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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS DURING MAY, 1929

By HERBERT H. KIMBALL

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 slightly below normal values for May at all three stations at which measurements are made.

Table 2 shows a deficiency in the total radiation received on a horizontal surface at Lincoln, as compared with the May normal, and an excess at Washington, Madison, Chicago, and New York.

Skylight polarization measurements obtained on six days at Washington give a mean of 51 per cent with a maximum of 60 per cent on the 7th. These are close to the corresponding averages for May at Washington. At Madison measurements obtained on nine days give a mean of 54 per cent, with a maximum of 63 per cent on the 7th. These are only slightly below the corresponding average for May at Madison.

TABLE 1.—*Solar radiation intensities during May, 1929*

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

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.*
Washington, D. C.											
May 7	7.87					1.33	1.09	0.90	0.71		6.02
May 8	3.99			0.81	1.03	1.20					4.37
May 10	3.99				0.94	1.27	0.93	0.72	0.56	0.46	4.57
May 16	14.10				0.99						15.11
May 17	3.81	0.74	0.85	1.03	1.20	1.38					3.99
May 22	7.29		0.62	0.77	0.99	1.23	0.92				3.30
May 23	7.87			0.71	0.86	1.19					6.27
May 27	12.24				0.59						16.79
May 31	16.79			0.47	0.73						16.79
Means		(0.74)	(0.74)	0.76	0.92	1.27	0.98	(0.81)	(0.64)	(0.46)	
Departures		+0.10	+0.03	−0.05	−0.06	−0.01	−0.01	+0.02	−0.02	−0.12	
Madison, Wis.											
May 4	3.15			1.01	1.20	1.42					4.37
May 7	3.15				1.23	1.44					3.63
May 9	4.37		0.67	0.86	1.09	1.34					3.00
May 15	11.81				1.04	1.34					15.11
May 16	3.81				1.06	1.34					3.30
May 19	3.45				1.20						3.99
May 20	3.30					1.36					2.62
May 21	5.16				1.07						5.56
May 22	15.65				1.00	1.26					5.36
May 24	6.76				1.10	1.28					4.75
May 25	5.79				0.98	1.20					8.48
Means			(0.67)	(0.94)	1.10	1.33					
Departures			−0.23	−0.01	−0.01	−0.03					
Lincoln, Nebr.											
May 2	3.45			1.11	1.22	1.49					3.45
May 13	7.87				0.76						7.04
May 14	8.81					1.37	1.13	0.96			11.38
May 15	13.61						1.15	0.94	0.80		5.79
May 16	4.37		0.91	1.01	1.20	1.41					3.81
May 21	7.29			0.68	0.93	1.27					7.04
May 24	8.48				0.88						12.24
May 25	10.97			0.91	1.08	1.28					10.59
Means			(0.91)	0.93	1.01	1.36	(1.14)	(0.95)	(0.80)		
Departures			+0.10	−0.01	−0.11	−0.02	+0.03	+0.02	+0.01		

[1] Extrapolated.

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter or horizontal surface]

Week beginning—	Average daily radiation							Average daily departure from normal				
	Washington	Madison	Lincoln	Chicago	New York	Twin Falls	Fresno	Washington	Madison	Lincoln	Chicago	New York
1929	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Apr. 30	339	463	414	154	274	646	724	−111	+11	−66	−201	−79
May 7	564	467	421	365	453	626	685	+107	−1	−66	−12	+99
May 14	425	471	588	448	318	[1] 823	614	−38	−2	+73	+64	−53
May 21	554	494	495	466	432	[1] 745	713	+72	+10	−33	+64	+35
May 28	545	581	321	432	432		742	+46	+94	−205	+15	+8
Excess or deficiency since first of year on June 3								−665	−1,057	−698	+1,029	−2,758

[1] 6-day mean.

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, 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	
1929	*h. m.*	°	°	°			
May 1 (Naval Observatory).	12 20	−63.0	64.8	+12.5	15		
		−40.5	87.3	−21.0		123	
		−34.0	93.8	−8.5		231	
		−25.5	102.3	−1.0		231	
		+9.0	136.8	+14.5		77	677
May 2 (Naval Observatory).	11 33	−51.0	64.0	+12.5		34	
		−47.5	67.5	−6.5		9	
		−28.0	87.0	−21.0		185	
		−21.0	94.0	−8.5		216	
		−12.0	103.0	−1.0		216	
		+22.0	137.0	+14.5		68	728
May 3 (Naval Observatory).	11 43	−69.5	32.2	−21.0	6		
		−37.0	64.7	+12.5		25	
		−14.0	87.7	−21.0		154	
		−7.0	94.7	−8.0		262	
		−2.5	99.2	+16.0		25	
		+2.0	103.7	−1.5		247	
		+34.5	136.2	+15.0	37		756
May 4 (Naval Observatory).	11 15	−52.0	36.7	−21.0	6		
		−1.0	87.7	−20.0		37	
		+6.0	94.7	−8.5		216	
		+12.5	101.2	+16.0		93	
		+16.5	105.2	−1.5		231	
		+47.5	136.2	+14.0	31		614
May 5 (Naval Observatory).	14 12	−68.0	5.9	+16.5	77		
		+21.5	95.4	−9.0		201	
		+26.0	99.9	+15.5		216	
		+31.0	104.9	−1.0		247	
		+61.5	135.4	+14.5	25		766
May 6 (Naval Observatory).	11 8	−74.5	347.9	+3.5	62		
		−69.5	352.9	+6.5	6		
		−56.5	5.9	+16.0		77	
		+33.0	95.4	−9.0		139	
		+38.0	100.4	+15.5		278	
		+43.5	105.9	−1.5		231	793
May 7 (Naval Observatory).	11 41	−61.0	347.8	+4.5	93		
		−39.5	9.3	+16.0	46		
		−37.0	11.8	+9.0	6		
		−27.0	21.8	−9.5		46	
		+41.5	90.3	−18.5		77	
		+46.5	95.3	−9.5		123	
		+52.0	100.8	+15.5		262	
		+57.0	105.8	−1.0		231	884
May 8 (Naval Observatory).	11 31	−76.5	319.2	+5.5	185		
		−46.5	349.2	+4.0	77		
		−26.5	9.2	+15.5		62	
		−12.5	23.2	−9.5		77	
		+61.5	97.2	−8.5		154	
		+65.5	101.2	+16.5		170	
		+70.5	106.2	−0.5		247	972
May 8 (Naval Observatory).	15 31	−74.0	319.5	+5.0	185		
		−71.5	322.0	−5.5	46		
		−44.5	349.0	+4.0	46		
		−24.5	9.0	+15.5		77	
		−10.0	23.5	−9.5		77	
		+57.0	90.5	−17.5		66	
		+63.0	96.5	−8.5		139	
		+66.0	99.5	+16.5		231	
		+72.0	105.5	−0.5		216	1,083

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	
1929	h. m.	°	°	°			
May 9 (Naval Observatory).	13 15	−62.5	319.0	+5.0	185		
		−59.0	322.5	−6.0	15		
		−32.0	349.5	+4.5	46		
		−11.0	10.5	+15.0	62		
		+2.0	23.5	−10.0		93	
		+76.5	98.0	−8.5		108	
		+76.5	98.0	+8.5	108		617
May 10 (Naval Observatory).	11 39	−48.5	320.7	+4.5	201		
		−19.0	350.2	+4.0	46		
		+0.5	9.7	+15.5		123	
		+14.5	23.7	−9.5		123	493
May 11 (Naval Observatory).	11 42	−49.0	306.9	+4.5	3		
		−36.0	319.9	+4.5	185		
		−6.0	349.9	+4.0	46		
		+13.5	9.4	+14.5		123	
		+27.0	22.9	−11.0		139	
		+44.0	39.9	+9.0		22	518
May 12 (Naval Observatory).	11 31	−22.5	320.3	+5.0	185		
		+8.0	350.8	+4.0	46		
		+29.0	11.8	+14.5	108		
		+41.0	23.8	−10.0		340	679
May 13 (Mount Wilson).	9 30	−78.0	252.8	−5.0	45		
		−45.0	285.8	−13.0		8	
		−10.0	320.8	+4.0		254	
		+20.0	350.8	+4.0		50	
		+30.0	0.8	−10.0		8	
		+42.0	12.8	+14.0	152		
		+54.0	24.8	−10.0		449	966
May 14 (Naval Observatory).	11 57	−68.5	247.6	+21.0	9		
		−60.5	255.6	−5.0	62		
		+4.5	320.6	+5.0	185		
		+34.5	350.6	+4.0	31		
		+55.0	11.1	+14.5		123	
		+68.0	24.1	−10.0		463	873
May 15 (Naval Observatory).	11 58	−56.5	246.4	+21.0		46	
		−56.0	246.9	+11.0	15		
		−47.0	255.9	−5.5	31		
		+18.0	320.9	+5.0	185		
		+48.0	350.9	+4.0	31		
		+62.0	4.9	−8.5	9		
		+68.0	10.9	+14.5		170	
		+83.0	25.9	−9.5		664	1,151
May 16 (Naval Observatory).	13 16	−43.0	246.0	+11.5		46	
		−42.5	246.5	+21.5	12		
		−33.0	256.0	−5.0	15		
		−22.0	267.0	+10.5	15		
		+32.0	321.0	+5.5	170		
		+62.5	351.5	+4.5	25		
		+83.0	12.0	+14.5	185		468
May 17 (Naval Observatory).	11 40	−31.0	245.6	+21.5	15		
		−30.0	246.6	+11.0		62	
		−20.5	256.1	−5.0	25		
		−9.0	267.6	+10.5		93	
		+45.0	321.6	+5.0	154		
		+74.0	350.6	+4.5	31		380
May 18 (Naval Observatory).	11 33	−18.5	244.9	+21.0	12		
		−18.0	245.4	+11.5		31	
		−8.5	254.9	−5.5		46	
		+4.5	267.9	+10.0		77	
		+58.0	321.4	+5.0	123		289
May 19 (Naval Observatory).	11 41	−4.0	246.1	+11.5		62	
		+4.0	254.1	−7.0	9		
		+18.5	268.6	+10.0		62	
		+38.5	288.6	−10.0		22	
		+71.0	321.1	+5.0	123		278
May 20 (Mount Wilson).	13 15	+11.0	247.1	+10.0		20	
		+33.0	269.1	+10.0		15	
		+85.0	321.1	+4.0	147		182
May 21 (Naval Observatory).	12 24	+23.5	246.8	+11.0		46	
		+47.0	270.3	+11.5		37	83
May 22 (Naval Observatory).	11 43	−75.5	134.9	+13.5	262		
		+36.0	246.4	−4.5	6		
		+37.5	247.9	+11.5		37	
		+47.0	257.4	+6.5	3		308

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	
1929	h. m.	°	°	°			
May 23 (Naval Observatory).	11 41	−64.0	133.2	+13.5		586	
		−34.5	162.7	+20.5		15	
		+50.5	247.7	−6.0		31	
		+55.0	252.2	+12.5	25		657
May 24 (Naval Observatory).	11 51	−76.0	107.9	+15.0	15		
		−52.0	131.9	+13.0		540	
		−21.0	162.9	+20.5		123	
		+63.5	247.4	−6.0	22		700
May 25 (Naval Observatory).	11 38	−74.5	96.3	+17.5	93		
		−62.5	108.3	+14.5	28		
		−38.0	132.8	+13.5		525	
		−7.0	163.8	+21.0		231	
		+17.0	187.8	+11.0		25	
		+34.5	205.3	+15.0	6		
		+80.5	251.3	−6.5		62	970
May 26 (Naval Observatory).	11 20	−60.5	97.2	+17.5	77		
		−48.5	109.2	+14.5	6		
		−22.5	135.2	+13.5		463	
		+6.5	164.2	+21.5		185	
		+48.5	206.2	+14.5		31	762
May 27 (Naval Observatory).	11 45	−47.0	97.3	+17.5	62		
		−35.0	109.3	+14.5	3		
		−8.5	135.8	+14.0		448	
		+21.0	165.3	+21.0		123	636
May 28 (Naval Observatory).	12 1	−33.5	97.4	+17.0	46		
		+5.5	136.4	+14.5		355	
		+35.0	165.9	+21.5		401	802
May 29 (Harvard).	12 7	−21.0	96.5	+17.5		67	
		+11.5	129.0	+13.0	78		
		+19.0	136.5	+15.0		520	
		+41.5	159.0	+20.0		22	
		+52.0	169.5	+22.0	82		769
May 30 (Naval Observatory).	11 16	−7.5	97.3	+17.0		46	
		+31.5	136.3	+14.5		324	
		+63.5	168.3	+21.5	15		385
May 31 (Naval Observatory).	11 18	−86.0	5.6	+13.5		93	
		+6.0	97.6	+17.0		46	
		+6.5	98.1	−12.0	9		
		+45.0	136.6	+14.5	370		518
Mean daily area for May							636

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR MAY, 1929

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

May, 1929	Relative numbers	May, 1929	Relative numbers	May, 1929	Relative numbers
1	[1] 65	11	52	21	30
2	94	12	48	22 [4]	34
3	M [2,3] 88	13	76	23	30
4	[1] 74	14	[1] 71	E [3] 24	49
5	74	15	73	25	61
6	83	16	E [2,3] 73	26 [1]	59
7	E [3] 71	17	53	27	59
8	[4] 79	18	[1] 47	28 [2]	59
9		19	28	29	35
10	[1,1] 62	20	[1] 32	30	35
				31	34

Mean, 30 days: 57.6.

[1] Passage of an average-size group through the central meridian.
[2] Passage of a large group through the central meridian.
[3] New formation of a large or average-sized center of activity: E, on the eastern part of the sun's disc; W, on the western part; M, in the central zone.
[4] Entrance of a large or average-sized center of activity on the east limb