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*		°	°	°	°				
Oct. 30	10 39	6658	−58	223	−14	62	12	2	VG	Mt. Wilson.
		6656	−32	249	−10	34	48	9		
		6656	−30	251	−7	33	194	8		
		6657	−25	256	+5	25	824	52		
		6655	−15	266	+22	23	194	14		
		6652	+29	310	+14	31	145	14		
		6654	+33	314	+4	34	6	3		
		6648	+57	338	−8	58	24	2		
		6648	+63	344	−9	64	727	20		
		6648	+68	349	−9	70	73	7		
				(281)	(+5)		2,247	131		
Oct. 31	11 7	6660	−68	200	+22	69	16	3	P	Do.
		6658	−45	223	−14	49	12	2		
		6656	−19	249	−10	24	48	6		
		6656	−17	251	−7	20	170	4		
		6657	−11	257	+7	16	679	30		
		6655	−3	265	+22	18	145	6		
		6659	+48	316	−6	50	6	1		
		6648	+78	346	−8	80	582	9		
				(268)	(+4)		1,658	61		

Mean daily area for 29 days=2,131.

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

PROVISIONAL SUNSPOT RELATIVE NUMBERS FOR OCTOBER 1939

[Dependent alone on observations at Zurich]

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

October 1939	Relative numbers	October 1939	Relative numbers	October 1939	Relative numbers
1	*ad* 144	11	56	21	*a* —
2	*a* 143	12	*Eac* —	22	*d* 94
3	----------	13	*a* —	23	----------
4	*aa* 92	14	*Eac* 68	24	*a* 112
5	----------	15	*Ec* 73	25	*bd* —
6	*ad* —	16	68	26	*d* 100
7	----------	17	*a* 79	27	----------
8	*d* —	18	*Eacd* 74	28	*a* 64
9	77	19	*d* 92	29	*Ec* 81
10	67	20	95	30	85
				31	*a* —

Mean, 19 days=87.6

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 center-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

The establishment of a widespread network of radiosonde observations became an accomplished fact during October with the opening of additional stations at Juneau and Fairbanks, Alaska, and Lakehurst, N. J.; the latter being changed by the United States Navy from an airplane station. For the first time, regularly scheduled daily observations of pressure, temperature and humidity, in the high levels above 28 radiosonde stations, extended from Alaska to the Caribbean. These stations are listed in table 1a, and the observations of the United States Navy by airplanes at 7 stations are given in table 1. Charts VIII, IX, X, and XI show the mean pressures and temperatures, as well as the resultant winds, at 1.5, 3, 4, and 5 kilometers, respectively. The pressures shown on chart VIII are for 5,000 feet only. Tables 2 and 3 list certain wind data, and table 4 shows the heights of the tropopauses. Isentropic data for October are shown on chart XII. A detailed description of the charts and tables was given in the January 1939 issue of the MONTHLY WEATHER REVIEW.

The mean free-air pressures for the current month for 5,000 feet, and 3, 4, and 5 kilometers, were well distributed. Highest pressure was indicated over the Southeast, being located at Pensacola, Fla., at 5,000 feet, and 3 and 4 kilometers, and over Miami, Fla., at 5 kilometers. Lowest mean pressure existed over the northern portion of the United States, being indicated at Sault Ste. Marie, Mich. To the south of the high-pressure area diminishing pressures were noted over Puerto Rico and Swan Island. Above 5 kilometers, where observations were made by radiosondes, lowest pressures prevailed along the northern border. These were centered over Sault Ste. Marie, Mich., up to 14 kilometers, and over Bismarck, N. Dak., in the higher levels. Lowest pressures occurred over Alaska, being lower at Fairbanks than at any station in the United States. Above 5 kilometers the highest mean pressures were noted over Miami, Fla., up to 11 kilometers, and then equalled by San Juan, P. R. Pressures over Swan Island were lower than those recorded at either Miami, Fla., or San Juan, P. R.

Mean pressures at stations using radiosonde in 1938 showed the current month to be lower than in October 1938 at all levels over Nashville, Tenn., Oklahoma City, Okla., Omaha, Nebr., and Sault Ste. Marie, Mich. The pressures at Nashville, Tenn., were very little lower than the previous year, but those at Sault Ste. Marie, Mich. became lower by a difference of 5 millibars at the surface to 10 millibars at 8 kilometers, then decreased with altitude to 2 millibars at 18 kilometers. Over Oakland, Calif., the current mean pressure was higher than in 1938 from the surface up to 11 kilometers, and then lower above. At Washington, D. C., the 1939 means were higher at all levels, the difference also becoming greatest at 8 kilometers.

During October the pressure differences at all levels between the southeastern HIGH (Miami, Fla.), and the northern LOW (Sault Ste. Marie, Mich.), showed a gradient increasing with altitude from 4 millibars at 500 meters to 25 millibars at 8 kilometers, and decreasing with additional altitude to 6 millibars at the maximum height of 17 kilometers. Also, a parallel case existed between the low-pressure area over Sault Ste. Marie, Mich., and the still lower one over Fairbanks, Alaska. In both cases the maximum gradient in millibars occurred at 8 kilometers. The pressure differences in millibars for all levels averaged 45 percent of those noted between Miami, Fla., and Sault Ste. Marie, Mich. And, as an interesting incidental, the difference in latitude between Fairbanks, Alaska, and Sault Ste. Marie, Mich., also is 45 percent of the difference between the latter place and Miami, Fla.

Mean relative humidities were high in the northern sections of the country (Sault Ste. Marie, Mich., Billings, Mont., Bismarck, N. Dak., and Spokane, Wash.). But outside of the United States proper the highest humidities

were recorded over Juneau and Fairbanks, Alaska, San Juan, P. R., and Swan Island. Elsewhere humidities were only moderately high, with the exception of the central States and the far Southwest. San Diego, Calif., Phoenix, Ariz., and El Paso, Tex., reported the lowest mean relative humidities recorded in the upper air during October.

Mean free-air temperatures for October were lower than those recorded in September at all levels up to an average of 14 kilometers, and higher than the preceding month at all levels above 14 kilometers. Oakland, Calif., Medford, Oreg., Spokane, Wash., and Atlanta, Ga., were the only exceptions, as these stations were colder in October at all levels. At Miami, Fla., the October mean temperature became warmer at 2.5 kilometers and remained so up to 16 kilometers, when it again became colder. Radiosonde temperatures at San Juan, P. R., showed that October was warmer than September at 6 to 12 kilometers only, while Swan Island was warmer up to 15 kilometers, and then colder above.

Comparing the October means at the 6 stations having radiosonde records for both 1938 and 1939 (Nashville, Tenn., Oakland, Calif., Oklahoma City, Okla., Omaha, Nebr., Sault Ste. Marie, Mich., and Washington, D. C.) it was found that the current month was generally colder than in October 1938. However, at Oakland, Calif., the October 1939 temperatures were warmer up to 6 kilometers and then colder above, while at Sault Ste. Marie, Mich., it was colder up to 12 kilometers and warmer above. Washington, D. C., was currently warmer at all levels up to 11 kilometers, and then colder above.

At 1.5 kilometers the mean free-air temperatures (chart VIII) were higher than 0° C. over the entire United States. The warmest occurred over San Juan, P. R., Miami, Fla., and El Paso, Tex., while the coldest was over Sault Ste. Marie, Mich. But at Fairbanks and Juneau, Alaska, below-zero mean temperatures were noted (−9.8° C. and −3.3° C., respectively). The level of 0° C. mean free-air temperature sloped upward toward the South from approximately 900 meters over Juneau, Alaska, to 1.6 kilometers over Sault Ste. Marie, Mich., 3.8 kilometers over Nashville, Tenn., and 4.9 kilometers over Miami, Fla., and San Juan, P. R. At 5 kilometers all stations reported below-zero (0° C.) temperatures.

Above 5 kilometers lowest temperatures were found over the southern stations in the higher levels, while the northern stations remained coldest at the lower levels. Fairbanks, Alaska, reported a mean of −53.9° C. at 10 kilometers, while Swan Island had −78 7° C. at 18 kilokilometers. Intermediate radiosonde stations along a vertical cross section extending from Spokane, Wash , to Miami, Fla., showed a steady decrease in mean minimum temperatures as the altitude increased.

The highest individual minimum temperature recorded during October was −61.2° C. on the 6th at 12 kilometers over Juneau, Alaska, while the lowest of −85.1° C. over Swan Island at 18 kilometers on the 30th was close to the lowest outdoor temperature ever recorded. Elsewhere, low individual temperatures occurred at 17 kilometers over San Juan, P. R. (−81.3° C.), on the 15th; Atlanta, Ga. (−80.6° C.), on the 27th; Miami, Fla. (−77.0° C.), on the 21st; El Paso, Tex. (−77.0° C.), on the 29th; and Denver, Colo. (−70.6° C.), on the 22nd. Also, low temperatures were noted at 16 kilometers over St. Louis, Mo. (−73.5° C.), on the 9th; and Oakland, Calif. (−70.3° C.), on the 22d; and over Sault Ste. Marie, Mich. (−67.1° C.) on the 9th, at 14 kilometers.

The resultant winds for the current month, computed for 1.5, 3, 4, and 5 kilometers, are shown in charts VIII, IX, X, and XI, respectively. In most cases the directions for October were more northerly than during the preceding seasonal summer and autumn months. Pilot-balloon observations made in October failed generally to equal the maximum altitudes reached during the several months immediately preceding. However, there were a number of excellent observations made during the month. All pilot-balloon stations reached 5 kilometers as a maximum, while 68, 18, and 7 percent exceeded 10, 15, and 20 kilometers, respectively. The highest individual altitudes were reached over Abilene, Tex., Miami, Fla., and Redding, Calif. (26.7, 22.9, and 20.3 kilometers, respectively), on the 13th. The first days of October were favorable for high balloon observations over the Great Lakes region; the 15th along the Mississippi and Ohio Valleys; and on the 16th over the Northeast. At many of these maximum altitudes northeasterly winds were encountered over the Southeastern States, as well as the central portions of the Pacific Coast and Rocky Mountain States.

At 1.5 kilometers (chart VIII) the resultant-wind directions, based on 5 a. m., 75th meridian time observations, were northwesterly over a belt extending from the Northwest to the Atlantic coast. Southeasterly winds over Florida and Cuba turned clockwise to become westerly over Louisiana, Alabama, and Georgia. This circulation was due to the high-pressure area centered over Pensacola, Fla. Winds in the far West appeared confused, where very light velocities were noted (Reno, Nev., 0.2 m. p. s.). Elsewhere, resultant velocities were higher than previous months, except over the east Gulf region. Highest wind speeds occurred from northern Texas to the Great Lakes and New England, reaching a maximum for the country at Albany, N. Y. (12.7 m. p. s.).

The October wind directions at 1.5 kilometers backed from normal by counterclockwise rotations over the eastern half of the country, and turned by clockwise rotations over the West, except at Medford, Oreg., and Spokane, Wash. The largest departures from normal occurred over San Diego, Calif. (134° clockwise rotation from normal), Houston, Tex. (104° clockwise), Seattle, Wash. (57° clockwise), and Atlanta, Ga. (46° counterclockwise). The departures from the normally light wind velocities were positive but small. Elsewhere, the current velocities were greater than normal over all stations, with the exception of Medford, Oreg., and Seattle, Wash., where they were less than normal. Positive departures of more than 3 m. p. s. occurred over the entire central portion of the United States at this level.

The resultant winds at 3 kilometers, also based on 5 a. m. observations (chart IX), showed that northwesterly directions predominated. However, the anticyclonic circulation continued to persist over the Southeast, with Miami, Fla., and Key West, Fla., reporting directions of 123° and 117°, respectively. Winds on the Pacific coast showed more definite directions at 3 kilometers with velocities exceeding those noted at 1.5 kilometers. High resultant velocities prevailed elsewhere in the country, except the extreme South and Southwest. Again the highest resultant wind speed in the country occurred over Albany, N. Y. (17.6 m. p. s.).

At 3 kilometers the current winds were oriented by departing from the normal in small counterclockwise rotations, except at San Diego, Calif., and Houston, Tex., where the departure differences were 178° and 110°, respectively. Clockwise departures were noted only at Medford, Oreg., Spokane, Wash., and Key West, Fla. The October velocities were larger than normal elsewhere, except over Houston, Tex., and Atlanta, Ga., where the departures were less than normal.

Chart X shows resultant winds at 4 kilometers based on observations made at 5 p. m. Northwesterly winds predominated at this level over all but the extreme southern portion of the United States, and Cuba and Mexico. Some indications of the anticyclone noted in the lower levels remained at 4 kilometers over Cuba, Puerto Rico, and southern Florida. Resultant velocities greater than 5 m. p. s. occurred over the entire country, except along the immediate Gulf coast and the extreme Southwest including California. Velocities over 15 m. p. s. prevailed west of the Great Lakes and in New England. Albany, N. Y., again had an outstanding velocity of 16.6 m. p. s., but this was surpassed by 18.0 m. p. s. recorded over Hartford, Conn.

Resultant winds at 5 kilometers are shown on chart XI. The directions showed definite northwesterly resultants over the United States with the exception of the extreme South. Indications of the anticyclonic circulation appeared over and southeast of southern Florida. Winds over California showed outstanding northerly tendencies. Resultant velocities at 5 kilometers were slightly higher than at 4 kilometers, but extreme velocities occurred over the North, particularly west of the Great Lakes (Milwaukee, Wis., 20.0 m. p. s., Fargo, N. Dak., 19.2 m. p. s., and Huron, S. Dak., 18.7 m. p. s.).

Comparing the current 5 p. m. winds with established 5 a. m. normals at 4 kilometers, it was found that the directions departed from normal in counterclockwise rotations east of the Rocky Mountains, and clockwise west of the Rockies. Outstanding departures from normal were noted over San Diego, Calif. (108° clockwise), Oakland, Calif. (58° clockwise), and Houston, Tex. (59° counterclockwise). But at 5 kilometers counterclockwise departures occurred over the entire southern half of the country, and clockwise departures over the northern portion. The largest difference noted was 47° (counterclockwise) at Houston, Tex. Resultant velocities for October exceeded the normal by more than 5 m. p. s. over the nothern part of the United States at 4 kilometers (+9.0 m. p. s. at Fargo, N. Dak.), and along a belt reaching from the far Northwest (+9.5 m. p. s. at Billings, Mont.) to the extreme Southeast (+5.7 m. p. s. at Atlanta, Ga.) at 5 kilometers.

In the higher levels, resultant winds, based on 5 p. m. observations (table 2), were northwesterly, except in the far South. At 6 kilometers, northwesterly winds in the far West became westerly over the East. Velocities were slightly higher than those noted at 4 and 5 kilometers. Resultant wind speeds of 21.9 m. p. s. and 18.2 m. p. s. were recorded over Fargo, N. Dak., and Omaha, Nebr., respectively.

At 8 kilometers the winds were unchanged except for direction at Miami, Fla., which shifted from the southwest into the northwest quadrant. Velocities were higher in the South at this level (Miami, Fla., 6.1 m. p. s.) than at 6 kilometers, but the maximum occurred over Huron, S. Dak. (19.2 m. p. s.). There were few changes in direction at 10 kilometers, except for southwesterly winds that reappeared over Little Rock, Ark., Oklahoma City, Okla., and Albuquerque, N. Mex. At this level high velocities occurred over Houston, Tex. (23.2 m. p. s.), Atlanta, Ga. (22.1 m. p. s.), and Cheyenne, Wyo. (22.1 m. p. s.). The velocities at Winslow, Ariz. (8.3 m. p. s.), and Las Vegas, Nev. (8.1 m. p. s.), were unusually light for 10 kilometers, and remained so up to 16 kilometers.

Diurnal changes in direction between 5 a. m. and 5 p. m. resultant winds (charts VIII and IX, and table 2, respectively) at 1.5 and 3 kilometers for October were noteworthy. The 5 p. m. winds turned away from the 5 a. m. directions through counterclockwise rotations over all of the country except the extreme Southeast and far middle West at 1.5 kilometers, and over the South and Pacific slope at 3 kilometers, where departures were by clockwise rotations. Largest diurnal direction changes took place along the west Gulf coast and far Southwest at both 1.5 and 3 kilometers, being outstanding at Las Vegas, Nev., Brownsville, Tex., and San Diego, Calif. The afternoon resultant velocities were less than the 5 a. m. over most of the country, except in the far Southeast and Southwest at 1.5 kilometers, while opposite velocity departures occurred over the same areas at 3 kilometers.

Table 3 lists the individual maximum wind velocities recorded over the United States during October. The winds of 42.2 m. p. s. at Las Vegas, Nev., 62.8 m. p. s. at Hartford, Conn., and 77.5 m. p. s. over Omaha, Nebr., at 2.1, 4.2, and 13.4 kilometers, respectively, were the highest recorded since June 1939.

MEAN MONTHLY ISENTROPIC CHART [1]

In the mean isentropic chart, $\theta=306°$, for October 1939 (chart XII), the westerlies cover the northern two-thirds of the United States, while an anticyclonic eddy of small dimensions and slight moisture contrasts is centered over eastern Texas.

The dry current over the middle Gulf States may be associated with the deficiency of precipitation there. Elsewhere too little is known of the normal isentropic flow pattern for October to indicate any correlation between the precipitation departures and the mean pattern for this month. With the seasonal change from predominantly convective precipitation in summer, when the moisture conditions aloft are rather stationary and determine the regions of shower activity, to the frontal precipitation of winter, when the moist currents move across the map rapidly, little correlation may be expected to exist.

In studying chart XII, it will be noted that the moisture and pressure lines bulge southward over the Great Lakes in a fashion similar to the pattern normally occurring on summer charts. The fact that the precipitation departures in this region are small suggests that this configuration of the lines is normal for autumn also, and that in the Great Lakes region the precipitation usually occurs at lower temperatures than at the same latitudes elsewhere in the country.

The precipitation excesses in the Middle Atlantic States and southern New England occurred in connection with wave disturbances passing northward along the coast on three occasions during the month. The precipitation occurred with the affected stations in the cold air, but the moisture aloft in connection with it shows up as a bending of the condensation pressure lines northward across the isobars over the region affected, with indication of a moist tongue to the east over the ocean.

[1] Prepared by the Division of Research and Education.

TABLE 8.—*Mean free-air barometric pressures (P.) in mb., temperatures (T.) in °C., and relative humidities (R. H.), in percent, obtained by airplanes during October 1939*

Stations and elevations in meters above sea level	Altitude (meters) m. s. l.																													
	Surface				500			1,000			1,500			2,000			2,500			3,000			4,000			5,000			
	Number of observations	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.
Coco Solo, C. Z. (15 m.)	24	1,010	25.1	94	952	23.8	85	904	21.4	86	853	19.1	87	804	17.0	83	759	14.9	77	715	12.6	72	635	7.6	72			
Norfolk, Va. (10 m.)	24	1,020	14.8	80	962	15.8	67	907	13.1	63	855	11.1	57	805	8.8	54	758	6.3	51	713	4.2	47	630	−2.4	45	554	−9.4	44
Pearl Harbor, T. H. (6 m.)	31	1,015	22.7	85	960	20.5	80	906	16.7	84	854	14.1	79	805	12.1	67	758	10.5	51	714	8.2	39	631	2.2	31			
Pensacola, Fla. (13 m.)	31	1,018	17.4	86	962	19.2	71	907	17.2	65	855	14.9	62	806	13.1	52	760	11.0	47	716	8.5	48	634	2.7	46	559	−3.9	44
St. Thomas, V. I. (8 m.)																												
San Diego, Calif. (10 m.)	30	1,013	16.6	75	957	19.1	57	903	17.7	48	851	15.2	40	802	12.6	35	755	10.2	28	711	7.4	24	629	1.5	19	555	−5.2	19
Seattle, Wash. (10 m.)	16	1,020	11.4	82	963	10.1	76	907	9.5	63	854	7.8	59	803	6.2	50	755	4.4	50	711	2.1	52	626	−4.1	47			

Observations made by U. S. Navy, and taken at 4 a. m., 75th meridian time, except along the Pacific coast and Hawaii where they are made at dawn.
NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

TABLE 1a.—*Mean free-air barometric pressures (P.) in mb., temperatures (T.) in °C., and relative humidities (R. H.) in percent obtained by radiosonde during October 1939*

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																											
	Albuquerque, N. Mex. (1,621 m.)				Atlanta, Ga. (298 m.)				Billings, Mont. (1,089 m.)				Bismarck, N. Dak. (508 m.)				Boise, Idaho (824 m.)				Buffalo, N. Y. (219 m.)				Charleston, S. C. (14 m.)			
	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T	R. H.
Surface	29	840	10.2	48	31	984	13.4	84	30	892	7.2	65	30	955	3.0	75	30	923	7.0	84	30	990	8.5	82	31	1,016	15.4	89
500					31	961	16.3	72													30	958	8.4	79	31	961	18.1	67
1,000					31	906	14.8	70					30	899	5.5	64	30	904	10.0	70	30	901	6.2	77	31	906	16.6	62
1,500					31	854	12.3	67	30	849	8.6	58	30	846	4.0	58	30	852	9.4	60	30	847	3.6	77	31	854	13.8	61
2,000	29	803	11.2	45	31	804	10.3	59	30	798	5.7	57	30	795	2.3	57	30	801	6.6	57	30	796	1.5	70	31	805	12.1	52
2,500	29	756	8.3	45	31	757	8.2	51	30	750	2.5	57	30	747	0.0	56	30	754	3.3	58	30	748	−0.6	63	31	758	10.0	46
3,000	29	711	4.8	44	31	712	5.7	45	30	706	−0.5	60	30	702	−2.7	54	30	708	0.0	58	30	703	−3.1	58	31	714	7.3	44
4,000	27	628	−1.3	42	31	630	0.8	37	30	622	−6.9	64	29	618	−8.5	57	30	625	−5.8	54	30	619	−8.5	59	29	632	2.2	38
5,000	27	553	−7.9	40	29	556	−5.1	31	30	546	−13.0	62	28	542	−14.7	59	30	549	−11.9	53	30	543	−14.1	51	28	558	−3.8	35
6,000	27	486	−14.3	36	29	488	−11.6	29	29	478	−19.8	60	28	474	−21.2	56	30	481	−18.5	50	30	475	−20.4	50	28	490	−10.0	31
7,000	27	425	−21.5	34	29	428	−18.1	28	28	417	−27.2	56	26	413	−28.6	54	30	420	−26.2	49	29	414	−27.5	50	26	430	−16.5	31
8,000	27	370	−29.1	33	29	374	−25.5	28	28	362	−35.0	54	25	359	−36.4	53	30	365	−34.1	49	29	360	−35.1	51	25	376	−23.7	29
9,000	27	321	−36.2	33	28	325	−32.7	28	28	313	−42.8		23	309	−44.1		30	316	−42.2	48	29	311	−42.0	50	25	326	−31.1	29
10,000	27	277	−43.0	33	28	281	−40.1	27	28	269	−50.1		23	266	−50.4		29	272	−49.9		26	268	−48.3		25	283	−39.0	28
11,000	26	238	−49.6		28	242	−47.5		28	231	−55.4		22	228	−54.7		29	233	−55.1		26	230	−53.6		24	244	−46.7	
12,000	23	204	−55.0		28	208	−54.0		28	197	−57.9		22	194	−57.5		29	199	−58.4		26	196	−57.5		23	209	−53.4	
13,000	21	174	−59.5		28	178	−59.3		28	168	−58.0		22	166	−58.5		28	169	−59.9		25	167	−59.2		22	179	−58.7	
14,000	20	148	−62.8		28	151	−64.0		28	143	−59.1		21	141	−58.1		28	144	−61.3		24	142	−60.4		19	152	−63.0	
15,000	19	125	−64.9		28	128	−68.2		28	122	−59.8		19	120	−58.7		27	123	−62.5		23	121	−62.1		18	129	−66.9	
16,000	16	106	−66.5		28	109	−70.7		28	104	−60.1		19	103	−58.9		26	104	−62.7		22	103	−62.6		15	109	−69.7	
17,000	15	90	−66.7		28	92	−70.5		26	89	−59.9		17	87	−58.8		24	88	−61.8		21	87	−62.0		14	92	−69.7	
18,000	10	76	−65.8		25	77	−69.2		20	76	−59.6		14	74	−58.0		18	75	−60.6		13	74	−60.6		11	77	−68.1	
19,000					22	66	−66.5		16	64	−58.8		9	63	−57.5		14	64	−59.7		13	63	−5[illegible].1		10	66	−65.3	
20,000					16	55	−63.5		5	55	−58.2						9	54	−58.4		5	53	−57.2		8	55	−62.3	
21,000					7	47	−61.0										6	46	−57.7									
22,000					6	40	−58.9																					

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																											
	Denver, Colo. (1,616 m.)				El Paso, Tex. (1,194 m.)				Ely, Nev. (1,909 m.)				Fairbanks, Alaska (152 m.)				Joliet, Ill. (178 m.)				Juneau, Alaska (49 m.)				Lakehurst, N J. (39 m.)			
	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.
Surface	30	838	6.6	52	31	884	13.7	52	29	813	1.9	76	30	990	−5.6	74	30	995	8.8	80	30	1,004	4.7	82	31	1,012	9.8	86
500													30	947	−6.3	77	30	956	10.7	66	30	950	2.3	84	31	958	11.0	66
1,000													30	889	−8.2	77	30	901	9.0	60	30	893	−0.7	86	31	903	9.4	61
1,500					31	853	16.5	45					30	833	−9.8	76	30	848	6.7	56	30	838	−3.3	87	31	851	7.7	58
2,000	30	800	11.2	46	31	804	13.8	42	29	803	4.3	69	30	780	−12.3	78	30	798	5.0	53	30	787	−5.8	87	31	801	5.9	52
2,500	30	754	8.6	43	31	757	10.3	43	29	756	5.0	56	30	730	−14.5	78	30	750	2.5	51	27	738	−8.1	87	31	753	3.4	50
3,000	30	709	4.6	41	31	712	6.7	45	29	710	2.3	54	30	683	−16.7	76	29	705	−0.2	49	24	691	−10.7	87	31	707	0.8	48
4,000	29	626	−2.8	41	31	630	0.5	42	29	627	−3.6	50	30	597	−22.5	76	27	621	−6.4	49	21	605	−16.1	82	31	624	−4.0	48
5,000	29	551	−10.0	42	31	556	−5.6	35	29	552	−9.8	44	30	520	−28.3	75	26	546	−12.7	46	21	528	−22.6	79	30	549	−9.9	46
6,000	29	483	−15.7	42	31	488	−11.9	30	28	483	−16.7	40	29	452	−34.8	73	26	478	−18.5	41	17	460	−28.7	77	28	480	−16.2	50
7,000	29	422	−23.5	41	30	428	−18.6	28	28	423	−24.0	38	26	391	−41.5	70	26	417	−25.7	40	12	398	−35.1	75	27	420	−23.4	53
8,000	29	368	−31.2	41	30	374	−26.0	27	28	368	−32.0	37	23	336	−47.6	65	26	362	−33.0	40	11	344	−40.9		25	366	−30.5	55
9,000	29	319	−39.0	39	29	324	−33.6	25	28	318	−40.2	36	24	288	−52.2		26	314	−39.6		9	296	−47.0		25	317	−38.0	61
10,000	28	275	−46.2		29	281	−41.0	24	28	275	−47.7		24	247	−53.9		26	270	−46.0		9	254	−51.4		23	274	−44.8	
11,000	27	236	−52.1		28	242	−47.7		28	235	−53.5		24	212	−53.1		25	232	−51.6		6	216	−52.8		19	235	−50.8	
12,000	27	202	−56.9		28	208	−53.9		28	201	−57.3		23	181	−52.1		24	198	−55.9		6	185	−53.5		18	202	−55.0	
13,000	25	172	−59.9		27	177	−59.5		28	172	−59.7		22	154	−51.7		21	169	−58.1		6	158	−53.5		17	172	−58.6	
14,000	24	146	−62.1		27	151	−64.0		28	146	−61.6		21	133	−51.8		21	144	−59.5		5	134	−54.2		16	147	−61.4	
15,000	23	124	−62.4		26	127	−68.1		28	124	−63.2		18	114	−52.3		19	123	−60.5						12	124	−63.7	
16,000	19	106	−63.8		24	108	−70.9		27	106	−63.7		12	97	−52.6		17	105	−60.9						11	105	−64.7	
17,000	17	90	−63.8		23	91	−71.1		26	90	−63.3		6	83	−53.0		16	89	−60.5						5	88	−65.0	
18,000	12	76	−62.9		23	77	−68.8		20	76	−62.2						15	76	−59.3									
19,000	6	64	−61.5		16	66	−65.4		6	65	−61.3						8	65	−57.5									
20,000					10	56	−62.6																					
21,000					6	47	−59.7																					

TABLE 1a.—*Mean free-air barometric pressures (P.) in mb., temperatures (T.) in °C., and relative humidities (R. H.) in percent obtained by radiosonde during October 1939*—Continued

Stations and elevations in meters above sea level

Altitude (meters) m. s. l.	Medford, Oreg. (401 m.)				Miami, Fla. (4 m.)				Minneapolis, Minn. (263 m.)				Nashville, Tenn. (180 m.)				Oakland, Calif. (2 m.)				Oklahoma City, Okla. (391 m.)				Omaha, Nebr. (300 m.)			
	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.
Surface	31	972	8.8	85	30	1,014	23.0	92	31	982	6.7	71	30	997	13.9	75	31	1,017	12.2	83	30	971	14.4	64	31	980	9.7	65
500	31	960	10.1	80	30	958	22.7	81	31	954	6.9	70	30	960	15.2	68	31	959	16.0	64	30	958	16.3	59	31	957	11.3	59
1,000	31	904	11.7	68	30	905	19.6	80	31	898	6.0	67	30	905	12.6	68	31	904	15.1	54	30	904	16.8	52	31	901	11.6	51
1,500	31	852	10.1	62	30	854	17.0	76	31	845	4.3	66	30	853	10.8	62	31	852	12.7	49	30	852	14.5	47	31	849	10.1	49
2,000	31	802	7.8	56	30	805	14.6	69	31	795	2.7	62	30	803	8.8	57	31	802	10.1	43	30	803	11.7	46	31	799	7.8	51
2,500	31	754	5.3	52	30	758	12.3	62	31	747	−0.2	60	30	756	6.3	51	31	756	7.5	39	30	756	8.4	47	31	752	4.8	50
3,000	31	709	2.4	48	30	714	10.0	57	31	701	−3.0	60	30	711	3.6	48	31	710	4.8	36	30	711	4.9	47	31	707	2.0	49
4,000	31	626	−3.3	43	30	633	4.6	51	31	617	−8.4	56	30	628	−1.9	44	30	628	−1.5	33	29	629	−1.1	42	31	624	−4.7	48
5,000	31	551	−9.1	40	29	559	−1.2	46	30	542	−14.6	52	30	553	−7.6	36	30	553	−7.7	32	29	554	−6.8	38	31	548	−10.5	44
6,000	30	483	−16.5	38	29	493	−7.3	45	30	474	−21.2	49	30	486	−14.0	34	29	486	−15.1	31	29	486	−13.4	35	31	481	−17.5	41
7,000	30	422	−24.0	37	29	433	−13.6	44	28	413	−28.7	47	30	425	−21.2	33	29	425	−22.9	30	29	426	−20.1	34	31	420	−24.6	39
8,000	29	367	−32.1	35	29	379	−20.1	44	27	359	−36.2	43	29	371	−28.3	33	27	370	−31.1	30	28	372	−27.0	32	31	366	−32.0	38
9,000	29	318	−39.7	35	28	330	−27.4	41	27	310	−42.8	----	28	322	−35.6	32	27	320	−38.9	29	28	323	−34.4	31	31	316	−39.8	37
10,000	29	274	−46.4	----	28	287	−35.2	41	25	267	−48.3	----	26	278	−42.5	31	27	277	−46.1	----	28	280	−42.0	29	30	273	−46.8	----
11,000	29	235	−52.5	----	28	248	−43.2	----	22	229	−52.9	----	26	239	−49.0	----	27	238	−52.5	----	29	240	−48.6	----	30	234	−52.2	----
12,000	28	201	−56.9	----	28	213	−50.4	----	20	196	−55.6	----	26	205	−54.4	----	26	203	−57.4	----	29	206	−54.3	----	30	200	−56.5	----
13,000	28	172	−60.2	----	28	182	−56.6	----	19	167	−56.6	----	26	175	−59.0	----	26	173	−60.4	----	29	176	−58.7	----	30	171	−59.1	----
14,000	28	146	−62.4	----	28	156	−62.7	----	19	143	−56.9	----	25	149	−62.7	----	26	147	−62.7	----	28	150	−62.8	----	30	146	−61.4	----
15,000	27	124	−63.2	----	28	132	−67.8	----	18	122	−57.4	----	23	127	−65.7	----	25	125	−65.0	----	28	128	−66.2	----	29	124	−62.4	----
16,000	25	105	−63.6	----	28	112	−70.8	----	17	104	−58.0	----	22	108	−67.2	----	23	106	−66.1	----	26	108	−68.3	----	29	105	−63.1	----
17,000	20	89	−62.9	----	28	94	−71.3	----	17	89	−57.7	----	19	91	−67.7	----	22	90	−65.6	----	25	92	−68.0	----	26	90	−62.9	----
18,000	17	76	−62.1	----	28	79	−71.0	----	14	76	−57.0	----	18	77	−65.5	----	20	76	−64.4	----	20	78	−66.8	----	22	76	−61.1	----
19,000	12	64	−60.7	----	24	67	−68.8	----	10	64	−56.3	----	16	65	−62.3	----	17	64	−62.6	----	17	66	−64.6	----	15	65	−59.4	----
20,000	6	54	−58.9	----	20	57	−65.9	----	----	----	----	----	12	55	−59.5	----	10	55	−61.0	----	15	56	−62.1	----	12	55	−58.0	----
21,000	----	----	----	----	15	48	−63.2	----	----	----	----	----	6	46	−56.3	----	----	----	----	----	6	48	−59.7	----	7	47	−56.6	----
22,000	----	----	----	----	11	41	−60.7	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
23,000	----	----	----	----	5	34	−58.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Stations and elevations in meters above sea level

Altitude (meters) m. s. l.	Phoenix, Ariz. (339 m.)				St. Louis, Mo. (176 m.)				San Juan, P. R. (13 m.)				Sault Ste. Marie, Mich. (221 m.)				Spokane, Wash. (597 m.)				Swan Island, W. I. (10 m.)				Washington, D. C.[1] (7 m.)			
	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.
Surface	31	974	15.7	52	30	997	12.4	71	29	1,009	25.1	87	31	987	4.2	87	31	948	6.7	80	31	1,009	26.7	84	30	1,018	11.4	86
500	31	956	21.0	45	30	960	14.3	56	29	956	23.0	85	31	954	4.4	85	----	----	----	----	31	955	23.2	87	30	960	12.7	68
1,000	31	902	20.2	37	30	904	12.6	51	29	903	20.0	82	31	897	2.9	82	31	903	8.0	71	31	902	19.7	84	30	904	10.9	61
1,500	31	851	16.8	36	30	852	10.3	51	29	852	17.4	80	31	843	0.4	82	31	850	5.8	68	31	851	16.6	80	30	852	9.0	57
2,000	31	802	13.2	36	30	802	7.9	49	29	803	14.8	75	31	792	−1.8	79	31	798	2.7	69	31	802	13.8	75	30	802	7.1	56
2,500	31	756	10.0	36	30	755	5.0	45	29	757	12.2	71	31	743	−3.7	72	31	750	−0.3	69	31	756	11.0	69	30	754	5.0	53
3,000	31	712	6.8	36	30	709	2.2	42	29	713	9.8	67	31	697	−5.6	67	31	705	−2.7	66	31	711	8.3	64	29	709	2.5	52
4,000	31	629	0.2	35	30	626	−3.8	38	29	631	4.6	62	30	613	−11.4	64	30	621	−7.8	54	31	630	2.9	56	29	626	−2.1	46
5,000	31	555	−6.4	32	30	551	−9.9	34	29	558	−1.3	60	30	538	−18.0	63	30	545	−13.4	50	31	556	−2.1	49	29	551	−7.9	45
6,000	31	487	−13.6	30	30	483	−16.5	33	28	491	−6.9	57	30	470	−24.1	62	30	477	−19.9	48	30	490	−7.4	45	29	484	−13.8	38
7,000	31	427	−21.2	29	30	422	−23.9	30	28	432	−13.0	52	30	408	−31.7	61	30	416	−27.2	49	30	430	−13.6	42	28	424	−20.7	38
8,000	30	372	−28.6	28	30	368	−31.6	29	28	378	−19.5	51	30	354	−38.5	59	30	351	−35.0	49	30	376	−20.2	42	21	370	−28.1	40
9,000	30	322	−35.7	28	30	318	−38.7	29	28	329	−26.6	48	29	305	−44.5	----	30	312	−42.6	50	30	328	−27.3	41	20	321	−35.6	39
10,000	30	279	−42.3	27	29	275	−45.5	----	28	286	−34.3	47	25	263	−49.4	----	29	268	−49.8	----	30	285	−34.6	40	19	277	−43.1	----
11,000	30	240	−48.3	----	29	236	−51.6	----	28	248	−42.0	----	25	225	−52.8	----	29	230	−55.6	----	30	246	−42.2	----	18	238	−49.9	----
12,000	29	206	−53.3	----	29	202	−56.5	----	28	214	−49.5	----	25	193	−54.8	----	28	196	−58.4	----	30	212	−49.9	----	17	204	−55.8	----
13,000	28	176	−57.3	----	26	172	−59.8	----	28	183	−56.6	----	23	165	−56.0	----	27	167	−59.4	----	30	182	−57.4	----	11	174	−59.8	----
14,000	28	150	−61.0	----	26	146	−62.7	----	28	156	−63.2	----	21	141	−56.2	----	27	142	−60.1	----	30	155	−64.4	----	8	148	−62.8	----
15,000	25	127	−63.9	----	25	124	−64.4	----	28	132	−69.2	----	20	121	−57.4	----	26	121	−60.7	----	30	131	−70.8	----	5	126	−63.8	----
16,000	25	108	−66.4	----	25	106	−64.9	----	28	112	−73.6	----	19	103	−58.2	----	25	103	−60.5	----	29	110	−75.7	----	----	----	----	----
17,000	25	92	−67.1	----	20	90	−63.7	----	28	94	−76.0	----	16	88	−58.2	----	20	87	−60.2	----	27	93	−78.7	----	----	----	----	----
18,000	21	77	−65.6	----	14	76	−61.8	----	27	79	−75.4	----	6	75	−59.0	----	14	75	−59.2	----	27	78	−78.7	----	----	----	----	----
19,000	18	66	−63.9	----	8	64	−58.4	----	25	67	−73.4	----	----	----	----	----	7	63	−58.6	----	19	65	−76.7	----	----	----	----	----
20,000	15	56	−61.5	----	----	----	----	----	18	56	−70.4	----	----	----	----	----	----	----	----	----	15	55	−74.1	----	----	----	----	----
21,000	9	48	−59.6	----	----	----	----	----	16	48	−67.3	----	----	----	----	----	----	----	----	----	10	46	−72.6	----	----	----	----	----
22,000	----	----	----	----	----	----	----	----	11	40	−64.5	----	----	----	----	----	----	----	----	----	7	39	−70.4	----	----	----	----	----

Observations taken about 4 a. m., 75th meridian time.

[1] Navy.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

Number of observations 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.

TABLE 1a.—*Mean free-air barometric pressures (P.) in mb., temperatures (T.) in °C., and relative humidities (R. H.) in percent obtained by radiosonde during October 1939*—Continued

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Altitude (meters) m. s. l.	Boise, Idaho (824 m.) Number of observations	Pressure	Temperature	Relative humidity	Altitude (meters) m. s. l.	Boise, Idaho (824 m.) Number of observations	Pressure	Temperature	Relative humidity
Surface	30	920	12.7	71	10,000	27	278	−43.5	42
500					11,000	27	239	−49.8	41
1,000	30	902	17.4	53	12,000	27	205	−53.9	
1,500	30	850	16.1	44	13,000	25	175	−56.3	
2,000	30	801	13.0	43	14,000	25	149	−58.5	
2,500	30	754	9.7	44	15,000	24	127	−60.9	
3,000	30	710	6.2	47	16,000	24	108	−61.7	
4,000	29	628	−1.0	51	17,000	24	92	−61.7	
5,000	29	553	−7.6	50	18,000	20	78	−61.4	
6,000	27	486	−14.1	48	19,000	16	66	−60.6	
7,000	27	425	−21.0	44	20,000	10	56	−59.5	
8,000	27	371	−28.7	44	21,000	5	47	−58.3	
9,000	27	321	−36.3	43					

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during October 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.) Direction	Velocity	Albuquerque, N. Mex. (1,554 m.) Direction	Velocity	Atlanta, Ga. (302 m.) Direction	Velocity	Billings, Mont. (1,095 m.) Direction	Velocity	Boise, Idaho (850 m.) Direction	Velocity	Brooklyn, N. Y. (15 m.) Direction	Velocity
	°		°		°		°		°		°	
Surface	195^{31}	2.5	244^{31}	2.4	294^{31}	1.6	281^{30}	3.6	292^{31}	2.4	285^{27}	2.7
500					316^{31}	1.8	286^{30}	5.2			279^{27}	5.0
1,000	202^{31}	3.5			316^{30}	1.8	278^{27}	7.4	297^{31}	2.6	279^{26}	6.0
1,500	198^{31}	3.3			285^{30}	2.0	278^{27}	8.8	324^{31}	2.7	280^{26}	7.8
2,000	207^{30}	3.2	228^{31}	3.8	287^{30}	3.0	287^{28}	10.6	310^{30}	3.0	281^{21}	9.2
2,500	237^{26}	3.4	238^{31}	3.5	285^{27}	4.6	293^{24}	13.8	285^{27}	4.2	285^{20}	11.6
3,000	260^{25}	4.0	258^{31}	3.7	293^{26}	6.0	304^{18}	15.2	286^{27}	5.4	285^{18}	13.4
4,000	262^{26}	6.2	270^{31}	5.5	287^{24}	7.6	311^{17}	18.1	289^{23}	6.9	282^{16}	15.2
5,000	266^{24}	7.1	264^{27}	8.0	278^{23}	10.2	314^{10}	19.2	286^{13}	10.2	272^{13}	14.0
6,000	262^{22}	9.0	272^{26}	10.3	279^{22}	11.9						
8,000	263^{21}	16.7	264^{20}	11.6	276^{21}	16.4						
10,000	268^{18}	20.3	264^{19}	16.2	278^{15}	22.1						
12,000	273^{12}	20.6	263^{12}	23.5	280^{10}	19.9						
14,000	261^{11}	25.1										

Altitude (meters) m. s. l.	Brownsville, Tex. (7 m.) Direction	Velocity	Buffalo, N. Y. (220 m.) Direction	Velocity	Burlington, Vt. (132 m.) Direction	Velocity	Charleston, S. C. (18 m.) Direction	Velocity	Cheyenne, Wyo. (1,873 m.) Direction	Velocity	Chicago, Ill. (192 m.) Direction	Velocity	Cincinnati, Ohio (157 m.) Direction	Velocity
	°		°		°		°		°		°		°	
Surface	109^{31}	2.6	259^{31}	3.4	231^{30}	1.3	25^{30}	0.3	268^{31}	4.2	248^{31}	3.2	226^{31}	2.3
500	98^{31}	2.8	248^{31}	6.0	217^{30}	4.2	333^{30}	0.6			245^{31}	4.9	240^{31}	4.0
1,000	99^{24}	2.4	241^{37}	9.4	252^{27}	6.5	304^{28}	1.6			245^{30}	7.1	243^{29}	4.7
1,500	130^{21}	1.5	250^{27}	11.2	258^{26}	9.0	306^{28}	3.2			250^{27}	8.6	252^{27}	6.7
2,000	358^{15}	.8	261^{21}	12.6	280^{17}	9.1	297^{22}	4.0	265^{21}	4.4	264^{25}	11.0	265^{27}	8.5
2,500	302^{14}	1.3	265^{15}	13.6	281^{14}	10.5	290^{22}	5.1	277^{21}	5.2	263^{22}	13.8	270^{26}	8.8
3,000	280^{12}	1.8					283^{21}	6.7	282^{21}	6.3	266^{21}	14.3	276^{24}	11.5
4,000	263^{10}	1.4					273^{18}	7.0	284^{18}	9.0	294^{11}	13.9	276^{20}	12.2
5,000							283^{16}	8.1	281^{18}	12.4			267^{13}	11.9
6,000							291^{12}	10.4	275^{22}	13.4			266^{12}	11.2
8,000									276^{22}	15.5				
10,000									295^{14}	21.2				
12,000														
14,000														

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.) Direction	Velocity	Fargo, N. Dak. (283 m.) Direction	Velocity	Greensboro, N. C. (271 m.) Direction	Velocity	Havre, Mont. (766 m.) Direction	Velocity	Houston, Tex. (21 m.) Direction	Velocity	Huron, S. Dak. (393 m.) Direction	Velocity
	°		°		°		°		°		°	
Surface	208^{31}	0.9	282^{26}	2.1	263^{29}	0.9	277^{26}	2.9	116^{31}	2.2	285^{21}	2.1
500			280^{26}	2.2	277^{29}	1.9			136^{30}	2.4	290^{31}	2.4
1,000			251^{24}	3.5	273^{29}	3.4	267^{26}	5.6	135^{30}	1.7	286^{31}	3.7
1,500	213^{31}	1.3	279^{23}	6.1	283^{28}	3.6	262^{26}	9.0	29^{30}	.6	278^{29}	5.9
2,000	210^{31}	1.8	285^{20}	9.2	283^{26}	6.3	270^{25}	11.2	319^{30}	1.1	282^{27}	9.5
2,500	211^{31}	2.7	284^{18}	10.7	282^{26}	7.7	274^{25}	12.8	262^{28}	1.0	285^{27}	11.0
3,000	229^{31}	3.5	279^{15}	12.6	285^{24}	8.8	279^{24}	13.3	263^{27}	2.8	289^{27}	12.3
4,000	255^{27}	5.4	277^{12}	16.5	277^{22}	12.5	284^{17}	12.9	253^{26}	5.2	283^{21}	16.0
5,000	251^{25}	6.9	274^{12}	19.2	278^{21}	14.7	293^{10}	13.9	251^{30}	7.6	287^{17}	18.7
6,000	270^{21}	6.8	282^{11}	21.9	284^{15}	12.8			253^{23}	9.8	282^{14}	17.6
8,000	279^{15}	9.3			281^{13}	16.7			253^{19}	15.3	276^{12}	19.2
10,000									261^{16}	23.2		
12,000									262^{11}	26.6		
14,000												
16,000												
18,000												

Altitude (meters) m. s. l.	Las Vegas, Nev. (570 m.) Direction	Velocity	Little Rock, Ark. (82 m.) Direction	Velocity	Medford, Oreg. (410 m.) Direction	Velocity	Miami, Fla. (10 m.) Direction	Velocity	Minneapolis, Minn. (261 m.) Direction	Velocity	Nashville, Tenn. (194 m.) Direction	Velocity	New Orleans, La. (19 m.) Direction	Velocity
	°		°		°		°		°		°		°	
Surface	78^{31}	1.4	187^{31}	1.2	323^{28}	0.5	65^{31}	4.0	258^{30}	2.4	256^{30}	2.2	21^{30}	2.2
500			213^{31}	2.6	339^{28}	.5	69^{31}	4.7	256^{30}	2.6	254^{30}	3.0	60^{30}	3.1
1,000	85^{31}	1.3	246^{31}	3.2	31^{28}	.5	66^{31}	4.0	244^{27}	4.5	254^{30}	3.2	52^{30}	2.9
1,500	261^{31}	.4	266^{30}	3.5	194^{28}	.5	71^{31}	2.8	259^{26}	7.2	264^{29}	3.9	45^{28}	2.3
2,000	246^{31}	1.9	271^{30}	4.0	222^{27}	1.3	85^{30}	2.2	267^{25}	8.9	273^{27}	4.9	356^{25}	2.2
2,500	252^{31}	2.4	272^{29}	5.8	279^{26}	1.8	103^{27}	2.0	276^{20}	12.7	283^{25}	5.8	315^{24}	2.3
3,000	263^{31}	2.5	266^{29}	6.3	307^{25}	3.0	124^{27}	1.5	277^{18}	13.5	294^{22}	7.9	302^{22}	3.1
4,000	270^{31}	3.7	273^{25}	6.4	301^{21}	4.0	132^{26}	2.0	269^{10}	15.5	293^{17}	11.9	262^{19}	3.6
5,000	285^{31}	4.3	276^{23}	9.4	289^{19}	5.8	169^{22}	1.2			291^{14}	11.9	266^{17}	5.9
6,000	268^{31}	5.5	271^{23}	10.7	282^{18}	6.5	247^{17}	1.1			291^{11}	12.9	266^{12}	7.8
8,000	281^{29}	7.7	269^{14}	12.1	291^{16}	10.0	305^{13}	6.1						
10,000	292^{26}	8.1	261^{10}	16.6	289^{13}	12.9								
12,000	278^{25}	9.7												
14,000	273^{21}	9.6												
16,000	277^{19}	8.3												
18,000	264^{15}	6.1												

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

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	262^{31}	3.7	199^{31}	3.9	247^{31}	2.0	287^{31}	0.9	234^{31}	2.8	267^{31}	1.2	287^{31}	3.8	75^{31}	3.8	276^{31}	1.9	243^{29}	2.0	220^{31}	2.5	282^{30}	1.8	234^{31}	3.0
500	318^{31}	2.3	209^{31}	4.0	245^{31}	2.5	------	------	249^{31}	4.3	------	------	286^{21}	2.3	90^{31}	3.9	277^{26}	3.3	223^{29}	2.4	------	------	282^{30}	3.6	------	------
1,000	338^{31}	1.5	212^{31}	4.3	227^{29}	4.3	------	------	232^{30}	6.0	------	------	112^{30}	.4	100^{30}	3.9	259^{22}	6.3	218^{29}	1.5	213^{31}	3.9	268^{24}	5.9	------	------
1,500	312^{30}	1.8	232^{30}	4.6	249^{28}	6.2	317^{31}	.7	248^{29}	8.0	251^{31}	1.4	99^{28}	2.2	102^{27}	3.7	257^{17}	9.9	254^{19}	2.0	228^{30}	5.0	280^{24}	8.9	------	------
2,000	329^{30}	2.1	248^{28}	4.7	256^{27}	9.0	220^{31}	.3	264^{28}	9.5	255^{31}	2.2	98^{25}	2.1	98^{26}	2.9	254^{13}	13.7	281^{17}	3.5	246^{25}	6.1	277^{24}	10.9	229^{31}	2.4
2,500	333^{29}	2.1	253^{27}	6.0	268^{26}	11.1	206^{30}	.9	274^{27}	11.0	230^{30}	2.7	78^{24}	2.6	102^{26}	2.9	264^{12}	16.3	282^{16}	4.1	265^{22}	7.1	274^{22}	11.0	222^{31}	2.5
3,000	328^{29}	2.6	262^{27}	6.8	273^{26}	12.8	238^{28}	.4	277^{24}	11.5	253^{28}	2.9	58^{31}	1.2	94^{23}	2.6	265^{10}	16.5	258^{12}	6.2	286^{30}	7.3	276^{19}	10.8	228^{31}	3.0
4,000	330^{28}	3.6	270^{23}	8.3	277^{26}	14.7	306^{23}	2.6	280^{11}	14.1	287^{23}	5.5	29^{30}	1.5	62^{20}	1.2	------	------	287^{10}	7.3	289^{14}	10.3	266^{18}	13.3	243^{30}	4.9
5,000	300^{22}	2.3	271^{24}	9.5	283^{24}	15.2	296^{25}	4.9	------	------	288^{23}	9.1	289^{19}	2.5	12^{16}	1.4	------	------	------	------	297^{11}	12.9	------	------	257^{27}	5.6
6,000	305^{19}	2.3	281^{23}	10.7	292^{23}	18.2	294^{23}	6.0	------	------	295^{20}	10.9	316^{16}	3.4	32^{13}	2.8	------	------	------	------	------	------	------	------	261^{28}	6.0
8,000	289^{11}	2.7	274^{16}	11.8	299^{19}	20.8	310^{20}	7.4	------	------	297^{13}	10.3	------	------	------	------	------	------	------	------	------	------	------	------	257^{24}	8.3
10,000	------	------	258^{15}	18.9	296^{12}	19.5	295^{18}	6.7	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	281^{21}	8.3
12,000	------	------	262^{10}	21.5	282^{13}	25.7	303^{13}	5.5	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	262^{19}	14.4
14,000	------	------	------	------	281^{13}	25.1	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	265^{15}	12.0
16,000	------	------	------	------	266^{11}	19.1	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	278^{10}	11.8

TABLE 3.—*Maximum free-air wind velocities (M. P. S.), for different sections of the United States, based on pilot-balloon observations during October 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]	35.5	WSW	1,570	19	Buffalo, N. Y.	62.8	NW	4,240	24	Hartford, Conn.	46.4	WNW	5,420	17	Harrisburg, Pa.
East-Central [2]	33.7	WNW	1,360	28	Washington, D. C.	38.2	WNW	5,000	23	Greensboro, N. C.	53.5	W	9,900	18	Greensboro, N. C.
Southeast [3]	29.6	NE	430	15	Jacksonville, Fla.	38.8	WSW	4,420	30	Mobile, Ala.	68.0	WSW	7,050	17	Atlanta, Ga.
North-Central [4]	40.4	WNW	900	11	Fargo, N. Dak.	47.0	NNW	3,120	31	Bismarck, N. Dak.	55.9	NNW	8,850	20	Fargo, N. Dak.
Central [5]	39.2	WSW	2,070	5	Moline, Ill.	48.0	NW	5,000	22	Indianapolis, Ind.	77.5	W	13,360	25	Omaha, Nebr.
South-Central [6]	34.0	SW	2,470	24	Amarillo, Tex.	48.4	SW	4,990	26	Amarillo, Tex.	66.0	WSW	12,230	19	Houston, Tex.
Northwest [7]	42.0	WNW	2,300	21	Havre, Mont.	40.0	SSW	3,430	24	Pocatello, Idaho	62.6	N	8,260	29	Billings, Mont.
West-Central [8]	39.8	S	2,500	24	Ely, Nev.	45.1	S	2,710	24	Ely, Nev.	69.0	SW	12,400	25	Cheyenne, Wyo.
Southwest [9]	42.2	SW	2,140	24	Las Vegas, Nev.	37.1	SW	4,880	3	Albuquerque, N. Mex.	75.6	WSW	10,760	27	Albuquerque, N. Mex.

[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 altitudes and temperatures of significant points identifiable as tropopauses during October 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 temperature	Albuquerque, N. Mex.			Atlanta, Ga.			Billings, Mont.			Bismarck, N. Dak.			Boise, Idaho			Buffalo, N. Y.			Charleston, S. C.		
	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature
290-299	------	------	------	------	------	------	2	6.4	−36.5	------	------	------	------	------	------	1	6.9	−45.0	------	------	------
300-309	------	------	------	------	------	------	2	8.7	−53.0	1	6.8	−40.0	2	6.4	−30.0	2	7.6	−44.5	------	------	------
310-319	1	7.6	−32.0	------	------	------	7	8.9	−47.7	10	8.9	−48.4	9	8.7	−44.6	7	9.1	−50.1	------	------	------
320-329	6	9.4	−43.0	6	8.5	−33.7	25	10.4	−54.2	18	10.2	−52.8	30	10.2	−52.0	15	10.0	−52.4	3	9.1	−41.3
330-339	16	11.0	−52.6	12	12.0	−55.4	23	11.7	−60.6	13	12.0	−60.0	24	11.4	−58.3	15	11.8	−60.3	15	11.3	−53.1
340-349	12	12.5	−60.2	12	12.4	−57.8	6	12.2	−59.5	6	12.4	−69.8	9	12.4	−60.1	6	12.5	−62.7	12	12.3	−56.8
350-359	4	13.5	−63.8	8	13.5	−63.0	2	13.1	−62.0	3	12.9	−61.3	4	13.3	−64.0	7	13.3	−63.0	9	13.6	−63.0
360-369	6	14.1	−63.7	11	15.0	−70.4	2	13.6	−63.5	------	------	------	5	13.4	−60.6	4	14.2	−65.8	5	14.6	−66.2
370-379	4	14.8	−64.8	8	15.7	−73.0	2	13.7	−57.5	1	13.7	−58.0	4	14.8	−65.5	2	15.6	−71.5	6	15.9	−72.8
380-389	1	15.1	−64.0	8	15.9	−70.6	5	15.1	−63.0	------	------	------	7	15.3	−66.0	3	14.9	−62.7	4	15.9	−69.0
390-399	6	16.3	−69.0	4	16.4	−70.0	2	16.0	−66.5	------	------	------	3	15.9	−66.0	1	16.0	−68.0	1	16.3	−70.0
400-409	3	16.5	−67.7	5	17.1	−72.0	------	------	------	------	------	------	------	------	------	2	16.8	−69.5	2	16.8	−69.0
Weighted means	------	12.7	−58.2	------	13.8	−62.5	------	11.3	−56.8	------	10.8	−55.0	------	11.5	−56.1	------	11.7	−58.4	------	13.1	−60.0
Mean potential temperature (weighted)	352.1			359.5			335.4			324.0			339.1			340.1			352.8		

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

Potential temperature	Denver, Colo.			El Paso, Tex.			Ely, Nev.			Joliet, Ill.			Lakehurst, N. J.			Medford, Oreg.			Miami, Fla.		
	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature
290-299																					
300-309										1	8.2	−51.0									
310-319	2	9.2	−47.0				4	8.8	−44.8	6	9.1	−51.3	3	8.3	−39.7	7	8.3	−41.6			
320-329	22	9.7	−45.5	6	9.6	−44.0	24	10.0	−48.7	10	10.2	−51.0	10	9.7	−46.2	18	10.0	−48.8	1	11.0	−53.0
330-339	20	11.6	−57.9	14	11.0	−50.9	23	11.4	−56.5	13	11.4	−58.2	10	10.5	−48.5	28	11.3	−55.5	5	11.3	−51.4
340-349	10	12.3	−58.8	13	12.3	−57.2	12	12.5	−60.6	9	12.2	−59.4	6	12.4	−58.8	9	12.4	−60.4	15	11.7	−48.9
350-359	8	13.2	−61.2	13	13.6	−63.8	6	13.3	−62.3	3	13.1	−61.7	2	14.0	−67.5	11	13.5	−64.3	12	13.4	−60.6
360-369	8	14.1	−64.6	13	14.9	−69.9	4	14.6	−66.5	3	13.9	−62.3	2	14.0	−63.0	7	14.2	−65.4	17	14.8	−68.0
370-379	2	14.8	−64.0	6	15.4	−70.7	5	14.7	−65.0	8	14.4	−61.6	3	14.6	−64.3	4	14.6	−63.2	13	15.7	−70.9
380-389	1	15.6	−67.0	10	16.2	−72.7	5	15.6	−66.8	4	15.0	−64.0				4	15.6	−67.2	9	16.6	−74.0
390-399	4	16.2	−68.0	7	16.8	−72.1	5	16.0	−66.6	1	16.0	−66.0	1	15.4	−65.0	3	16.4	−68.7	7	17.0	−73.6
400-409	4	16.6	−67.8	3	17.0	−70.7	3	16.5	−65.0	2	15.9	−63.5	1	16.7	−66.0	3	16.7	−67.7	2	17.5	−75.5
Weighted means		12.1	−56.6		13.7	−62.7		12.2	−57.2		12.1	−57.8		11.4	−52.7		12.0	−57.1		14.3	−64.0
Mean potential temperature (weighted)	341.6			359.2			346.0			346.4			340.7			347.8			364.2		

Potential temperature	Minneapolis, Minn.			Nashville, Tenn.			Oakland, Calif.			Oklahoma City, Okla.			Omaha, Nebr.			Phoenix, Ariz.			St. Louis, Mo.		
	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature
290-299	1	6.6	−42.0																		
300-309	2	7.0	−39.0	1	6.4	−32.0	2	6.9	−34.0										1	7.8	−48.0
310-319	12	8.4	−44.8	4	8.3	−39.8	3	8.0	−38.3				8	8.3	−41.6	1	7.9	−37.0	5	8.4	−40.6
320-329	20	10.0	−51.4	11	9.6	−46.3	21	9.7	−45.4	7	9.6	−44.7	24	9.7	−47.2	10	9.5	−42.0	19	9.8	−48.7
330-339	15	11.4	−58.1	14	11.2	−54.1	20	11.4	−55.8	14	11.3	−51.3	29	11.4	−56.8	24	10.6	−48.0	17	11.2	−54.9
340-349	4	12.9	−65.8	13	12.3	−56.9	12	12.4	−59.8	12	12.2	−55.5	12	12.1	−57.2	18	12.0	−54.6	11	12.5	−56.4
350-359	1	12.7	−58.0	7	13.2	−59.4	4	13.2	−60.8	12	13.4	−62.0	10	13.4	−62.4	4	13.5	−63.0	4	13.6	−63.2
360-369	1	14.1	−67.0	5	14.5	−67.0	6	14.4	−66.2	9	14.5	−65.8	4	14.2	−64.0	8	13.9	−61.3	7	14.3	−65.4
370-379	2	14.2	−58.5	7	14.9	−66.0	7	14.9	−66.9	9	15.3	−68.3	3	14.6	−65.0	5	15.0	−66.0	10	15.1	−67.5
382-389	1	15.2	−64.0	5	16.3	−73.8	6	15.9	−68.8	8	15.8	−69.2	5	15.2	−64.4	8	16.0	−69.9	3	15.8	−69.0
390-399	2	14.6	−58.0	5	16.0	−66.0	6	16.4	−68.3	4	16.2	−67.8	2	15.8	−67.0	8	16.2	−67.5	2	16.2	−67.0
400-409	2	16.2	−65.5	3	16.7	−66.7	3	16.2	−63.3	5	17.0	−70.0	3	16.6	−65.3	7	16.5	−66.3	3	16.6	−67.0
Weighted means		10.7	−53.5		12.7	−57.5		12.3	−56.5		13.5	−60.3		11.7	−55.2		12.8	−56.2		12.1	−56.8
Mean potential temperature (weighted)	333.6			353.4			352.1			363.4			343.3			355.1			350.0		

Potential temperature	San Juan, P. R.			Saulte Ste. Marie, Mich.			Spokane, Wash.			Swan Island, W. I.		
	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature
290-299				5	6.7	−42.4						
300-309				11	7.5	−44.6	1	7.9	−47.0			
310-319				14	8.9	−49.9	7	8.6	−44.7			
320-329				18	10.3	−54.5	21	10.0	−50.3			
330-339	1	10.7	−46.0	12	11.2	−56.4	20	11.4	−58.6			
340-349	13	11.9	−50.4	7	12.1	−57.9	11	12.4	−61.1	5	12.5	−57.6
350-359	14	13.4	−59.6	2	12.8	−60.5	2	13.4	−64.0	17	13.8	−64.9
360-369	22	15.0	−69.5	2	13.7	−59.0	1	13.1	−58.0	21	15.2	−73.1
370-379	11	16.3	−75.9				1	14.6	−64.0	14	16.3	−79.0
380-389	10	16.7	−76.4				4	15.1	−63.8	13	16.9	−77.6
390-399	9	17.3	−76.3	2	15.6	−60.5	1	15.5	−61.0	6	17.5	−79.7
400-409	6	17.7	−77.0				2	17.0	−68.5	7	18.1	−80.1
Weighted means		15.0	−67.6		10.0	−50.7		11.4	−56.0		15.6	−73.3
Mean potential temperature (weighted)	369.2			325.1			337.6			371.2		