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SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING OCTOBER, 1929

By HERBERT H. KIMBALL, Solar Radiation Investigations

For a description of instruments and exposures, and an account of the method of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1929, **57**: 26.

Table 1 shows that solar radiation intensities averaged below the normal values for October at Madison, Wis., and Lincoln, Nebr., and close to normal at Washington, D. C.

Table 2 shows an excess in the total solar radiation (direct + diffuse) received on a horizontal surface at Washington, close to normal at Madison, and a deficiency at Lincoln, Chicago, and New York.

Skylight polarization measurements obtained on nine days at Washington give a mean of 53 per cent and a maximum of 66 per cent on the 17th. At Madison, measurements obtained on seven days give a mean of 60 per cent, with a maximum of 70 per cent on the 17th. The mean values obtained at the two stations are below their respective October normals, but their maximum values are close to their respective average maxima.

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

[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.*
Oct. 8	6.27	0.57	0.76	0.96	1.18	1.45					4.57
Oct. 9	4.95					1.00	0.83	0.69	0.48		4.17
Oct. 11	5.79	0.66	0.75	0.86							4.75
Oct. 12	7.29		0.76	0.92	1.07						7.87
Oct. 16	6.76	0.51									7.57
Oct. 17	6.02	0.78	0.86	0.90	1.04		1.18	1.12	0.94	0.84	3.99
Oct. 18	3.45	0.90	0.97	1.09	1.26	1.46	1.14	0.95	0.83	0.76	3.45
Oct. 19	6.02	0.79	0.86	1.02	1.13		1.05	0.87	0.71		3.15
Oct. 23	7.29	0.89	0.98	1.05	1.19		1.18	0.98	0.79	0.65	6.50
Oct. 24	6.76	0.57	0.69	0.86	1.06						4.37
Oct. 26	5.16	0.80	0.90	1.05	1.25	1.51	1.20	1.03	0.89		3.30
Oct. 28	5.56		0.92	1.02	1.14						4.95
Means		0.72	0.84	0.97	1.15	1.36	1.10	0.94	0.77	0.75	
Departures		−0.04	±0.00	+0.02	+0.04	−0.05	−0.01	+0.01	−0.03	+0.05	

Madison, Wis.

Oct. 1	6.50				1.21						4.57
Oct. 2	6.50		0.72	0.86	1.02						6.76
Oct. 5	5.16		0.83	1.00	1.15						7.04
Oct. 7	6.27		0.82	0.91	1.03	1.39					5.16
Oct. 8	5.79		0.71	0.85	1.12	1.34					4.17
Oct. 14	6.02	0.77	0.89	1.04		1.34	1.18				6.02
Oct. 15	7.04			0.88	1.14		1.23				10.21
Oct. 16	8.81			1.07	1.25	1.46					6.27
Oct. 17	6.27	0.80			1.16		1.23				4.75
Oct. 18	5.16	0.75	0.84	0.97							5.79
Oct. 21	5.16			0.93							5.36
Oct. 24	4.57				1.44						4.37
Oct. 25	3.81			1.04							5.16
Means		0.77	0.89	0.96	1.17	1.38	1.21				
Departures		−0.01	−0.13	−0.09	−0.02	−0.02	+0.02				

Lincoln, Nebr.

Oct. 5	9.14								0.84	0.71	9.83
Oct. 7	6.76					1.39	1.12	0.83	0.77		7.87
Oct. 12	5.79		0.98	1.10	1.27	1.44	1.25	1.08	0.89	0.78	6.02
Oct. 13	9.14						1.22	0.99	0.92	0.80	8.81
Oct. 14	9.47		0.74	0.90	1.08		1.17	1.02	0.90	0.78	12.24
Oct. 16	10.59		0.99	1.12	1.29	1.50	1.26	1.06	0.93	0.81	10.21
Oct. 17	7.04		0.89	1.05	1.22	1.41	1.13	0.93	0.77	0.66	9.83
Oct. 24	4.17			1.12	1.29						5.36
Oct. 25	4.17			1.17	1.37		1.33	1.20	1.08	0.94	4.95
Oct. 26	4.17	0.59	0.72	1.03	1.22		1.30	1.09	0.98	0.80	5.56
Means		(0.59)	0.86	1.07	1.25	1.44	1.22	1.02	0.90	0.78	
Departures		−0.28	−0.08	−0.03	−0.03	−0.04	−0.03	−0.06	−0.05	−0.05	

[1] Extrapolated.

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

[Gram-calories per square centimeter of horizontal surface]

Week beginning	Average daily radiation								Average daily departure from normal				
	Washington	Madison	Lincoln	Chicago	New York	Twin Falls	Fresno	La Jolla	Washington	Madison	Lincoln	Chicago	New York
1929	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Oct. 1	252	323	302	236	150	459	423	374	−69	+51	−24	+22	−97
Oct. 8	402	189	206	147	247	407	432	293	+100	−58	−94	−42	±0
Oct. 15	308	245	285	193	221	349	388	217	+34	+22	−17	+25	+23
Oct. 22	272	188	288	120	180	343	349	281	+8	−17	+18	−39	−8
Excess or deficiency since first of year on Oct. 28									+6,300	−553	−4,122	−686	−5,943

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.*	°	°	°			
Oct. 1 (Mount Wilson)	12 45	−45.0	219.5	+10.0		185	
		+15.0	279.5	+11.0		254	
		+52.0	316.5	+14.0		11	450
Oct. 1 (Yerkes)	9 56	−50.5	215.6	+12.8		133	
		−47.3	218.8	+10.5	24		
		−44.8	221.3	+11.3		121	
		−43.3	222.8	+9.9		54	
		−39.3	226.8	+10.8	17		
		+8.8	274.9	+8.7	27		
		+9.6	275.7	+10.2		141	
		+10.2	276.3	+10.1	20		
		+10.8	276.9	+10.0	20		
		+11.2	277.3	+12.3	31		
		+16.2	282.3	+10.4		173	
		+20.1	286.2	+10.5	97		
		+52.2	318.3	+12.9	14		872
Oct. 2 (Mount Wilson)	13 15	−30.0	221.0	+11.0		248	
		+30.0	281.0	+12.0		216	
		+68.0	319.0	+15.0		22	486
Oct. 2 (Yerkes)	15 37	−36.2	213.5	+13.1		106	
		−33.2	216.5	+10.3	16		
		−28.6	221.1	+10.7		377	
		−25.7	224.0	+11.5		147	
		−22.8	226.9	+11.0		215	
		+23.8	273.5	+9.4	22		
		+24.9	274.6	+10.7		117	
		+28.9	278.6	+10.7	15		
		+34.1	283.8	+11.0	104		
		+36.0	285.7	+11.7	123		
		+67.0	316.7	+13.2	20		1,262
Oct. 3. (Naval Observatory).	10 38	−52.0	187.3	+13.5		15	
		−25.5	213.8	+12.0		62	
		−15.0	224.3	+10.5		340	
		+42.0	281.3	+10.5		185	
		+79.0	318.3	+12.5		62	664
Oct. 4 (Naval Observatory).	11 44	−38.0	187.5	+12.5	6		
		−12.0	213.5	+12.5		46	
		−1.0	224.5	+10.0		370	
		+57.0	282.5	+10.5		154	576
Oct. 5 (Naval Observatory).	12 13	−38.0	174.0	−5.0		22	
		−24.0	188.0	+13.0		31	
		+2.0	214.0	+13.0		18	
		+13.0	225.0	+10.0		401	
		+70.5	282.5	+11.0		154	626
Oct. 6 (Naval Observatory).	10 31	−55.0	144.8	−19.5		55	
		−31.0	168.8	−8.0	6		
		−12.5	187.3	+13.5		52	
		+26.0	225.8	+10.5		386	
		+83.0	282.8	+11.5		139	638
Oct. 7 (Naval Observatory).	10 44	−76.0	110.5	−10.5	324		
		−73.0	113.5	+5.0		46	
		−42.5	144.0	−18.5		62	
		+2.0	188.5	+14.0		25	
		+39.5	226.0	+11.0		417	874
Oct. 8 (Naval Observatory).	10 52	−62.5	110.7	−10.5	340		
		−57.5	115.7	+4.5		139	
		−30.0	143.2	−20.0		170	
		+16.0	189.2	+13.5		12	
		+55.0	228.2	+11.5		432	1,003

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.	°	°	°			
Oct. 9 (Naval Observatory).	10 32	−49.5	110.7	−11.0	478		
		−45.0	115.2	+4.5		170	
		−15.5	144.7	−20.0		201	
		+10.5	170.7	−8.5		22	
		+69.0	229.2	+11.0		494	1,365
Oct. 10 (Naval Observatory).	10 43	−36.0	110.9	−11.0	494		
		−31.0	115.9	+4.0		231	
		−2.0	144.9	−20.0		355	
		+23.0	169.9	−8.5		77	
		+82.0	228.9	+11.5		478	1,635
Oct. 11 (Naval Observatory).	10 45	−22.5	111.2	−11.0	463		
		−17.5	116.2	+4.0		340	
		+11.5	145.2	−20.0		556	
		+36.0	169.7	−8.0		15	1,374
Oct. 12 (Naval Observatory).	10 42	−9.0	111.5	−11.0	448		
		−4.5	116.0	+4.0		417	
		+25.0	145.5	−19.5		741	1,606
Oct. 13 (Naval Observatory).	10 42	+4.0	111.3	−11.0	432		
		+9.5	116.8	+4.0		355	
		+38.0	145.3	−20.0		617	1,404
Oct. 14 (Naval Observatory).	10 54	+17.5	111.5	−11.0	556		
		+22.5	116.5	+4.5		309	
		+50.5	144.5	−20.0		694	1,559
Oct. 15 (Naval Observatory).	13 30	+31.5	110.9	−11.0	571		
		+38.0	117.4	+4.5		278	
		+66.0	145.4	−21.0		617	1,466
Oct. 16 (Naval Observatory).	10 47	+43.5	111.2	−11.0	540		
		+51.0	118.7	+4.0		216	
		+78.0	145.7	−21.0		556	1,312
Oct. 17 (Naval Observatory).	10 42	−3.0	51.6	−12.0		22	
		+57.5	112.1	−11.5	586		
		+68.0	122.6	+3.0		185	793
Oct. 18 (Naval Observatory).	13 14	−73.0	327.0	+12.0	9		
		−3.0	37.0	−9.0		18	
		+10.5	50.5	−12.5	9		
		+71.5	111.5	−12.5	617		
		+82.5	122.5	+2.0	170		823
Oct. 19 (Naval Observatory).	10 41	−61.5	326.7	+11.5	6		
		+10.0	38.2	−9.0		18	
		+23.5	51.7	−11.5		12	
		+84.5	112.7	−11.0	617		653
Oct. 20 (Naval Observatory).	10 39	−54.0	321.0	+8.0	6		
		+24.0	39.0	−9.0		31	
		+38.0	53.0	−11.0		68	105
ct. 21 (Naval Observatory).	11 9	−72.0	289.6	+12.0	68		
		+38.5	40.1	−9.5	9		
		+52.5	54.1	−10.5		46	123
Oct. 22 (Naval Observatory).	14 14	−57.5	289.2	+11.5	46		
		+68.5	55.2	−11.5	6		52
Oct. 23 (Naval Observatory).	10 40	−46.5	289.0	+11.5	46		
		+33.5	9.0	−15.5		12	58
Oct. 24 (Naval Observatory).	10 46	−83.0	239.2	+9.0		231	
		−34.0	288.2	+11.5		46	277
Oct. 25 (Naval Observatory.	11 29	−71.0	237.6	+8.5		494	
		−20.5	288.1	+10.5		18	
		+17.0	325.6	+9.0	3		515
Oct. 26 (Naval Obesrvatory).	10 39	−59.0	236.9	+8.5		586	
		−32.5	263.4	+13.5		18	
		−8.5	287.4	+12.0		9	
		+30.0	325.9	+8.5		25	638

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.	°	°	°			
Oct. 27 (Naval Observatory).	10 41	−46.5	236.2	+9.0		540	
		−18.0	264.7	+13.5		216	
		+4.0	286.7	+11.5		12	
		+40.5	323.2	+9.5		77	845
Oct. 28 (Naval Observatory).	10 41	−54.5	215.0	−21.5		12	
		−33.5	236.0	+9.0		586	
		−4.0	265.5	+13.0		355	
		+53.5	323.0	+8.5	31		
		+71.0	340.5	−11.0		22	1,006
Oct. 29 (Mount Wilson).	12 40	−71.0	184.2	+15.0	8		
		−20.0	235.2	+10.0		940	
		+10.0	265.2	+15.0		680	
		+68.0	323.2	+11.0	6		1,634
Oct. 30 (Mount Wilson).	13 15	−69.0	172.7	+3.0	10		
		−60.0	181.7	+15.0		29	
		−5.0	236.7	+10.0		1,218	
		+22.0	263.7	+15.0		236	1,493
Oct. 31 (Naval Observatory).	14 19	−53.5	174.4	+4.0	12		
		−46.5	181.4	+16.0		93	
		+9.5	237.4	+9.5		571	
		+36.5	264.4	+13.5		293	969
Mean daily area for October, Naval Observatory and Mount Wilson.							875
Mean daily area for October, Naval Ovservatory and Yerkes.							913

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR OCTOBER, 1929 [1]

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

October, 1929	Relative numbers	October, 1929	Relative numbers	October, 1929	Relative numbers
1	47	11	77	21	32
2	53	12	b 79	22	22
3	64	13	b 78	23	33
4	b 55	14	63	24	d 17
5	55	15	56	25	
6	Ec 64	16	40	26	Mc 36
7	d 74	17	37	27	Mc 68
8	68	18	26	28	a 97
9	76	19	18	29	57
10	b 84	20	19	30	b 76
				31	Ec 69

Mean, 30 days=54.7.

[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 ativity on the east limb.

AEROLOGICAL OBSERVATIONS

By RICHMOND T. ZOCH

Free-air temperatures were below normal at all levels at Broken Arrow, Due West, and Groesbeck and in the lower levels at Royal Center. Free-air temperatures in the upper levels at Royal Center and at all levels at Ellendale were above normal. (See Table 1.)

Free-air relative humidity departures were variable at all of the aerological stations excepting Broken Arrow, where there was a large positive departure at all levels. Vapor-pressure departures also were variable at all stations excepting Broken Arrow, where they were above normal.

In the lower levels the resultant winds had a southerly component except in the Southeastern States. (See Table 3.) Above 1,000 meters the resultant winds were from the northwest east of the Rocky Mountains. On the Pacific coast the resultant winds were variable.

The kite flight at Ellendale on October 15 is very interesting, in that there was a pronounced inversion up to 107 meters above the surface. Through this stratum the temperature rose 17.4° C., a remarkable increase for this season of the year. A well-defined mirage was observed at the time of this observation.