

Positions and areas of sun spots—Continued

Date	Eastern standard civil time	Heliographic			Area		Total area for each day
		Diff. long.	Longi-tude	Lati-tude	Spot	Group	
1929—Continued							
Jan. 26 (Naval Observa-tory).	12 00	°	°	°			
		-2.0	298.5	+8.0		170	
		+26.0	328.5	+5.5		31	
		+65.0	5.5	-11.0		340	541
Jan. 27 (Harvard)	13 10	+13.5	299.5	+8.0		124	
		+28.0	314.0	+12.0		17	
		+81.5	7.5	-10.0		710	851
Jan. 28 (Naval Observa-tory).	12 12	+22.5	296.6	-22.0	12	185	
		+26.0	300.1	+7.5		15	
		+49.0	323.1	+6.5		77	212
Jan. 29 (Naval Observa-tory).	11 53	+40.0	301.1	+7.5		15	92
		+61.5	322.6	+6.0			
Jan. 30 (Naval Observa-tory).	12 1	-7.5	240.4	-4.5		123	
		+54.5	302.4	+8.0		77	200
Jan. 31 (Naval Observa-tory).	11 15	-71.0	164.1	+5.0		154	
		+6.0	241.1	-5.0		77	293
		+67.0	302.1	+8.5			
Mean daily area for January.							756

PROVISIONAL SUN-SPOT RELATIVE NUMBERS<sup>1</sup> FOR JANUARY, 1929

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

January, 1929	Relative numbers	January, 1929	Relative numbers	January, 1929	Relative numbers
1		11	44	21	77
2		12	<sup>3</sup> M 82	22	65
3	64	13	<sup>4</sup> 82	23	102
4	66	14	<sup>4</sup> 90	24	( <sup>4</sup> )
5	45	15	77	25	51 ?
6	<sup>3</sup> E 39	16	113	26	( <sup>2</sup> )
7	61	17	( <sup>2</sup> )	27	55
8	<sup>4</sup> 73	18	89	28	20
9	80	19	77	29	22
10	<sup>4</sup> 74	20	92	30	<sup>3</sup> M 29
				31	<sup>4</sup> 31

Mean, 26 days, 65.4.

- <sup>1</sup> Dependent alone on observations at Zurich University and its station at Arosa.
- <sup>2</sup> Passage of a large group through the central meridian.
- <sup>3</sup> New formation of a larger or average-sized center of activity; E, on the eastern part of the sun's disk; M, near the central meridian.
- <sup>4</sup> Passage of an average-sized group through the central meridian.

AEROLOGICAL OBSERVATIONS

By L. T. SAMUELS

Free-air temperatures for the month averaged below normal except at the eastern stations, Due West and Washington. (Table 1.) The negative departures were greatest at Ellendale where they were excessive but were successively smaller at the stations farther south.

Free-air relative humidities averaged above normal in many cases and particularly in the upper levels at Royal Center where the departures were unusually large. At this station and at Ellendale where negative temperature departures were greatest the total precipitation for the month exceeded all previous amounts for January. In this connection it is noted that the average vapor pressures in the higher levels at Royal Center were appreciably above normal notwithstanding the fact that the mean temperatures at the same levels were considerably below normal.

Table 2 shows the monthly resultant wind velocities to have been close to normal and the directions having in general a more northerly or less southerly component than normal.

It is interesting to note the Groesbeck kite record of the 27th in connection with the dissipation of a solid layer of stratus clouds over that station at 5:40 a. m. The balloon observation at that time showed the height of their base to be 500 meters and the wind at this elevation from the southwest. By 7:20 a. m. these clouds had dissipated and the kite observations showed the wind at 500 meters to be from the west although the surface wind continued from the southwest. This station was at the time in front of a wind shift line and it is evident that with the change in wind direction at the 500-meter level, dry air from a totally different source arrived and resulted in the dissipation of the clouds. The shift to northerly at the surface, however, did not occur until several hours later.

An interesting condition of snow flurries in a high-pressure area occurred at Royal Center on the 15th. The kite flight made during the occurrence of this precipitation revealed an inverted lapse rate from the ground to the cloud level at 500 meters, practically isothermal from the base to the top of the clouds at 850 meters, superimposed by another inversion layer to 1,850 meters. The occurrence of light snow flurries falling from air actually warmer than the air below it, is a result of the neighboring Great Lakes. These flurries form over the relatively warm water and later extend some distance beyond over the land which is considerably colder than the water.

TABLE 1.—Free-air temperatures, relative humidities, and vapor pressures during January, 1929

Altitude m. s. l.	TEMPERATURE (° C.)											
	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C. (7 meters)	
	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal
Surface	0.0	-3.2	4.8	-0.9	-17.7	-6.6	8.4	+0.4	-8.5	-4.2	-1.6	-0.8
250	-0.1	-3.2	4.8	-0.8			8.0	+0.2	-8.6	-4.1	-1.8	-0.8
500	-1.0	-3.7	5.3	-0.1	-17.9	-6.9	7.2	-0.3	-9.9	-4.4	-2.3	-1.0
750	-1.1	-3.6	5.8	+0.7	-17.6	-7.8	6.6	-0.7	-10.3	-4.7	-2.7	-1.0
1,000	-0.1	-2.7	5.4	+0.9	-16.6	-7.4	6.5	-0.8	-9.6	-4.1	-3.5	-1.1
1,250	0.4	-2.2	4.7	+0.9	-15.9	-7.9	6.6	-0.4	-9.6	-4.0	-4.2	-1.1
1,500	0.3	-2.0	3.7	+0.8	-15.8	-7.7	6.0	-0.4	-9.8	-3.8	-4.3	-0.8
2,000	-0.6	-1.5	1.4	+0.4	-16.4	-6.8	4.7	0.0	-10.6	-3.6	-4.5	0.0
2,500	-2.6	-1.3	-0.9	+0.1	-17.8	-6.0	2.6	0.0	-11.9	-3.0	-5.5	+0.6
3,000	-4.9	-1.1	-2.9	+0.3	-19.9	-5.5	0.4	+0.1	-14.3	-3.1	-6.8	+1.1
3,500	-7.5	-1.1	-5.1	+0.3	-21.4	-4.2	-2.8	-0.3	-16.8	-3.1	-8.4	+1.4
4,000	-10.8	-1.5	-8.4	-0.1	-24.0	-4.2	-5.6	-0.3	-18.9	-3.6	-10.2	+1.4
4,500			-12.3	-1.1					-21.2	-3.4	-11.9	+1.4

RELATIVE HUMIDITY (%)												
Surface	73	+3	73	+5	78	-3	75	-2	78	-3	66	-1
250	73	+3	72	+5			72	-3	78	-3	62	-2
500	71	+7	63	+2	77	-2	69	-2	75	0	59	-2
750	69	+9	57	-1	76	+4	67	0	70	0	57	-2
1,000	63	+8	55	-1	73	+7	60	-2	68	+1	56	-3
1,250	55	+5	54	0	71	+10	56	-1	65	+4	55	-3
1,500	49	+3	56	+4	71	+12	55	+1	67	+9	51	-5
2,000	44	-3	58	+9	67	+9	49	0	60	+7	47	-7
2,500	42	+2	57	+12	58	0	47	+1	66	+12	48	-5
3,000	40	0	58	+16	58	0	40	-2	74	+19	46	-7
3,500	42	+1	55	+16	50	-6	39	-1	79	+22	55	+1
4,000	44	+2	56	+15	45	-9	40	+2	79	+23	63	+1
4,500			57	+16					78	+23	73	+1

VAPOR PRESSURE (mb.)												
Surface	4.67	-1.01	6.78	+0.03	1.26	-1.14	8.88	+0.02	2.57	-1.24	3.83	-0.33
250	4.63	-1.01	6.68	+0.01			8.38	-0.12	2.54	-1.19	3.56	-0.39
500	4.30	-0.76	6.09	-0.03	1.23	-1.12	7.54	-0.26	2.26	-1.05	3.26	-0.45
750	4.09	-0.51	5.72	-0.03	1.25	-0.95	7.04	-0.17	2.06	-0.97	3.08	-0.45
1,000	4.00	-0.20	5.36	-0.01	1.31	-0.84	6.22	-0.28	2.03	-0.76	2.84	-0.45
1,250	3.57	-0.21	4.90	0.00	1.35	-0.74	5.75	-0.08	2.02	-0.53	2.62	-0.44
1,500	3.12	-0.25	4.78	+0.36	1.36	-0.61	5.43	+0.20	2.01	-0.32	2.38	-0.47
2,000	2.53	-0.21	4.23	+0.61	1.24	-0.46	4.58	+0.40	1.71	-0.21	2.06	-0.38
2,500	2.04	-0.26	3.52	+0.74	0.98	-0.41	3.91	+0.54	1.80	+0.15	1.94	-0.16
3,000	1.65	-0.30	3.30	+1.11	0.84	-0.24	3.06	+0.40	1.70	+0.26	1.64	-0.15
3,500	1.56	-0.12	3.00	+1.33	0.69	-0.09	2.77	+0.65	1.66	+0.39	1.72	+0.11
4,000	1.45	+0.04	2.54	+1.12	0.64	+0.07	2.65	+0.91	1.60	+0.59	1.60	+0.11
4,500			2.09	+0.93					1.54	+0.71	1.55	+0.11

<sup>1</sup> Naval Air Station.

TABLE 2.—Free-air resultant winds (m. p. s.) during January, 1929

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)			
	Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Meters																								
Surface	N.49 W.	0.8	S.51 W.	1.0	N.82 W.	0.5	N.81 W.	1.3	N.50 W.	3.1	N.63 W.	3.1	S.25 W.	2.4	S.88 W.	0.5	S.79 W.	2.6	S.58 W.	2.2	N.64 W.	1.2	N.44 W.	1.7
250	N.47 W.	0.8	S.47 W.	1.2	N.85 W.	0.6	N.84 W.	1.5	N.52 W.	3.3	N.67 W.	3.6	S.29 W.	1.9	S.89 W.	0.8	S.74 W.	2.4	S.54 W.	2.6	N.73 W.	3.6	N.71 W.	3.7
500	S.58 W.	1.4	S.39 W.	2.3	S.77 W.	2.7	S.86 W.	3.1	N.57 W.	4.6	N.65 W.	5.7	S.45 W.	3.3	S.54 W.	2.1	S.08 W.	3.6	S.61 W.	5.2	N.72 W.	7.4	N.73 W.	3.7
750	S.53 W.	2.3	S.46 W.	3.2	S.89 W.	4.4	S.85 W.	4.7	N.52 W.	4.6	N.65 W.	5.7	S.44 W.	4.7	S.56 W.	3.1	S.72 W.	3.6	S.69 W.	7.0	N.72 W.	10.0	N.72 W.	7.7
1,000	S.61 W.	2.9	S.61 W.	3.8	S.82 W.	5.8	S.83 W.	6.0	N.57 W.	5.5	N.63 W.	6.7	S.64 W.	5.6	S.60 W.	3.9	S.70 W.	5.8	S.77 W.	7.9	N.69 W.	10.9	N.71 W.	8.4
1,250	S.79 W.	3.7	S.73 W.	4.4	S.86 W.	6.7	S.88 W.	8.0	N.61 W.	6.3	N.62 W.	8.7	S.63 W.	6.3	S.67 W.	4.9	S.69 W.	6.9	S.82 W.	8.9				
1,500	N.89 W.	5.0	S.77 W.	5.5	S.78 W.	8.1	S.87 W.	10.1	N.61 W.	7.4	N.63 W.	8.4	S.70 W.	7.2	S.72 W.	6.0		9.4	S.85 W.	10.3	N.67 W.	11.6	N.70 W.	11.0
2,000	N.82 W.	7.3	S.85 W.	7.5	S.83 W.	11.3	S.89 W.	12.5	N.58 W.	10.2	N.63 W.	11.0	S.80 W.	8.4	S.79 W.	7.2	N.74 W.	11.4	S.87 W.	12.1	N.66 W.	13.5	N.72 W.	11.1
2,500	N.87 W.	9.1		9.0	S.77 W.	14.3	S.88 W.	14.9	N.63 W.	12.1	N.65 W.	13.0	N.80 W.	9.2	S.82 W.	8.5	N.63 W.	8.9	N.89 W.	13.4	N.71 W.	15.4	N.79 W.	15.6
3,000	N.84 W.	11.7	N.87 W.	10.3	S.70 W.	13.0	S.87 W.	15.9	N.61 W.	15.4	N.65 W.	14.6	S.88 W.	10.0	S.82 W.	9.9		15.0	W.	14.2	N.67 W.	18.4	N.80 W.	15.5
3,500	N.79 W.	11.2	N.84 W.	10.9	S.63 W.	14.8	S.84 W.	16.1	N.75 W.	12.4	N.66 W.	15.4	S.83 W.	8.9	S.84 W.	10.9	S.45 W.	18.0	S.94 W.	13.4	N.68 W.	16.5	N.77 W.	17.0
4,000	S.79 W.	10.3	N.84 W.	10.8	S.69 W.	17.1	S.84 W.	15.6	S.68 W.	19.0	N.63 W.	16.7	S.78 W.	14.3	S.75 W.	12.1								
4,500					S.45 W.	20.0	N.87 W.	8.4					S.78 W.	14.7	S.75 W.	14.1								

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THE WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By P. C. DAY

GENERAL CONDITIONS

Unlike the first month of the winter of 1928-29, January was a notably cold and disagreeable month over nearly all northern districts, with deep snows from the upper Mississippi Valley eastward to and including the Great Lakes. In other districts, however, normal winter conditions prevailed as a rule.

PRESSURE AND WINDS

The month was ushered in with a cold wave over the Great Plains and a cyclone of wide proportions centered near the Great Lakes, and rain or snow had fallen during the preceding 24 hours over a wide area from the Great Plains eastward nearly to the Atlantic coast, heavy snow being reported at points in the lower Missouri Valley and over other near-by areas. This storm moved rapidly to the lower St. Lawrence Valley by the morning of the 2d, the snow continuing in portions of the Great Lakes region, but precipitation had generally ended to the southward and fair weather prevailed on the 3d over most districts.

A cyclone that had developed over the Southwest without material precipitation was centered over the lower Missouri Valley by the morning of the 4th and widespread precipitation had covered the Great Plains and eastward to the Mississippi Valley, snow occurring over the districts to northward of the center and some heavy rains to the southward. During the following day precipitation extended eastward to the Atlantic coast, snow continuing over northern districts and rain over the more eastern and southern, followed by a wide area of cold that carried freezing temperatures to or near the Gulf coast within a few days. During this period warmer weather overspread the western districts and, with the passage of the precipitation area into the Atlantic, fair weather prevailed over nearly all districts, a change to colder following quickly over the central valleys and this again by warmer, changes amounting from 20° to 50° in 24 hours being reported from points in the upper Mississippi Valley and other areas.

By the 9th another cyclone had developed over the southern plains and within the following 24 hours the storm center had moved to the northward of the Great

Lakes and precipitation, mostly rains, had extended to all central and eastern districts, except the extreme Southeast. At the same time high pressure dominated the plateau region and by the end of the first decade the weather had cleared over most districts except along the northern border where clouds and local precipitation, mostly snow, persisted for several days.

About the 17th stormy conditions had developed in the central valleys and precipitation was more or less general from the Mississippi Valley eastward; similar conditions continued for several days, during which time widespread snows occurred over the western mountains and general rains occurred over many eastern districts. By the end of the second decade fair and cold weather had overspread most northern districts, continuing with some interruption during the remainder of the month, more or less rain or snow falling at intervals during the period, but particularly about the 25th, when a cyclone advanced from southern Texas to the Great Lakes, becoming severe as it approached the latter area and attended by rain or snow and high winds. During this period cold weather continued in the far Northwest.

Anticyclonic conditions existed during much of the latter half of the month over the far Northwest and also in the Missouri and upper Mississippi Valleys.

General high winds occurred over portions of the upper Mississippi Valley and Great Lakes region on several dates in connection with cyclones passing over those regions, causing much drifting of snow, and resulting in inconvenience and delay to transportation, but these caused no important damage to property.

Severe local storms assuming tornadic force occurred locally in Texas on the 4th and in Kentucky, Indiana, Illinois, and Missouri on the 18th. A full account of the principal destructive wind storms of the month appears as usual at the end of this section, and the details of wind direction and barometric pressure data are shown on the usual charts.

TEMPERATURE

Cold weather prevailed at the beginning of the month over the central valleys, but there was some warming up generally as the week advanced over most central and eastern districts, followed quickly by sharp changes to colder and again to warmer toward the end of the week, the average temperature for the period being moderately below normal over the greater part of the country, and