SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING MARCH, 1930

By HERBERT H. KIMBALL, Solar Radiation Investigation

For reference to descriptions of instruments and exposures, and an account of the method of obtaining and reducing the measurements, the reader is referred to this volume of the REVIEW, page 26.

Table 1 shows that solar radiation intensities averaged below the normal intensity for March at all three stations.

No skylight polarization measurements were obtained at Madison during the month. At Washington measurements obtained on four days give a mean of 58 per cent and a maximum of 61 per cent on the 5th. These values are close to the corresponding averages for Washington.

NOTE.—The data for Table 2 will appear in the next issue of the REVIEW.

TABLE 1.—*Solar radiation intensities during March, 1930*

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date	Sun's zenith distance										
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Mar. 4	1.60		0.68								1.45
Mar. 5	3.15	0.64	0.74	0.90	1.14	1.44					3.00
Mar. 13	3.81		0.68	0.81	0.99	1.27					4.37
Mar. 14	2.36			1.02	1.33						2.06
Mar. 15	1.68	0.63	0.73	0.85	1.02	1.28	0.94	0.71			1.52
Mar. 20	3.99			0.93	1.12	1.46	0.92				3.00
Mar. 21	5.36						1.18				3.15
Mar. 22	1.68					1.50	1.23	0.89			1.96
Mar. 24	4.17	0.54	0.63	0.77	1.03	1.49					5.56
Mar. 26	2.26				0.89						2.26
Mar. 31	3.15		0.59	0.77	1.15	1.36					2.87
Means		**0.60**	**0.68**	**0.86**	**1.08**	**1.40**	**1.07**	**(0.80)**			
Departures		**−0.12**	**−0.12**	**−0.09**	**−0.07**		**−0.06**	**−0.13**			

Madison, Wis.

Mar. 3	1.32		0.90	1.06							1.12
Mar. 4	2.26			1.03	1.33	1.60	1.30				3.63
Mar. 5	2.36		0.98	1.12	1.33	1.59	1.30				2.26
Mar. 7	3.00			0.76							3.81
Mar. 8	2.06			1.12	1.35	1.60	1.36				2.16
Mar. 12	3.00						1.17				3.30
Mar. 13	2.49						1.34				2.16
Mar. 14	2.62						1.11				2.26
Mar. 19	3.15		0.98	1.12	1.27	1.47					3.81
Mar. 20	3.99		0.70	0.89	1.06						2.74
Mar. 21	1.07			1.16	1.33	1.55					0.71
Mar. 24	4.17			0.90	1.21						3.81
Means			**0.89**	**1.02**	**1.27**	**1.56**	**1.26**				
Departures			**−0.14**	**−0.14**	**−0.04**		**−0.03**				

Lincoln, Nebr.

Mar. 2	1.02					1.57	1.37	1.20	1.05	0.88	1.32
Mar. 4	1.60			1.03	1.23	1.55	1.27	1.10	0.96	0.86	1.88
Mar. 5	2.36	0.86	1.02	1.08	1.17		1.29	1.06	0.87	0.65	2.16
Mar. 12	3.15						1.15	0.99	0.82	0.72	3.45
Mar. 13	4.17	0.73	0.83	0.98	1.17		1.07	0.86	0.72	0.57	3.15
Mar. 15	6.50	0.45	0.59	0.74	0.93						8.48
Mar. 19	3.15				1.27		1.29	1.17	0.99	0.90	4.37
Mar. 28	2.16			1.13	1.33	1.55	1.29	1.14	0.99	0.91	2.62
Mar. 29	2.62					1.55	1.33	1.18	1.04	0.91	3.30
Means		**0.68**	**0.81**	**0.99**	**1.18**	**1.56**	**1.26**	**1.09**	**0.93**	**0.80**	
Departures		**−0.15**	**−0.13**	**−0.10**	**−0.09**		**−0.02**	**±0.00**	**−0.01**	**−0.01**	

[1] Extrapolated.

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. C. S. Freeman, Superintendent U. S. Naval Observatory Data furnished by Naval Observatory in cooperation with Harvard, Yerkes, Mount Wilson, and Perkins 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	
1930	*h m*	°	°	°			
Mar. 1 (Mount Wilson)	12 30	−71.0	4.0	−14.0		579	
		+9.0	84.0	−5.0		180	759
Mar. 2 (Naval Observatory).	12 7	−65.0	357.0	−15.5		664	
		+22.5	84.5	−5.5	123		787
Mar. 3 (Naval Observatory).	11 21	−52.0	357.3	−17.5		880	
		+35.5	84.8	−6.0	108		988
Mar. 4 (Naval Observatory).	11 20	−39.0	357.1	−17.0		1,034	
		+49.0	85.1	−6.0	77		1,111
Mar. 5 (Naval Observatory).	11 15	−26.0	357.0	−17.5		895	
		+62.5	85.5	−6.5	108		1,003
Mar. 6 (Naval Observatory).	11 25	−12.0	357.7	−17.0		864	
		+76.0	85.7	−6.5	93		957
Mar. 7 (Mount Wilson)	12 30	−24.0	331.9	+22.0		6	
		−3.0	352.9	−19.0		218	
		+9.0	4.9	−17.0		558	782
Mar. 8 (Naval Observatory).	14 23	−9.0	332.7	+20.5		12	
		+14.5	356.2	−17.0		679	691
Mar. 9 (Naval Observatory).	11 28	+26.0	356.1	−16.5		586	586
Mar. 10 (Naval Observatory).	12 7	−78.0	238.6	+9.5	9		
		+41.0	357.6	−16.5		509	518
Mar. 11 (Naval Observatory).	15 56	−64.5	236.8	+9.0		46	
		+59.0	0.3	−16.0		494	540
Mar. 12 (Naval Observatory).	10 56	−53.5	237.4	+9.5		31	
		+70.0	0.9	−16.0		370	401
Mar. 13 (Naval Observatory).	11 10	−63.0	214.6	+15.5		185	
		−42.0	235.6	+9.5	12		
		+84.0	1.6	−16.0		386	583
Mar. 14 (Naval Observatory).	10 51	−50.0	214.6	+16.0		93	
		−31.5	233.1	+11.0		22	
		−24.5	240.1	−10.5	3		118
Mar. 15 (Naval Observatory).	11 17	−35.0	216.2	+16.5		31	
		−23.0	228.2	+23.5		31	
		−17.5	233.7	+10.0		31	93
Mar. 16 (Naval Observatory).	10 58	−32.0	206.2	−7.5		6	
		−19.0	219.2	+16.5		31	
		−10.0	228.2	+24.0		31	
		−6.5	231.7	+11.5		370	438
Mar. 17 (Naval Observatory).	11 6	−35.5	189.4	+7.0	15		
		−15.0	209.9	−0.5		62	
		−5.5	219.4	+16.5		19	
		+2.5	227.4	+22.5	6		
		+8.0	232.9	+11.5		494	596
Mar. 18 (Naval Observatory).	11 2	−21.5	190.3	+7.5	12		
		−1.5	210.3	−1.0		93	
		+8.5	220.3	+16.5	3		
		+20.0	231.8	+12.0		370	478
Mar. 19 (Naval Observatory).	11 8	−7.5	191.0	+7.5	12		
		+12.5	211.0	−1.0		93	
		+34.5	233.0	+11.5		340	445
Mar. 20 (Naval Observatory).	11 9	−78.0	107.3	+6.0	62		
		+6.0	191.3	+7.5	9		
		+26.5	211.8	−1.0		77	
		+48.0	233.3	+11.5		216	364
Mar. 21 (Naval Observatory).	11 0	−65.0	107.2	+6.5	12		
		+19.5	191.7	+7.5	3		
		+42.0	214.2	0.0	15		
		+61.5	233.7	+11.5		185	215
Mar. 22 (Naval Observatory).	13 44	−73.5	84.0	+11.0	123		
		−50.0	107.5	+6.0	9		
		+39.5	197.0	+8.5		12	
		+57.0	214.5	0.0	31		
		+80.5	238.0	+10.0	123		298
Mar. 23 (Naval Observatory).	10 58	−61.0	84.9	+11.0	123		
		−31.5	114.4	+2.0		15	
		+20.0	165.9	−5.0	15		
		+69.0	214.9	0.0	6		159
Mar. 24 (Naval Observatory).	11 1	−73.0	59.7	+10.0	77		
		−48.0	84.7	+11.0	123		
		−18.0	114.7	+2.0		15	215
Mar. 25 (Naval Observatory).	12 41	−58.5	60.1	+9.5	62		
		−34.0	84.6	+10.5	108		170

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard civil time	Heliographic: Diff. long.	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day
	h m	°	°	°			
Mar. 26 (Naval Observatory).	11 47	−80.5	25.4	−4.0	216		
		−45.5	60.4	+9.5	31		
		−32.0	73.9	+8.5		6	
		−21.0	84.9	+10.5	93		346
Mar. 27 (Naval Observatory).	11 1	−68.5	24.6	−3.0		340	
		−32.5	60.6	+10.5	31		
		−8.0	85.1	+10.5	62		433
Mar. 28 (Naval Observatory).	11 15	−55.0	24.8	−3.5		340	
		−19.5	60.3	+10.0	34		
		−5.0	74.8	+9.0		6	
		+5.0	84.8	+10.0		34	414
Mar. 29 (Naval Observatory).	11 4	−41.0	25.7	−4.0	293		
		−7.0	59.7	−17.5		49	
		−6.0	60.7	+9.0		37	
		+18.5	85.2	+10.0	25		404
Mar. 30 (Naval Observatory).	11 19	−30.0	23.4	−5.0		386	
		+7.0	60.4	−18.0		62	
		+9.0	62.4	+9.5		34	
		+31.5	84.9	+10.0	12		494
Mar. 31 (Naval Observatory).	11 7	−17.0	23.3	−5.0		509	
		+21.0	61.3	−16.5		43	
		+23.5	63.8	+9.5		56	608
Mean daily area for March							516

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR MARCH, 1930 [1]

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

March, 1930	Relative numbers	March, 1930	Relative numbers	March, 1930	Relative numbers
1	a 23	11	17	21	37
2	24	12	30	22	d
3	28	13	26	23	7
4	54	14	17	24	23
5	55	15	Ec 28	25	17
6	50	16	Mc 44	26	d
7	b 50	17	b 49	27	36
8	b 49	18	a 44	28	a 31
9	53	19		29	30
10	28	20	32	30	Mc 52
				31	52

Mean, 28 days=35.0.

[1] Dependent alone on observations at Zurich and its station at Arosa.
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 large or average-sized 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 RICHMOND T. ZOCH

Except for the levels close to the surface at Ellendale, free-air temperatures were below normal at all levels at all of the aerological stations.

Relative humidity departures were positive in the upper levels at Due West and Groesbeck and in the lower levels at Royal Center. Elsewhere they were negative.

Free-air vapor pressures were mostly below normal.

The resultant winds were variable at the 500 and 1,000 meter levels. At the 1,500 to 3,000 meter levels they were northwesterly throughout the northern and eastern part of the country. Above the 4,000-meter level they were northwesterly over the entire country.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during March, 1930*

TEMPERATURE (° C.)

Altitude (meters) m. s. l.	Broken Arrow, Okla. (233 meters): Mean	Broken Arrow: Departure from normal	Due West, S. C. (217 meters): Mean	Due West: Departure from normal	Ellendale, N. Dak. (444 meters): Mean	Ellendale: Departure from normal	Groesbeck, Tex. (141 meters): Mean	Groesbeck: Departure from normal	Royal Center, Ind. (225 meters): Mean	Royal Center: Departure from normal
Surface	7.7	−2.3	8.5	−3.2	−1.4	+0.6	12.0	−1.3	1.4	−2.9
500	6.6	−1.7	7.0	−2.8	−1.9	+0.3	10.5	−1.1	0.1	−2.0
1,000	4.8	−1.5	4.1	−3.1	−4.0	−0.5	8.8	−1.3	−2.2	−2.4
1,500	3.1	−1.7	1.6	−3.2	−5.9	−1.3	7.0	−1.8	−4.2	−3.0
2,000	0.5	−2.5	−1.1	−3.6	−8.0	−1.6	5.3	−2.0	−5.9	−3.0
2,500	−2.3	−3.0	−3.5	−3.7	−10.6	−1.8	3.1	−2.0	−7.9	−2.7
3,000	−5.2	−3.4	−5.3	−3.4	−12.7	−1.1	0.7	−1.8	−10.3	−2.7
4,000	−10.0	−2.9	−9.1	−2.3	−18.5	−1.5	−4.5	−1.2	−15.2	−2.6
5,000	−16.8	−2.9	−14.4	−1.5	−25.3	−2.4			−22.3	−3.5

RELATIVE HUMIDITY (%)

Altitude (meters) m. s. l.	Broken Arrow: Mean	Broken Arrow: Departure from normal	Due West: Mean	Due West: Departure from normal	Ellendale: Mean	Ellendale: Departure from normal	Groesbeck: Mean	Groesbeck: Departure from normal	Royal Center: Mean	Royal Center: Departure from normal
Surface	58	−6	63	−1	66	−7	71	0	74	+3
500	57	−5	60	−2	66	−6	66	−1	71	+1
1,000	54	−5	59	−2	60	−4	62	+2	68	+4
1,500	47	−5	58	−2	55	−3	55	+4	59	+2
2,000	44	−2	57	+1	50	−6	48	+5	51	−3
2,500	41	−1	54	+3	50	−6	47	+8	46	−6
3,000	40	0	50	+6	47	−10	49	+12	48	−4
4,000	35	−2	46	+5	48	−5	50	+12	39	−10
5,000	25	−2	54	+7	47	−6			39	−15

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during March, 1930*—Continued

VAPOR PRESSURE (*mb.*)

Altitude (meters) m. s. l.	Broken Arrow, Okla. (233 meters): Mean	Broken Arrow: Departure from normal	Due West, S. C. (217 meters): Mean	Due West: Departure from normal	Ellendale, N. Dak. (444 meters): Mean	Ellendale: Departure from normal	Groesbeck, Tex. (141 meters): Mean	Groesbeck: Departure from normal	Royal Center, Ind. (225 meters): Mean	Royal Center: Departure from normal
Surface	6.49	−1.73	7.48	−1.87	3.71	−0.23	10.25	−1.32	5.13	−1.21
500	6.03	−1.19	6.52	−1.66	3.59	−0.24	8.87	−1.07	4.57	−0.84
1,000	4.95	−0.98	5.32	−1.50	2.72	−0.30	7.28	−0.74	3.76	−0.59
1,500	3.82	−0.95	4.33	−1.24	2.15	−0.40	5.79	−0.30	2.80	−0.71
2,000	2.91	−0.79	3.56	−0.80	1.69	−0.46	4.62	+0.22	2.16	−0.80
2,500	2.06	−0.88	2.66	−0.64	1.34	−0.44	3.92	+0.52	1.60	−0.86
3,000	1.69	−0.68	2.02	−0.27	1.05	−0.39	3.40	+0.70	1.43	−0.70
4,000	1.10	−0.36	1.51	+0.17	0.71	−0.16	1.63	−0.23	0.81	−0.56
5,000	0.98	−0.36	1.42	+0.30	0.33	−0.23			0.59	−0.47

TABLE 2.—*Free-air data determined at Naval air stations during March, 1930*

Altitude (meters) m. s. l.	Temperature (°C.): Pensacola, Fla.	Temperature: San Diego, Calif.	Temperature: Washington, D. C.	Relative humidity (%): Pensacola, Fla.	Relative humidity: San Diego, Calif.	Relative humidity: Washington, D. C.
Surface	9.6	16.4	4.4	73	64	64
500	8.6	15.4	3.4	59	59	56
1,000	6.3	13.9	1.2	46	51	55
2,000	1.6	7.9	−4.1	41	42	58
3,000	−1.3	1.3	−7.9	32	34	46
4,000						
5,000						