POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, Superintendent United States Naval Observatory. Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, Perkins, and Mount Wilson Observatories. The differences of longitude are measured from central meridian, positive west. The north latitudes are plus. Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere. The total area, including spots and groups, is given for each day in the last column]

Date	Eastern standard civil time		Heliographic			Area		Total area for each day
			Diff. long.	Longitude	Latitude	Spot	Group	
1931	h	m	°	°	°			
Apr. 1 (Mount Wilson)	12	50	−79.0	169.6	−2.0	138		
			−22.0	226.6	+8.0		44	
			+32.0	280.6	−9.0	149		
			+58.0	306.6	+10.0	7		
			+75.0	323.6	−17.0		126	464
Apr. 2 (Naval Observatory)	12	20	−63.0	172.7	0.0	46		
			−5.0	230.7	+9.5		15	
			+47.0	282.7	−8.0	77		138
Apr. 3 (Naval Observatory)	10	52	−50.5	172.8	−1.0	123		
			+8.0	231.3	+8.0	3		
			+7.5	230.8	−8.0		12	
			+53.0	276.3	−4.0	9		
			+59.5	282.8	−9.0	46		193
Apr. 4 (Mount Wilson)	9	45	−38.0	172.6	−2.0		125	
			+17.0	227.6	+8.0		26	
			+30.0	240.6	−7.0		8	
			+67.0	277.6	−3.0		12	
			+71.0	281.6	−7.0	26		197
Apr. 5 (Yerkes Observatory)	11	43	−62.2	134.2	+5.4	22		
			−31.4	165.0	−2.9	9		
			−23.1	173.3	−3.0	57		
			+30.4	226.8	+6.3		36	
			+32.5	228.9	+6.6	18		
			+68.5	264.9	+5.7	31		173
Apr. 6 (Mount Wilson)	13	15	−51.0	131.4	+5.0		88	
			−10.0	172.4	−2.0		92	
			+40.0	222.4	+4.0		102	
			+46.0	228.4	+9.0	5		287
Apr. 7 (Perkins Observatory)	10	45	−35.0	135.4	+10.0		217	
			+3.0	173.4	+4.0	155		
			+51.0	221.4	+7.0		186	558
Apr. 8 (Naval Observatory)	11	14	−70.0	87.1	+3.0	9		
			−22.0	135.1	+5.0		216	
			+13.0	170.1	−3.0		139	
			+66.0	223.1	+2.0		123	487
Apr. 9 (Naval Observatory)	11	13	−70.0	73.9	+5.0	15		
			−10.0	133.9	+4.5		170	
			+28.0	171.9	−3.0		154	
			+78.0	221.9	+3.0		46	385
Apr. 10 (Naval Observatory)	11	14	+3.0	133.7	+5.0		216	
			+22.0	152.7	−3.5		31	
			+41.0	171.7	−3.0		123	370
Apr. 11 (Perkins Observatory)	14	0	−60.0	56.0	+10.0		124	
			+21.5	137.5	+12.0		124	
			+56.0	172.0	+2.0	124		372
Apr. 12 (Naval Observatory)	11	12	−65.0	39.3	+22.0		77	
			+21.0	125.3	+7.0		154	
			+33.0	137.3	+3.5		31	
			+69.0	173.3	−3.0	46		308
Apr. 13 (Naval Observatory)	11	15	−50.0	41.1	+22.0		46	
			−37.5	53.6	+7.0		139	
			+85.0	176.1	−3.0	31		216
Apr. 14 (Naval Observatory)	11	50	−61.0	16.5	+11.0		123	
			−38.0	39.5	+22.0	31		
			−22.5	55.0	+8.0		185	339
Apr. 15 (Naval Observatory)	11	17	−50.0	14.6	+10.0		216	
			−27.0	37.6	+22.0	15		
			−20.0	44.6	+11.5	15		
			−11.0	53.6	+8.0		216	462
Apr. 16 (Naval Observatory)	11	28	−40.0	11.3	+11.0		154	
			−15.0	36.3	+25.0		31	
			+2.5	53.8	+9.0		123	308
Apr. 17 (Naval Observatory)	11	14	−23.5	14.8	+11.5		185	
			−5.0	33.3	+2.5		46	
			+16.5	54.8	+9.0		123	354
Apr. 18 (Naval Observatory)	11	14	−10.5	14.6	+11.0		123	
			+30.0	55.1	+8.5		123	246

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	°	°	°			
Apr. 19 (Naval Observatory)	11	9	+2.0	13.9	+11.5	154		
			+43.0	54.9	+9.0	123		277
Apr. 20 (Naval Observatory)	11	18	+16.0	14.6	+11.5	154		
			+41.0	39.6	+10.0	31		
			+58.0	56.6	+8.5	154		339
Apr. 21 (Naval Observatory)	11	0	+29.5	15.1	+12.0		123	
			+57.0	42.6	+10.0		247	
			+71.0	56.6	+9.0		62	432
Apr. 22 (Mount Wilson)	9	45	+42.0	15.0	+10.5		249	
			+66.0	39.0	+8.5		295	
			+89.5	62.5	+7.0	124		668
Apr. 23 (Naval Observatory)	11	13	−14.0	305.0	+15.0		62	
			+55.0	14.0	+11.5		123	185
Apr. 24 (Naval Observatory)	11	27	−80.0	225.7	+8.0	15		
			+0.1	305.8	+16.0		62	
			+68.0	13.7	+10.0	93		170
Apr. 25 (Yerkes Observatory)	15	51	−59.6	230.4	+4.4		8	
			+12.1	302.2	+14.1	16		
			+14.0	304.1	+13.9		4	
			+15.8	305.9	+14.3	8		
			+16.9	307.0	+14.8	25		61
Apr. 26 (Naval Observatory)	14	20	−48.0	229.7	+4.0	15		
			+27.5	305.2	+15.0		93	
			+30.0	307.7	−7.0	9		117
Apr. 27 (Naval Observatory)	11	22	−38.0	228.1	+5.0	31		
			+38.0	304.1	+17.5		62	93
Apr. 28 (Naval Observatory)	11	20	−23.0	229.9	+5.0	31		31
Apr. 29 (Naval Observatory)	11	24	−10.0	229.6	+5.0	15		
			+33.0	272.6	+14.0	19		34
Apr. 30 (Naval Observatory)	11	22	+4.0	230.4	+5.0	15		
			+48.0	274.4	+15.0		62	77
Mean daily area for April								278

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR APRIL, 1931 [1]

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

April, 1931	Relative numbers	April, 1931	Relative numbers	April, 1931	Relative numbers
1	*d* 34	11	*d* 36	21	Wc 38
2	32	12	36	22	41
3	29	13	*a* 44	23	27
4		14	38	24	Mc 29
5	Ec 25	15	37	25	37
6	31	16	*a* 31	26	21
7	*a* 40	17	41	27	19
8	44	18	22	28	14
9	45	19	*a* 20	29	Wc 17
10	*a* 29	20	20	30	18

Mean: 29 days=30.9.

[1] Dependent alone on observations at Zurich and its station at Arosa.
a=Passage of an average-sized group 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

By L. T. SAMUELS

Free-air temperatures during April were moderately above normal at the northern stations, viz, Ellendale and Royal Center, and below normal at the more southern stations. (Table 1.)

Relative-humidity departures were small and variable in most cases.

Vapor-pressure departures were mostly negative.

In Table 2 are shown the mean free-air temperatures and relative humidities at the Naval Air stations, and it will be noted that the agreement with the kite data is close when geographical location is considered.

Free-air resultant winds at the 3,000 meter level were predominantly westerly. The highest resultant velocities occurred in the northern and northeastern sections of the country.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during April, 1931*

TEMPERATURE (°C.)

Altitude (meters) 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)	
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal
Surface	12.9	−2.7	13.8	−2.5	6.4	+0.8	14.2	−3.8	9.5	−0.9
500	12.0	−1.9	12.3	−1.9	6.4	+1.2	13.0	−2.7	8.7	+0.8
1,000	9.5	−2.0	9.7	−1.8	5.6	+2.9	11.1	−2.9	6.7	+1.2
1,500	6.9	−2.5	6.9	−1.8	2.5	+2.0	10.4	−2.4	3.7	+0.4
2,000	4.4	−2.7	4.3	−1.6	−0.6	+1.5	8.6	−2.1	1.1	+0.2
2,500	1.6	−2.6	1.3	−2.2	−4.0	+0.9	5.9	−2.2	−1.1	+0.6
3,000	−1.2	−2.3	−1.7	−2.5	−7.2	+0.7	3.1	−2.1	−3.1	+1.2
4,000	−7.5	−2.5	−7.7	−3.2	−13.6	+0.4	−2.1	−1.0	−7.7	+1.8
5,000	−11.7	−1.0			−20.8	−1.0			−12.7	+2.6

RELATIVE HUMIDITY (%)

Surface	73	+9	70	+7	63	−2	74	+1	66	+1
500	68	+5	66	+4	61	−3	66	−5	62	−3
1,000	62	+2	61	0	53	−7	60	−2	59	−3
1,500	60	+5	57	−3	53	−4	51	+2	62	+3
2,000	57	+7	54	−3	51	−4	48	+5	61	+4
2,500	54	+5	53	+1	50	−4	52	+11	59	+7
3,000	54	+6	53	+3	51	−3	40	0	55	+5
4,000	52	+7	68	+20	52	−4			46	−3
5,000	46	0			52	−2			51	+7

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during April, 1931*

VAPOR PRESSURE (*mb.*)

Altitude (meters) 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)	
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal
Surface	11.16	−0.68	11.28	−0.58	5.73	−0.11	12.16	−3.28	7.81	−0.82
500	9.78	−0.62	9.60	−0.73	5.62	−0.06	10.17	−2.90	7.05	−0.31
1,000	7.65	−0.74	7.45	−1.14	4.62	+0.09	8.28	−1.86	5.94	−0.05
1,500	6.16	−0.51	5.74	−1.20	3.70	0.00	6.57	−0.58	4.95	+0.01
2,000	4.90	−0.20	4.47	−0.79	2.84	−0.13	5.43	+0.08	3.99	−0.01
2,500	3.69	−0.40	3.63	−0.30	2.13	−0.27	4.74	+0.48	3.19	+0.14
3,000	2.88	−0.39	2.98	−0.05	1.70	−0.23	2.80	−0.63	2.51	+0.10
4,000	1.53	−0.48	3.28	+1.28	0.93	−0.35			1.29	−0.34
5,000	0.73	−0.62			0.63	−0.15			0.75	−0.37

TABLE 2.—*Free-air obtained by airplanes at naval air stations during April, 1931*

Altitude (meters) m. s. l.	Temperature (°C.)				Relative humidity (%)			
	Hampton Va.	Pensacola, Fla.	San Diego, Calif.	Washington, D. C.	Hampton, Va.	Pensacola, Fla.	San Diego, Calif.	Washington, D. C.
Surface	12.1	15.2	19.1	10.8	64	80	65	64
500	10.6	14.5	16.3	9.1	53	70	70	57
1,000	7.9	12.4	15.7	7.4	50	61	57	55
2,000	2.9	7.7	12.0	2.5	47	52	36	53
3,000	−3.0	2.2	5.6	−1.8	51	50	29	56
4,000		−4.8				65		

TABLE 3.—*Free-air resultant winds (meters per second) based on pilot balloon observations made near 7 a. m. (E. S. T.) during April, 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)		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)		Los Angeles, Calif. (127 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 87 E	0.7	S 66 E	0.6	S 8 W	1.4	N 75 W	3.6	N 50 W	0.5	S 28 E	0.9	N 21 W	0.4	N 75 W	1.7	S 87 W	1.4	N 37 W	0.6	N 55 E	1.4	N 50 E	0.7
500			S 27 E	6.1	S 42 W	3.2			N 65 W	2.9	S 14 E	3.7	N 74 W	2.2	N 86 W	1.9			S 8 W	0.3	S 87 E	3.7	S 75 E	1.7
1,000			S 4 E	4.8	S 76 W	4.0			N 55 W	5.4	S 44 E	2.0	N 75 W	3.2	S 79 W	3.6	S 72 W	4.3	S 33 W	1.0	S 53 E	2.9	N 38 E	1.0
1,500			S 10 E	2.6	N 52 W	5.3			N 64 W	6.3	S 26 E	0.5	N 67 W	3.8	N 83 W	4.2	S 86 W	6.2	S 82 W	1.0	N 89 E	1.4	N 27 E	0.5
2,000	S 31 W	1.8	S 3 E	2.2	N 45 W	5.4	N 76 W	5.7	N 69 W	8.7	N 45 W	0.1	N 72 W	3.3	N 77 W	5.7	N 88 W	5.9	N 77 W	4.0	N 42 W	0.5	N 70 W	1.0
2,500	S 82 W	2.7	S 75 W	1.7	N 49 W	8.0	N 68 W	8.5	N 59 W	10.2	N 28 W	1.5	N 79 W	5.5	N 68 W	6.5	N 90 W	5.6	N 80 W	4.5	N 85 W	2.2	N 71 W	3.0
3,000	N 85 W	5.3	N 86 W	2.6	N 44 W	7.8	N 60 W	7.6	N 66 W	6.8	S 65 W	1.2	N 60 W	6.4	N 60 W	8.9	N 80 W	4.9	N 85 W	4.7	S 89 W	3.2	N 60 W	3.2
4,000	N 83 W	7.1	N 61 W	10.1	N 78 W	6.5	N 70 W	9.0					N 61 W	9.0	N 61 W	10.7	N 59 W	4.1	N 88 W	7.8	N 80 W	6.3	N 51 W	7.7
5,000	N 88 W	4.6					N 81 W	7.9					N 55 W	9.8	N 76 W	12.5			N 79 W	10.2	S 76 W	4.8		

Altitude (meters) m. s. l.	Medford, Oreg. (410 meters)		Memphis, Tenn. (145 meters)		Modena, Utah (1,665 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 4 W	0.9	N 10 E	0.7	S 70 W	2.0	N 54 E	0.8	S 56 E	0.4	S 20 E	0.7	S 85 E	0.6	S 83 E	2.5	S 42 E	2.6	N 18 E	0.5	S 52 E	0.9	N 64 W	0.5
500	N 6 W	0.7	N 86 W	0.9			N 73 E	2.2	N 74 W	1.0	S 16 E	1.7	S 29 W	0.8	S 77 E	2.3			S 41 W	0.9	S 2 W	2.6	N 87 W	7.1
1,000	N 34 E	0.2	N 59 W	1.8			N 65 E	1.1	N 36 W	2.7	S 28 W	2.4	S 82 W	3.7	S 19 W	1.0			N 82 W	4.5	S 8 E	3.1	N 68 W	4.1
1,500	S 23 E	2.0	N 43 W	2.8			N 54 W	1.0	N 70 W	2.6	S 59 W	0.9	S 88 W	5.2	S 58 W	2.1	S 23 E	2.7	N 64 W	6.6	S 5 W	2.3	N 63 W	7.5
2,000	S 11 W	2.0	N 48 W	4.7	S 51 W	0.3	N 68 W	2.3	S 87 W	1.6	N 79 W	1.7	N 84 W	4.9	S 39 W	2.5	S 36 W	2.2	N 57 W	7.9	S 40 W	1.8	N 67 W	7.3
2,500	S 31 W	1.5	N 66 W	4.8	S 43 W	1.1	W	2.7	S 84 W	2.7	N 68 W	3.5	N 56 W	5.5	S 36 W	2.6	S 70 W	2.7	N 56 W	8.0	S 72 W	3.9	N 65 W	8.5
3,000	S 49 W	1.8	N 82 W	6.3	S 70 W	2.0	S 87 W	3.5	N 80 W	3.9	S 88 W	4.9	N 45 W	4.7	S 53 W	3.4	S 89 W	3.9	N 47 W	8.4	S 85 W	5.7	N 62 W	9.8
4,000	S 85 W	1.5			N 83 W	5.7	S 78 W	7.1	N 81 W	1.0	S 71 W	5.9	N 80 W	4.9	S 83 W	3.8	N 79 W	5.6	N 48 W	8.7			N 57 W	11.4
5,000					N 70 W	6.9	N 82 W	9.5					N 68 W	9.5			N 79 W	8.8	N 52 W	8.2				

TABLE 4.—*Observations by means of kites, captive and limited height sounding balloons during April, 1931*

	Broken Arrow, Okla.	Due West, S. C.	Ellendale, N. Dak.	Groesbeck, Tex.	Royal Center, Ind.
Mean altitudes (meters), m. s. l., reached during month	3,247	2,576	3,197	2,049	3,315
Maximum altitude (meters), m. s. l., reached	[1] 5,314	4,771	4,993	4,702	[1] 5,712
Number of flights made	32	31	30	20	31
Number of days on which flights were made	29	30	29	20	30

[1] Limited-height sounding balloon observation.

In addition to the above, there were approximately 176 pilot balloon observations made daily at 60 Weather Bureau stations in the United States.