

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	East-ern stand-ard time		Mt. Wilson group No.	Helio-graphic			Area		Spot count	Observatory
				Diff. in longi-tude	Longi-tude	Lat-i-tude	Spot or group	Total for each day		
1938 Sept. 26	h	m		°	°	°				
	11	9	6123	-9.0	138.0	+17.0	242	-----	23	U. S. Naval.
			6112	-7.0	140.0	-11.0	338	-----	9	
			6111	+14.0	161.0	-10.5	383	-----	20	
			6119	+15.0	162.0	+12.0	194	-----	11	
			6105	+71.0	218.0	+21.0	61	2,430	2	
27	11	24	6127	-70.0	03.6	-9.0	73	-----	6	Do.
			6122	-46.0	87.6	-12.0	24	-----	2	
				-46.0	87.6	+35.0	12	-----	2	
			6121	-37.0	96.6	+16.0	48	-----	14	
			6121	-29.0	104.6	+15.0	73	-----	12	
			*	-30.0	103.6	-24.0	16	-----	2	
			6117	-9.0	124.6	+31.0	36	-----	7	
			6116	-3.0	130.6	-12.0	485	-----	75	
			6123	+5.0	138.6	+18.0	315	-----	35	
			6112	+7.0	140.6	-11.0	388	-----	8	
			6111	+27.0	160.6	-9.5	436	-----	17	
			6119	+29.5	163.1	+12.0	97	-----	14	
			6105	+85.0	218.6	+21.0	97	2,100	1	
28	11	3	6131	-88.0	32.6	-17.5	97	-----	1	Do.
			6127	-57.0	63.6	-9.0	61	-----	5	
			6122	-34.0	86.6	-13.0	36	-----	3	
			6122	-33.0	87.6	-17.0	16	-----	7	
			6121	-17.0	103.6	+14.0	121	-----	27	
			6117	-1.0	119.6	+31.0	12	-----	2	
			6116	+10.0	130.6	-13.0	533	-----	65	
			6123	+18.0	138.6	+18.0	339	-----	36	
			6112	+19.5	140.1	-11.0	388	-----	6	
			6111	+41.0	161.6	-10.0	485	-----	18	
			6119	+42.0	162.6	+13.0	36	2,124	9	
30	9	22	6131	-57.0	38.2	-17.0	109	-----	1	Mt. Wilson.
			6130	-56.0	39.2	+21.0	194	-----	16	
			6127	-30.0	65.2	-9.0	48	-----	9	
			6125	-22.0	73.2	+13.0	48	-----	30	
			6129	-21.0	74.2	+9.0	36	-----	5	
			6122	-9.0	86.2	-13.0	48	-----	1	
			6121	+7.0	102.2	+14.0	291	-----	47	
			6116	+37.0	132.2	-13.0	218	-----	24	
			6123	+43.0	138.2	+17.0	194	-----	26	
			6112	+46.0	141.2	-12.0	485	-----	6	
			6111	+69.0	164.2	-11.0	436	-----	9	
			6128	+73.0	168.2	+15.0	73	2,180	1	

Mean daily area for 27 days = 1,655.
 * = not numbered.
 ** Total spot count for day = 110.

PROVISIONAL SUNSPOT RELATIVE NUMBERS FOR SEPTEMBER 1938

[Dependent alone on observations at Zurich, Switzerland]

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

September 1938	Relative numbers	September 1938	Relative numbers	September 1938	Relative numbers
1	d 106	11	d 67	21	ad 56
2	ad 124	12	59	22	70
3	a 101	13	44	23	86
4	107	14	48	24	d 97
5	b 120	15	d 44	25	MMacc 131
6	136	16	a 47	26	150
7	a 106	17	46	27	ab 143
8	a 88	18	65	28	137
9	74	19	d 55	29	a 125
10	56	20	57	30	131

Mean, 30 days = 89.0.

- Sept. 8. Middle large, bright chromospheric eruption h m h m 11 00-11 15, W.
- 21. Middle large, bright chromospheric eruption 6 56- 7 14, E.
- 22. Middle large, bright chromospheric eruption 13 31-13 50, E.
- 23. Middle large, bright chromospheric eruption 15 45-16 20, E.
- 25. Middle large, bright chromospheric eruption 9 00- 9 15, E.
- 26. Middle large, bright chromospheric eruption 8 43- 9 03, M.

NOTE.—The complete list of eruptions observed at the different stations is being regularly published in our "Bulletin for Character Figures of Solar Phenomena." No. 43, containing the observations of the eruptions in July, August, and September 1938, will not be ready until January 1939.—W. Brunner.

a = Passage of an average-sized group through the central meridian.
 b = Passage of a large group or spot 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

During the month of September 1938 a total of 307 radiometeorograph and 208 airplane observations were made from 18 systematically-located stations in the United States. The mean free-air data based on these observations are given in tables 1 and 1a, and they include the basic meteorological elements of pressure (P), temperature (C), and relative humidity (R. H.), recorded at certain standard geometric heights. All the stations listed in table 1a made a total of 146 observations at a height of 16 kilometers, while at four of these stations, 27 observations were continued to 22 kilometers.

These "means" are omitted whenever less than 15 observations are made at the surface and less than 5 at a standard height, but 15 observations are required for those levels that fall within the limits of the monthly vertical range of the tropopause. The method used for computing these means has been described in "Aerological Observations," appearing in the January 1938 issue of the MONTHLY WEATHER REVIEW.

Chart I, published elsewhere in this REVIEW, shows that the mean surface temperature (° F.) for September was warmer than normal over all portions of the country, except in the Northeast and a few sections of the South and Southwest. Over the northern Rocky Mountain region, and from the lower Missouri Valley and central Plains

States northward, the current month was from 4° to 10° warmer than normal, while the far Western States experienced a departure as high as 4° above the normal. But, to the East and Northeast, from the western Great Lakes region and northern middle Atlantic States, the month showed moderate below-normal departures from the mean surface temperatures. For the country, as a whole, the temperature remained above the normal as was the case in the preceding months of July and August.

The mean free-air temperature (° C.) recorded above the surface over the country was seasonally lower in September than during the preceding month of August. But over the far Northwest, at Seattle and Spokane, Wash., higher mean temperatures prevailed in September at all levels from 0.5 to 5 kilometers, inclusive. Over Seattle, Wash., the September means were higher than in August by 1.7°, 4.3°, 4.1°, 3.4°, 2.8°, 2.6°, and 2.5° C., at 0.5, 1, 1.5, 2, 2.5, 3, and 4 kilometers, respectively. The free-air temperature was lower in September than in July at all stations, with the exception of San Diego, Calif., at 0.5 and 1 kilometer, where a difference of 3.9° occurred at 0.5 kilometer. Temperatures during the current month were approximately the same as recorded in September 1937 in the lower levels, but at the higher elevations the mean temperatures exceeded those recorded in 1937 over the Rocky

Mountain region. They were lower generally, however, over most portions of the East and South.

The highest free-air mean temperatures for September in the United States in the different levels were recorded at Pensacola, Fla. (21.6° C.) at 0.5 kilometer, and at San Diego, Calif. (23.4° , 21.6° , 18.8° , 15.0° , 11.2° , 3.6° , and -2.8° C.) at 1, 1.5, 2, 2.5, 3, 4, and 5 kilometers, respectively. The lowest free-air temperatures for all levels occurred at Sault Ste. Marie, Mich., during September. Over the United States a maximum temperature of 23.4° C. occurred at 1 kilometer at San Diego, Calif., and a minimum of -10.7° C. was recorded over Sault Ste. Marie, Mich., at 5 kilometers.

Above 5 kilometers, in the high altitudes reached by radiometeorographs (table 1a), the lowest mean temperature of the month (-66.9° C.) was recorded at 17 kilometers over Oklahoma City, Okla. But over the more northerly stations of Fargo, N. Dak., and Sault Ste. Marie, Mich., slightly higher temperatures (-63.2° C. and -59.9° C.) were recorded at 16 and 17 kilometers, respectively. The lowest temperatures found in the high altitudes during September, over all stations using radiometeorographs, occurred approximately along the 17-kilometer level. A gradual increase in mean temperature was then noted, from 17 kilometers up to the maximum elevation reached (23 kilometers), and was as much as 9° C. increase over Nashville, Tenn.

The pressure data given in tables 1 and 1a, when entered on isobaric charts for all levels up to and including 5 kilometers, showed that during September a statistical low pressure area persisted above the northern Great Lakes region with its center over Sault Ste. Marie, Mich. Another, but smaller, area of low pressure was noted in the lower levels over the southern Pacific coast region. Pressure generally was high throughout the southern States and Rocky Mountain region above 2 kilometers. During the current month mean free-air pressures were lower, except in the far Northwest, than those which were recorded in the preceding month of August. The statistical center of low pressure that existed over Sault Ste. Marie, Mich., at all levels below 5 kilometers, also extended upward through all high-altitude levels to 19 kilometers, and then spread out east and west to include the region over Fargo, N. Dak., up to 22 kilometers.

High relative humidity occurred over the eastern half of the United States during September up to 4 kilometers, and over the Pacific Coast at 0.5 kilometer. The highest mean humidity (86 percent) was recorded over Sault Ste. Marie, Mich., at 0.5 kilometer. High humidities elsewhere were reported over Washington, D. C., at 1, 1.5, 2, 2.5, and 3 kilometers, and over El Paso, Tex., at 4 and 5 kilometers. Low humidity prevailed over the western States and the Pacific Slope at all levels above 1 kilometer, and over New England and the immediate coast along the middle Atlantic States at 2, 2.5, 3, and 4 kilometers. There was little difference between the humidities reported during September and the preceding month of August, except over the far West, but the current month had higher humidities at all levels than during the corresponding month of 1937, and particularly so over the Eastern half of the country above 1.5 kilometer.

Resultant winds in the free atmosphere, based on pilot-balloon observations made at 26 stations near 5 a. m. (75th meridian time), are given in table 2. The resultant winds during the month of September diverged more than usual from the normal directions at many stations over the United States at all levels, but the departures in resultant velocity from normal were not so outstanding, except high over the northern Rocky Mountain region.

Unusual departures in resultant directions from the normal in each level occurred at several scattered stations during September. On the surface, at Fargo, N. Dak., the monthly resultant was 39° ; at 0.5 kilometer, over Fargo, N. Dak., the resultant was 340° ; at 1 kilometer, over Atlanta, Ga., it was 296° ; at 1.5 kilometers, over Seattle, Wash., it was 180° ; at 2 kilometers, over Oakland, Calif., the resultant was 184° ; at 2.5 kilometers, over Seattle, Wash., it was 209° ; at 3 kilometers, over Pensacola, Fla., it was 301° ; at 4 kilometers, over Albuquerque, N. Mex., it was 165° ; and at 5 kilometers, over Key West, Fla., the monthly resultant wind direction was 302° ; as compared with the normal directions of: 183° , 210° , 98° , 288° , 297° , 295° , 49° , 261° , and 87° , respectively.

Large departures of resultant direction from the normal were noted at Seattle, Wash.; Atlanta, Ga.; Fargo, N. Dak.; Pensacola, Fla.; Oakland, Calif.; Spokane, Wash.; Sault Ste. Marie, Mich.; Medford, Ore.; Key West, Fla.; and Oklahoma City, Okla. The stations reporting the least departures at all levels were: Boston, Mass.; Detroit, Mich.; and Washington, D. C. At Salt Lake City, Utah; Spokane, Wash.; Oakland, Calif.; Pensacola, Fla.; and Atlanta, Ga.; the winds departed from normal at all levels by rotating in a counterclockwise direction, while at Cincinnati, O., Nashville, Tenn., Omaha, Nebr., and Chicago, Ill., the departures were opposite, when considered as being rotated in a clockwise direction away from the normal. Wind directions for September varied from the normal more than during any of the preceding summer months of June, July, and August 1938.

Seattle, Wash., showed the most outstanding departures from normal direction in September. The differences between the monthly resultants and their normal directions were: 100° —with the monthly direction departing in a clockwise rotation from its normal; 95° —when rotated counterclockwise; 108° —counterclockwise; 82° —counterclockwise; 86° —counterclockwise; and 49° —counterclockwise; at 0.5, 1, 1.5, 2, 2.5, and 3 kilometers, respectively. At all levels above 1 kilometer the resultant directions for September at Seattle, Wash., had southwesterly components. And, as was previously noted, Seattle experienced unusual warmth in the upper air. Fargo, N. Dak., and Sault Ste. Marie, Mich., showed strong clockwise departures from normal above the surface, with the winds for September becoming more northwesterly than usual. These two stations reported low free-air temperatures at all levels, as previously indicated. In the South, over Atlanta, Ga., the departures in direction were unusual in the lower levels, with the current winds being westerly instead of easterly. And, at Pensacola, Fla., the September wind directions were 27° , 49° , 50° , 36° , 24° , 345° , 301° , and 305° , as compared to the normal directions of 35° , 82° , 103° , 109° , 94° , 13° , 49° , and 347° , respectively. Key West, Fla., however, indicated only slight departures from its normal easterly directions at all levels below 2.5 kilometers, but with the current resultant directions backing gradually away from their normal directions to as much as 302° at 5 kilometers, as compared to its normal of 87° .

The distribution of resultant wind directions over the country at all levels during September in the four quadrants of the compass also showed the existence of irregular upper-air conditions. At the surface most of the winds had normal northerly components—36 percent falling in the northwest quadrant, and 32 percent in the northeast. But, above 0.5 kilometer, where only 5 percent of the winds were northeasterly and 55 percent northwesterly, a gradual increase in northeasterly winds was noted up to 4 kilometers. Here it was found that 15

Table 3 shows the maximum wind velocities recorded during September. Below 2.5 kilometers the highest velocity recorded was 33.8 m. p. s. (W.) over Newark, N. J.; between 2.5 and 5 kilometers the greatest was 38.5 m. p. s. (S.) over Winnemucca, Nev.; and above 5

kilometers, a wind speed of 61.0 meters per second (147 miles per hour) from the NNE. was recorded at 8.3 kilometers, over Fargo, N. Dak. At 12.9 kilometers, over Albuquerque, N. Mex., a velocity of 56.0 m. p. s. from the WNW., was observed.

TABLE 2.—Free-air resultant winds (meters-per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during September 1938
[Wind from N=360°, E=90°, etc.]

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (306 m)		Billings, Mont. (1,095 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (157 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (283 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (410 m)		Nashville, Tenn. (194 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	4	1.5	327	1.0	283	1.4	277	1.5	276	3.6	283	0.2	122	0.2	277	1.0	39	0.3	22	0.9	90	2.2	238	0.3	204	0.6
500			316	1.9			296	3.3			305	.6	248	1.9	280	1.6	340	.8	144	2.2	104	3.4	247	.6	237	3.1
1,000			296	2.5			296	3.6			278	2.9	266	5.1	271	3.2	311	3.3	140	2.1	119	3.2	293	1.1	271	3.2
1,500			290	2.5	287	1.0	291	4.6			291	4.7	277	5.2	276	5.7	314	4.9	121	2.1	112	3.1	115	.7	270	2.3
2,000	154	.9	278	1.7	246	1.1	293	6.5	273	4.5	294	7.4	276	5.3	292	7.1	319	6.6	74	1.5	107	2.9	169	1.7	283	3.2
2,500	198	2.9	276	2.9	270	2.0	299	7.7	272	3.3	297	7.2	283	5.9	284	7.1	315	6.9	39	2.3	97	2.0	186	3.1	283	3.9
3,000	193	2.3	261	2.9	275	3.3	296	8.6	293	2.9	313	6.1	294	6.3	304	7.0	332	7.1	44	2.9	73	1.7	189	3.7	290	4.2
4,000	165	1.0	266	3.6	281	4.2	285	9.2	319	4.5			290	6.2					32	2.1	71	1.3	195	3.0	276	5.4
5,000	295	.3	228	2.5	300	2.5			289	4.1									293	2.2	302	1.6	202	3.0	289	3.4

Altitude (meters) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Harbor, Territory of Hawaii ¹ (88 m)		Pensacola, Fla. ¹ (24 m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,292 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washington, D. C. (3 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	349	1.3	253	0.1	175	2.1	171	0.4			27	3.0	277	0.8	145	3.8	18	1.3	1	0.3	138	0.7	79	1.6	328	0.6
500	332	2.1	284	1.8	180	3.1	207	2.2			49	3.6	267	4.2			350	4.2	359	.5	336	.2			320	1.2
1,000	279	3.6	317	2.2	211	4.7	248	4.4			50	2.4	277	4.1			344	1.7	320	2.6	202	.5	148	1.3	308	4.1
1,500	272	6.4	233	.6	249	2.6	262	4.8			36	1.8	288	4.1	154	5.6	228	1.6	324	5.2	180	1.3	192	1.8	290	5.8
2,000	274	7.3	184	1.9	268	2.2	284	4.7			24	1.0	290	4.1	172	4.8	207	3.2	314	5.6	217	1.7	196	2.0	280	7.0
2,500	283	9.1	170	2.7	294	2.9	291	5.5			345	.7	303	4.6	187	3.8	188	5.1	318	6.8	209	2.6	211	2.9	270	7.6
3,000	294	7.7	166	4.7	307	3.1	296	5.9			301	1.4	307	3.5	208	3.5	174	6.9	312	7.4	252	1.5	220	3.3	270	7.8
4,000					3	2.8	334	6.6			305	2.8	289	4.3	213	4.3	180	6.9	299	7.7			228	4.2	280	6.3
5,000					24	.9	349	3.9					257	3.4	212	2.9	196	7.1					246	4.1		

¹ Navy stations.

TABLE 3.—Maximum free air wind velocities (m. p. s.), for different sections of the United States, based on pilot balloon observations during September 1938

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	33.8	W	820	21	Newark, N. J.	34.7	SW	5,000	19	Cleveland, Ohio	39.2	SW	5,560	19	Cleveland, Ohio.
East-Central ²	26.2	NNE	1,230	21	Richmond, Va.	28.8	WSW	3,750	22	Richmond, Va.	39.4	WSW	11,190	27	Knoxville, Tenn.
Southeast ³	21.3	SW	1,180	29	Jacksonville, Fla.	29.4	SW	3,580	17	Spartanburg, S. C.	29.5	WSW	10,600	24	Charleston, S. C.
North-Central ⁴	33.0	NW	2,270	4	Sault Ste. Marie, Mich.	36.8	NW	3,530	4	Sault Ste. Marie, Mich.	61.0	NNE	8,290	18	Fargo, N. Dak.
Central ⁵	23.4	NW	1,400	17	Kansas City, Mo.	30.6	NW	4,800	18	Wichita, Kans.	56.0	N	10,840	19	Omaha, Nebr.
South-Central ⁶	29.2	NNW	2,470	18	Oklahoma City, Okla.	27.0	WNW	4,870	19	Vicksburg, Miss.	34.0	WNW	11,910	17	Abilene, Tex.
Northwest ⁷	20.7	SSW	2,500	20	Portland, Oreg.	26.3	SSW	4,780	3	Medford, Oreg.	42.4	ESE	12,420	26	Pendleton, Oreg.
West-Central ⁸	30.4	S	2,130	18	Winnemucca, Nev.	38.5	S	3,040	18	Winnemucca, Nev.	57.0	SSW	8,240	28	Reno, Nev.
Southwest ⁹	24.9	SSE	2,180	27	Fresno, Calif.	34.4	S	3,720	27	Las Vegas, Nev.	56.0	WNW	12,920	26	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.