	−51.1	7	8.8	−45.0
320–329	19	10.3	−52.1	21	10.3	−53.7	23	10.5	−56.3	11	10.3	−56.2	17	10.5	−56.1	17	10.3	−56.7	10	10.2	−51.4
330–339	17	11.6	−58.4	18	11.6	−59.1	9	11.5	−59.2	6	11.3	−57.2	16	11.7	−60.5	6	11.1	−56.5	14	11.7	−59.9
340–349	9	12.7	−62.9	9	12.7	−64.3	2	12.4	−63.5	2	12.0	−58.0	5	12.8	−64.8	3	11.8	−56.7	6	12.7	−63.2
350–359				3	14.2	−70.3				1	12.9	−60.0							4	13.2	−63.5
360–369	6	14.7	−69.5	7	14.1	−67.0	2	13.4	−59.5	1	14.1	−69.0							2	14.5	−68.5
370–379	4	15.0	−67.5	4	15.1	−68.5	1	15.2	−68.0				1	15.0	−68.0	1	14.0	−61.0	3	14.9	−66.7
380–389	4	15.8	−70.8	8	15.5	−68.4	1	15.1	−66.0	2	15.0	−62.5									
390–399	10	16.5	−70.7	7	16.0	−67.6	4	15.6	−62.5				3	15.5	−64.3	2	14.8	−58.5	4	16.0	−68.8
400–409	3	16.5	−68.0	4	16.3	−66.2	2	15.8	−60.5				1	16.3	−63.0	2	15.5	−60.0	2	16.6	−67.0
Weighted means		12.5	−60.1		12.5	−60.5		10.4	−53.8		9.6	−53.4		10.8	−56.1		9.5	−51.5		12.3	−58.4
Mean potential temperature °A. (weighted)	348.1			348.3			322.5			318.8			329.5			322.3			342.6		

Potential temperatures, °A.	Denver, Colo.			El Paso, Tex.			Ely, Nev.			Fairbanks, Alaska			Joliet, Ill.			Lakehurst, N. J.			Medford, Oreg.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.
290–299										26	6.8	−47.1				1	5.9	−34.0			
300–309	1	7.0	−39.0	1	8.6	−50.0	9	7.2	−40.0	33	8.3	−55.5	9	7.1	−40.9	6	7.1	−41.0	4	7.5	−43.2
310–319	16	9.0	−48.5	8	8.2	−39.2	12	8.3	−40.8	15	9.1	−54.9	16	9.0	−49.1	13	9.0	−50.5	8	8.7	−46.0
320–329	27	10.3	−53.6	14	10.1	−50.4	27	10.4	−54.0	6	9.6	−53.8	15	10.3	−55.2	5	10.2	−54.4	15	10.6	−56.4
330–339	14	11.6	−59.1	19	11.5	−57.5	17	11.6	−59.1	3	10.6	−56.0	6	10.8	−55.8	4	11.0	−57.0	10	11.7	−60.6
340–349	4	12.6	−62.2	12	12.6	−61.3	7	12.6	−62.1				3	11.9	−57.3	1	11.1	−54.0	5	12.6	−61.5
350–359	1	14.1	−68.0	5	14.3	−70.0	3	13.3	−64.0				1	13.5	−64.0	1	13.3	−62.0	1	12.4	−57.0
360–369	3	14.2	−65.0	10	14.7	−70.1	5	14.2	−65.4				1	13.3	−62.0				3	14.3	−66.0
370–379	1	15.2	−71.0	10	15.4	−70.8	7	14.8	−66.1				1	15.0	−66.0				2	14.0	−59.0
380–389	2	15.4	−67.0	9	15.7	−69.3	3	15.9	−68.7												
390–399	4	15.6	−64.5	6	16.4	−70.5	4	16.4	−67.0							1	15.3	−61.0	5	16.1	−67.4
400–409	2	16.0	−63.0	1	16.7	−71.0	1	17.0	−70.0										1	16.2	−63.0
Weighted means		11.2	−55.9		12.9	−61.5		11.3	−55.5		8.1	−52.7		9.7	−51.6		9.7	−52.0		11.5	−56.9
Mean potential temperature °A. (weighted)	335.2			353.2			337.3			305.6			322.9			321.3			338.1		

Potential temperatures, ° A.	Miami, Fla.			Minneapolis, Minn.			Nashville, Tenn.			Oakland, Calif.			Oklahoma, Okla.			Omaha, Nebr.			Pensacola, Fla.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.
290–299																2	6.4	−39.5			
300–309				17	7.6	−44.8	2	6.8	−33.0				1	7.2	−38.0	8	7.7	−46.0			
310–319				21	8.0	−49.7	9	8.8	−45.3	10	9.4	−51.7	7	8.6	−46.7	22	8.9	−49.1			
320–329	9	10.0	−47.6	21	10.1	−53.5	15	9.9	−49.4	21	10.4	−53.7	12	10.7	−56.8	18	10.0	−51.8	4	9.1	−42.0
330–339	18	10.9	−56.8	7	11.2	−59.0	13	11.0	−54.8	22	11.8	−60.8	16	11.5	−57.6	14	11.3	−57.9	15	11.0	−52.9
340–349	20	12.8	−61.9	3	12.1	−60.0	5	12.4	−60.2	7	12.4	−60.9	6	12.2	−58.8	5	12.4	−61.8	10	12.4	−60.0
350–359	16	13.9	−67.4	2	12.6	−58.0	3	13.2	−63.7	4	13.3	−64.0	2	13.1	−58.0	1	13.2	−62.0	6	13.1	−60.8
360–369	10	14.7	−69.5	2	13.4	−60.0	3	14.3	−66.0	5	14.4	−68.0	5	14.5	−68.2	1	13.6	−61.0			
370–379	8	15.6	−71.5				4	14.8	−66.5	5	14.8	−66.6	2	14.8	−64.5	1	14.2	−62.0	1	14.4	−63.0
380–389	8	15.9	−70.6	1	14.5	−57.0	4	14.8	−59.8	7	15.6	−70.1	4	15.5	−66.5	2	15.0	−64.0	2	16.2	−73.9
390–399	5	16.6	−71.8	4	14.8	−56.8				5	16.0	−68.4	3	16.1	−69.0	2	16.3	−67.0	1	16.7	−69.0
400–409	3	17.4	−73.7	1	15.7	−60.0	2	16.4	−67.0	7	16.5	−66.3	2	16.5	−65.0	3	15.7	−60.7			
Weighted means		13.1	−62.4		9.9	−51.9		11.2	−54.3		12.3	−59.9		12.1	−58.5		10.4	−53.3		12.0	−56.5
Mean potential temperature ° A. (weighted)	347.3			326.6			339.9			347.4			344.0			329.5			343.4		

TABLE 4.—*Mean altitudes and temperatures of significant points identifiable as tropopauses during December 1939, classified according to the potential temperatures (10-degree intervals between 290° and 409° A.) with which they are identified. (Based on radiosonde observations)*—Continued

Potential temperatures, °A.	Phoenix, Ariz.			St. Louis, Mo.			San Antonio, Tex.			Sault Ste. Marie, Mich.			Spokane, Wash.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.
290-299				2	6.6	−41.5				8	6.3	−40.5	4	5.8	−36.0
300-309	1	7.7	−44.0	6	7.9	−49.2				20	7.9	−48.6	9	7.2	−41.4
310-319	7	9.1	−48.0	13	9.1	−50.2	2	8.0	−33.5	22	9.2	−53.4	18	9.0	−49.4
320-329	19	10.2	−51.5	17	10.3	−54.1	10	10.0	−49.9	15	10.2	−56.1	26	10.4	−55.1
330-339	18	11.2	−55.3	10	11.7	−60.5	20	11.1	−53.4	6	11.2	−59.5	9	11.1	−56.8
340-349	10	12.5	−60.1	6	11.7	−56.5	14	12.5	−59.9	2	11.0	−53.5	1	12.3	−63.0
350-359	3	13.5	−65.3	1	13.1	−61.0	5	13.1	−61.4						
360-369	9	14.6	−68.4	2	13.6	−55.5	5	14.0	−63.6				1	13.5	−63.0
370-379	2	15.4	−70.5	3	14.7	−66.3	7	15.3	−68.6				3	14.2	−63.3
380-389	10	16.1	−72.6	2	14.4	−60.0	10	15.7	−68.3	1	14.0	−59.0			
390-399	5	16.3	−70.8				4	16.8	−72.8						
400-409	3	16.9	−71.3	6	15.9	−62.7	7	16.9	−70.6				1	15.2	−54.0
Weighted means		12.5	−59.8		11.0	−55.3		13.0	−60.2		9.0	−51.8		9.8	−51.7
Mean potential temperature °A. (weighted)	347.5			336.1			355.0			315.0			323.2		

LATE REPORTS FOR SAN ANTONIO, TEX.

Potential temperatures, °A.	July 1939			Aug. 1939			Sept. 1939			Oct. 1939		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.
320-329										3	9.0	−38.0
330-339				2	11.2	−49.0	1	10.4	−41.0	10	11.0	−49.6
340-349	3	11.4	−46.0	6	12.3	−53.3	8	11.9	−53.4	14	12.1	−53.7
350-359	11	13.7	−62.0	12	13.8	−64.3	17	13.6	−62.1	9	13.9	−64.1
360-369	10	14.8	−66.3	15	14.9	−66.1	12	14.7	−67.3	11	14.6	−66.4
370-379	14	15.6	−68.4	8	15.6	−69.1	7	15.5	−70.3	16	15.6	−70.5
380-389	11	16.4	−70.9	15	16.3	−70.9	12	16.0	−70.9	7	16.2	−70.8
390-399	6	17.1	−72.5	4	17.1	−72.0	5	16.9	−72.4	5	17.1	−72.8
400-409	4	17.6	−70.2	3	17.3	−70.3	7	17.4	−72.0	3	17.2	−72.0
Weighted means		15.3	−66.8		15.0	−66.1		14.8	−65.8		14.0	−62.5
Mean potential temperature °A. (weighted)	372.9			369.3			368.9			361.5		

AEROLOGICAL OBSERVATIONS FOR THE YEAR 1939

[Aerological Division, D. M. LITTLE in charge]

By B. FRANCIS DASHIELL

An increase in the use of radiosondes for obtaining observations of pressure, temperature and humidity in the upper air was one of the outstanding features of the aerological work of the Weather Bureau during 1939. At the close of the year radiosonde observations were being made daily at 25 stations of the Weather Bureau, 3 of the United States Navy, and 1 of the Army. Airplane meteorological flights were conducted by the Navy at 6 stations. Valuable radiosonde data were obtained during the 1939 hurricane season at San Juan, P. R., and Swan Island. Special observations were also made by radiosonde at Boston, Mass., and St. Georges, Bermuda, under the direction of the Massachusetts Institute of Technology, and by the United States Coast Guard when on duty at Halifax, Nova Scotia, and at sea in a patrol area extending from latitudes 40° to 44° N. and longitudes 47° to 53° W. Mean pressures, temperatures and humidities, computed from the above data, have been published regularly in the MONTHLY WEATHER REVIEW.

Pilot-balloon observations of wind directions and velocities were being made 4 times daily at 98 Weather Bureau stations in the United States proper, at 4 in Alaska, and 1 in Puerto Rico. All of the above stations, with the exception of 2 in Alaska, substituted helium gas for hydrogen on July 1, 1939. A selected group of 27 stations, where afternoon visibilities were unusually favorable, have been using 100-gram pilot balloons for the 5 p. m., 75th meridian time, observations. This was an increase of 12 stations over those in operation at the beginning of the year. During 1939 pilot-balloon observations formerly made at Cleveland were transferred to Akron, Ohio; Vicksburg to Jackson, Miss.; Fort Worth to Dallas, Tex.; and Floyd Bennett Field to the New York City airport. New pilot-balloon stations were opened during 1939 at Birmingham, Ala.; Butte, Mont.; Camden, N. J.; Des Moines, Iowa; Elkins, W. Va.; Elmira, N. Y.; Hartford, Conn.; Little Rock, Ark.; Louisville, Ky.; Milwaukee, Wis.; Mobile, Ala.; Pueblo, Colo.; Rapid City, S. Dak.; San Antonio, Tex.; Springfield, Mo.; and Toledo, Ohio.

A monthly series of flights by sounding balloons carrying recording meteorographs, checked by two theodolite observations, was conducted at Omaha, Nebr., during the month of April in accordance with the international program.

The work of reducing all existing Weather Bureau pilot-balloon observations to punch cards was completed by the Works Progress Administration at its special cooperative Weather Bureau project in New Orleans, La. At the close of the year approximately one million individual flights had been reduced to cards, and the data are being summarized and combined in quickly available forms.

In the upper air, at 1.5, 3, 4, and 5 kilometers, where observations were made both by airplanes and radiosondes,