Positions and areas of sun spots—Continued

Date	Eastern standard civil time	Heliographic			Area		Total area for each day
		Diff. long.	Longitude	Latitude	Spot	Group	
1931	h m	°	°	°			
Dec. 14 (Naval Observatory)	12 43	+21.0	114.7	+4.0	15		
		+39.0	132.7	+12.0		278	293
Dec. 15 (Naval Observatory)	11 20	+33.0	114.3	+4.0	25		
		+50.0	131.3	+11.0		123	148
Dec. 16 (Naval Observatory)	10 30	+47.0	115.6	+4.0	15		
		+63.0	131.6	+11.0		93	108
Dec. 17 (Naval Observatory)	10 39	+78.0	133.4	+11.0		93	93
Dec. 18 (Naval Observatory)	11 36	−69.0	332.7	+11.0	93		93
Dec. 19 (Naval Observatory)	10 37	−56.0	333.0	+11.5	93		93
Dec. 20 (Naval Observatory)	10 48	−41.5	334.3	+11.0		46	46
Dec. 22 (Yerkes Observatory)	14 23	−12.6	334.9	+12.1	15		15
Dec. 23 (Naval Observatory)	10 37	−4.0	332.3	+11.0		31	
		+46.0	22.3	+14.0	31		62
Dec. 24 (Mount Wilson)	11 0	−80.0	242.9	−2.0		47	
		−80.0	242.9	−12.0	84		
		+5.0	327.9	+9.5		28	
		+59.5	22.4	+11.0		27	186
Dec. 25 (Yerkes Observatory)	13 26	−64.9	243.6	−13.4	284		
		−59.0	249.5	−2.5	19		303
Dec. 26 (Naval Observatory)	11 24	−54.0	242.4	−12.0	108		
		−47.0	249.4	−1.5	15		123
Dec. 27 (Naval Observatory)	14 10	−40.0	241.7	−14.0	139		139
Dec. 29 (Naval Observatory)	15 2	−13.0	241.9	−13.0		139	139
Dec. 30 (Naval Observatory)	12 49	−1.0	241.9	−13.0		139	139
Mean daily area for December							175

PROVISIONAL SUN-SPOT RELATIVE NUMBERS, FOR DECEMBER, 1931

(Data dependent alone on observations at Zurich and its station at Arosa)

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

December, 1931	Relative numbers	December, 1931	Relative numbers	December, 1931	Relative numbers
1	20	11	a 35	21	8
2	16	12	37	22	16
3	7?	13	a 38	23	17
4		14	37	24	d 23
5	0	15	26	25	31
6	Ec 7	16		26	31
7	12	17	15	27	31
8	13	18	8	28	15
9	24	19	8	29	9
10	Ec —	20	8	30	a 11
				31	9

Mean: 28 days=18.3.

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 center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central zone.
d=Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[The Aerological Division, W. R. GREGG, in charge]

By L. T. SAMUELS

Free-air temperatures were decidedly above normal and relative humidities were close to normal at all stations for December.

At the 1,000-meter level the resultant wind directions were close to normal at the northern stations but contained a considerably greater south component than normal at most of the southern stations. Resultant velocities were somewhat above normal at most stations.

At 3,000 meters the resultant directions were close to normal except at the extreme southern stations. At Key West a pronounced easterly component persisted to 4,000 meters as compared to the normal westerly direction at that level. Resultant velocities at 3,000 meters exceeded the normal appreciably in New England and at some southern stations.

TABLE 1.—*Mean free-air temperatures and humidities obtained by airplanes (or kites) during December, 1931*

TEMPERATURE (°C)

Altitude (meters) m. s. l.	Chicago, Ill.[1] (190 meters)	Cleveland, Ohio[1] (245 meters)	Dallas, Tex.[1] (149 meters)	Due West, S. C.[2] (217 meters)	Ellendale, N. Dak.[2] (444 meters)	Hampton Roads, Va.[2] (3 meters)	Omaha, Nebr.[1] (299 meters)	Pensacola, Fla.[2] (2 meters)	San Diego, Calif.[3] (9 meters)	Washington, D. C.[3] (2 meters)
Surface	1.7	2.3	7.2	9.1	−6.0	8.1	0.1	16.3	12.4	3.2
500	1.7	2.3	8.7	9.8	−5.4	7.2	0.7	15.8	10.8	4.6
1,000	1.3	1.5	8.6	9.9	−1.0	6.1	2.4	15.7	8.7	4.2
1,500	0.9	0.3	8.0	9.5	−0.1		3.0			
2,000	0.0	−0.8	6.7	7.9	−1.9	4.1	1.7	12.1	4.9	1.8
2,500	−1.7	−2.5	4.8	6.0	−4.3		−0.6			
3,000	−4.0	−4.8	2.6	3.4	−6.8	0.6	−3.1	7.0	0.9	−0.4
4,000	−9.4	−9.3	−3.9		−13.7		−9.5		−5.7	
5,000	−16.5	−14.6	−11.0		−19.7		−16.7		−13.6	
6,000			−16.2				−23.9			

RELATIVE HUMIDITY (PER CENT)

Altitude (meters) m. s. l.	Chicago, Ill.[1] (190 meters)	Cleveland, Ohio[1] (245 meters)	Dallas, Tex.[1] (149 meters)	Due West, S. C.[2] (217 meters)	Ellendale, N. Dak.[2] (444 meters)	Hampton Roads, Va.[2] (3 meters)	Omaha, Nebr.[1] (299 meters)	Pensacola, Fla.[2] (2 meters)	San Diego, Calif.[3] (9 meters)	Washington, D. C.[3] (2 meters)
Surface	85	82	86	87	88	76	86	90	59	77
500	79	78	72	76	85	66	79	82	58	67
1,000	67	72	58	66	60	64	60	73	54	60
1,500	57	63	51	54	52		43			
2,000	49	56	45	53	56	41	37	63	40	46
2,500	45	50	42	42	56		36			
3,000	44	49	37	34	56	32	36	65	34	32
4,000	40	44	35		83		35		36	
5,000	30	39	36		65		32		60	
3,000			10				24			

[1] Airplanes (Weather Bureau). [2] Kites. [3] Airplanes (Navy).

TABLE 2.—*Free-air resultant winds (meters per second) based on pilot balloon observations made near 7 a. m. (E. S. T.) during December, 1931*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,528 meters)		Brownsville, Tex. (12 meters)		Burlington, Vt. (132 meters)		Cheyenne, Wyo. (1,873) meters)		Chicago, Ill. (198 meters)		Cleveland, Ohio (245 meters)		Dallas, Tex. (154 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Havre, Mont. (762 meters)		Jacksonville, Fla. (14 meters)		Key West Fla. (11 meters)	
	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	N 29 E	1.1	N 78 W	1.6	S 27 W	1.3	N 74 W	4.2	S 76 W	0.9	S 69 W	1.9	S 87 W	0.5	N 48 E	1.2	N 60 W	1.0	S 66 W	2.2	N 48 E	0.7	S 78 E	3.4
500			S 9 W	1.7	S 64 W	4.5			S 86 W	4.2	S 77 W	5.7	S 54 W	3.2	N 65 W	1.4	N 65 W	1.4			S 12 E	3.8	S 69 E	8.9
1,000			S 22 W	3.0	N 83 W	7.4			S 84 W	6.7	N 84 W	7.9	S 70 W	4.2	S 83 W	2.9	N 51 W	3.6	S 62 W	6.9	S 5 W	3.8	S 59 E	8.0
1,500			S 19 W	4.4	N 62 W	10.6			N 83 W	12.8	N 87 W	10.7	S 49 W	5.5	S 84 W	5.8	N 60 W	5.0	S 79 W	9.5	S 41 W	4.4	S 57 E	6.0
2,000	N 23 W	1.8	S 72 W	5.2	N 62 W	14.1	N 82 W	7.4	N 87 W	10.3	N 85 W	11.3	S 60 W	6.9	W	8.8	N 64 W	8.3	N 89 W	9.3	S 57 W	5.2	S 54 E	5.1
2,500	N 71 W	3.9	S 44 W	7.0	N 61 W	16.3	N 86 W	9.3			N 87 W	12.9	S 64 W	8.9	N 83 W	8.1	N 70 W	8.5	N 87 W	9.4	S 44 W	5.5	S 52 E	3.9
3,000	N 71 W	5.8	S 51 W	9.2	N 55 W	21.3	N 82 W	7.1					S 67 W	10.5	S 89 W	8.9	N 76 W	9.9	N 87 W	10.7			S 57 E	4.3
4,000	N 79 W	8.7					S 89 W	9.0					S 80 W	10.2			N 70 W	14.5					S 40 E	3.4
5,000	S 77 W	7.2					S 88 W	6.8																
6,000							N 72 W	2.4																

Altitude (meters) m. s. l.	Los Angeles, Calif. (217 meters)		Medford, Oreg. (410 meters)		Memphis, Tenn. (89 meters)		New Orleans, La. (25 meters)		Oakland, Calif. (8 meters)		Oklahoma City, Okla. (392 meters)		Omaha, Nebr. (299 meters)		Phoenix, Ariz. (356 meters)		Salt Lake City, Utah (1,294 meters)		Sault Ste. Marie, Mich. (198 meters)		Seattle, Wash. (14 meters)		Washington, D. C. (10 meters)	
	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	N 42 W	0.3	S 58 E	0.7	S 2 E	0.7	N 62 E	1.2	S 68 E	1.6	S 64 W	0.8	S 30 E	0.9	S 61 E	1.5	S 26 E	3.2	S 75 E	0.2	S 49 E	2.1	N 51 W	1.4
500	N 73 E	0.4	S 56 E	1.5	S 16 W	0.8	S 32 E	2.9	S 26 E	2.3	S 34 W	2.1	S 58 W	2.9	S 77 E	2.3			N 55 W	0.1	S 3 E	6.6	N 70 W	7.3
1,000	N 30 E	0.3	S 17 E	5.6	S 65 W	2.6	S 29 W	4.8	S 47 W	1.8	S 66 W	3.7	S 60 W	8.3	S 78 E	1.9			N 65 W	2.7	S 16 W	9.8	N 73 W	9.6
1,500	N 60 W	1.9	S 26 W	6.4	S 52 W	4.2	S 38 W	2.5	S 55 W	4.0	S 57 W	5.1	S 67 W	8.6	S 37 E	1.5	S 11 E	4.3	N 46 W	4.5	S 23 W	11.7	N 68 W	13.6
2,000	N 68 W	3.7	S 35 W	9.9	S 89 W	5.1	S 54 W	7.4	S 62 W	4.5	S 72 W	6.0	N 86 W	8.5	S 22 W	0.3	S 6 W	5.9	N 44 W	6.3	S 19 W	11.3	N 70 W	15.0
2,500	N 62 W	3.4	S 41 W	10.9	S 85 W	7.5	S 57 W	8.0	S 58 W	5.1	S 79 W	6.9	S 84 W	9.6	N 89 W	2.6	S 20 W	5.5	N 53 W	8.6				
3,000	N 47 W	3.8	S 44 W	12.3	N 78 W	10.8	S 52 W	5.8	S 72 W	3.4	S 78 W	8.9	N 89 W	9.4	N 73 W	4.4	S 48 W	3.9	N 34 W	7.1				
4,000			S 44 W	9.6					S 67 W	2.5	S 85 W	5.8	N 80 W	10.5	N 83 W	7.5	N 57 W	5.2						
5,000																								

TABLE 3.—*Observations by means of airplanes, kites, captive and limited-height sounding balloons during December, 1931*

	Dallas, Tex.[1]	Due West, S. C.[2]	Ellendale, N. Dak.[2]	Chicago, Ill.[1]	Cleveland, Ohio[1]	Omaha, Nebr.[1]
Mean altitudes, meters, m. s. l., reached during month	5,285	2,091	3,192	4,678	4,914	5,838
Maximum altitudes, meters, m. s. l., reached	5,982	3,570	5,161	5,273	5,671	6,547
Number of flights made	32	29	28	30	30	26
Number of days on which flights were made	31	29	28	30	30	25

[1] Airplanes. [2] Kite.

AEROLOGICAL OBSERVATIONS FOR THE YEAR 1931

[The Aerological Division, W. R. Gregg, in charge]

By L. T. SAMUELS

Table 1 shows the mean free-air temperatures and relative humidities for the year at Due West, Ellendale, and Washington, D. C., and for the parts of the year indicated at the other stations. Kite observations were discontinued during the year at Broken Arrow, Groesbeck, and Royal Center and regular daily airplane observations started at Chicago, Cleveland, Dallas, and Omaha.

An inspection of the departures from the normal free-air temperatures (not shown in table) for the corresponding periods at the various stations shows small negative values at all levels at Due West and moderately large positive departures at Ellendale and Washington, where full year records were obtained. Approximate normals for Dallas were obtained by interpolating latitudinally between Groesbeck and Broken Arrow. From these it is found that the free-air temperatures at Dallas and Omaha (the latter based on normals of the Drexel, Nebr., kite station) for the latter half of the year were above normal at all levels. The largest departures occurred at Omaha where they were nearly 4° C. at the 2,500 meter level. Positive departures of equal magnitude are found when the mean temperatures for Chicago are compared with the normals for Royal Center, situated 100 miles to the southeast.

TABLE 1.—*Mean free-air temperatures and humidities obtained by airplanes (or kites) during year 1931*

TEMPERATURE (°C)

Altitude (meters) m. s. l.	Broken Arrow, Okla.[1] (233 meters)	Chicago, Ill.[2] (190 meters)	Cleveland, Ohio[2] (245 meters)	Dallas, Tex.[2] (149 meters)	Due West, S. C. (217 meters)	Ellendale, N. Dak. (444 meters)	Groesbeck, Tex.[3] (141 meters)	Omaha, Nebr.[4] (299 meters)	Royal Center, Ind.[3] (225 meters)	Washington, D. C. (Naval Air Sta.) (2 meters)
Surface	9.3	12.6	12.4	18.2	15.3	7.3	10.4	10.4	8.3	11.8
500	8.6	13.4	13.3	19.3	14.5	7.3	9.8	11.1	6.7	11.7
1,000	7.0	12.8	12.8	18.6	12.6	7.5	7.9	12.3	4.7	10.2
1,500	4.9	10.6	10.4	16.6	10.0	6.1	6.5	11.3	2.7	------
2,000	2.8	8.0	8.1	14.1	7.5	3.9	4.5	9.3	0.7	5.8
2,500	0.2	5.5	5.8	11.5	4.9	1.2	2.1	6.8	−1.3	------
3,000	−2.4	2.8	3.4	8.8	2.2	−1.6	−0.4	3.9	−3.5	1.4
4,000	−8.6	−2.9	−1.5	2.5	−3.8	−7.5	−6.5	−2.6	−8.8	−3.8
5,000	−13.5	−8.9	−6.7	−2.0	−9.8	−13.9	------	−9.4	−14.7	−10.0
6,000	------	------	−12.3	−8.0	------	−19.6	------	−16.6	−21.6	------

RELATIVE HUMIDITY PER CENT

Altitude (meters) m. s. l.	Broken Arrow, Okla.[1] (233 meters)	Chicago, Ill.[2] (190 meters)	Cleveland, Ohio[2] (245 meters)	Dallas, Tex.[2] (149 meters)	Due West, S. C. (217 meters)	Ellendale, N. Dak. (444 meters)	Groesbeck, Tex.[3] (141 meters)	Omaha, Nebr.[4] (299 meters)	Royal Center, Ind.[3] (225 meters)	Washington, D. C. (Naval Air Sta.) (2 meters)
Surface	72	84	83	79	74	72	77	82	74	74
500	67	73	75	71	69	71	67	75	73	63
1,000	62	65	67	63	64	60	61	60	69	58
1,500	59	61	65	60	62	56	53	53	63	------
2,000	54	57	61	58	59	54	50	48	59	54
2,500	52	52	55	55	55	54	48	45	56	------
3,000	51	50	51	51	51	54	42	45	55	47
4,000	47	45	43	47	48	55	46	42	54	42
5,000	39	37	40	41	56	57	------	40	54	28
6,000	------	------	47	51	------	55	------	37	54	------

[1] January to May, inclusive, only.
[2] July to December, inclusive, only.
[3] January to April, inclusive, only.
[4] August to December, inclusive, only.
[5] January to June, inclusive, only.