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SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING SEPTEMBER, 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 September at Madison, Wis., and close to normal at Washington, D. C., and Lincoln, Nebr.

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

Skylight polarization measurements obtained on five days at Washington give a mean of 51 per cent and a maximum of 56 per cent on the 24th. At Madison, measurements obtained on seven days give a mean of 50 per cent and a maximum of 69 per cent on the 18th. The values obtained at both stations are below the September averages for the respective stations.

TABLE 1.—*Solar radiation intensities during September, 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.*
Sept. 3	13.13						0.71	0.55			13.13
Sept. 7	19.89					1.09					19.23
Sept. 9	19.23			0.81	0.93						19.23
Sept. 10	16.79			0.86	1.02						17.96
Sept. 11	9.14				1.18	1.42					7.87
Sept. 12	8.18				1.11						9.83
Sept. 18	8.81						1.24				7.29
Sept. 19	4.57	0.86	0.98	1.11	1.30	1.50					4.37
Sept. 21	6.27			0.72							5.79
Sept. 24	8.81	0.77	0.89	1.03	1.18	1.33	1.06	0.91	0.75	0.62	5.36
Means		(0.82)	(0.94)	0.91	1.12	1.34	1.00	(0.73)	(0.75)	(0.62)	
Departures		+0.12	+0.19	+0.03	+0.07	+0.01	−0.05	+0.12	−0.02	−0.04	

Madison, Wis.

Sept. 3	15.11			0.44	0.63	0.90					14.60
Sept. 11	6.76		0.91	1.02	1.19	1.29					7.04
Sept. 14	6.27		0.99	1.11	1.25	1.40					5.36
Sept. 17	6.27				1.27	1.49					4.37
Sept. 18	4.95		0.95	1.14	1.31	1.51	1.27				5.36
Sept. 21	7.04			0.78	1.02						6.76
Sept. 23	6.76		0.57	0.73	0.97	1.28	1.08				8.18
Sept. 26	8.48				0.78						12.24
Means			0.86	0.87	1.05	1.31	(1.18)				
Departures			−0.05	−0.15	−0.11	−0.06	+0.02				

Lincoln, Nebr.

Sept. 13	10.59			1.04	1.26						9.14
Sept. 14	7.29		0.97	1.09	1.28	1.48			1.03	0.86	7.04
Sept. 16	7.29			1.00	1.14						6.27
Sept. 17	7.87		0.71	0.98	1.13	1.36	1.09	0.91	0.76	0.62	7.29
Sept. 23	11.38						0.84	0.70	0.64		10.21
Sept. 24	10.59						0.94				10.21
Sept. 26	12.68							0.74			13.13
Means			(0.84)	1.03	1.20	(1.42)	0.96	0.78	0.81	(0.74)	
Departures			−0.03	+0.02	+0.01	+0.02	−0.19	−0.19	−0.02	+0.01	

[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	Fresno	La Jolla	Washington	Madison	Lincoln	Chicago	New York
1929	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Sept. 3	369	314	274	296	182	582	254	−7	−52	−150	−19	−124
Sept. 10	361	338	436	297	281	529	205	−13	−4	+29	+13	−14
Sept. 17	400	437	360	281	288	425	265	+49	+98	−23	+14	+13
Sept. 24	402	267	305	149	202	490	417	+62	−23	−35	−84	−55
Excess or deficiency since first of year on Sept. 30.								+5,789	−539	−3,303	−973	−5,369

REFLECTIVITY OF DIFFERENT KINDS OF SURFACES—A CORRECTION

Dr. L. F. Richardson invites our attention to an error in our paper on the above subject in the REVIEW for July of the current volume, page 291, as follows:

"There is a definite mistake in line 25 from the beginning. You state that 'A_s' is the area of the window. Unfortunately this is hardly even roughly true. There is no short name for A_s. It is not a solid angle. It is the rather complicated idea explained in paragraph 5 (1) of the Prague report.[1]

"Perhaps the best short explanation would be to say $\frac{A_s}{A_G}=\left(\frac{\sin\ \alpha_s}{\sin\ \alpha_G}\right)^2$ where α_G is the semi-vertical angle of a cone having its vertex at the midpoint of the edge of the white wedge and bounded by the iris and where α_s is a similar angle for the sky window."

The reader is referred to the paper by Richardson, above cited, for further details.—*H. H. K. and I. F. H.*

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.*	°	°	°			
Sept. 1 (Naval Observatory).	12 5	−18.0	282.9	−12.5		15	
		−10.0	290.9	+4.5		6	21
Sept. 2 (Naval Observatory).	10 50	−4.0	284.4	−13.0		18	
		+3.5	291.9	+5.0		12	30
Sept. 3 (Naval Observatory)	10 45	−79.0	196.2	+21.5	93		
		−45.5	229.7	+12.5	6		
		−14.0	261.2	−24.5		9	
		+11.5	286.7	−11.0		15	
		+16.0	291.2	+5.0	6		129
Sept. 4 (Naval Observatory).	11 6	−65.5	196.3	+21.0	77		
		−43.5	218.3	+10.0	9		
		+2.5	264.3	−5.5	12		
		+30.0	291.8	+4.5	3		101
Sept. 5 (Naval Observatory).	11 49	−81.5	166.7	−10.0	154		
		−53.0	195.2	+20.5	62		
		−28.5	219.7	+12.5	3		
		−15.0	233.2	+17.2	3		
		+15.0	263.2	−5.0		216	438
Sept. 6 (Naval Observatory).	14 6	−67.0	166.8	−10.5	62		
		−39.0	194.8	+20.5	56		
		+7.5	241.3	−13.5		12	
		+30.5	264.3	−5.0		216	346

[1] Richardson, L. F., 1928. Report on photometers for a survey of the reflectivity of the earth's surface. Union Géodésique et Géophysique Internationale, Section de Météorologie. Troisième Assemblée Générale: Prague, 1927.

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.	°	°	°			
Sept. 7 (Naval Observatory).	10 37	−55.0	167.5	−9.5	46		
		−27.5	195.0	+21.0	40		
		−5.0	217.5	+13.5		3	
		+19.5	242.0	−13.0		6	
		+42.0	264.5	−5.0		201	
		+50.5	273.0	+10.0		46	342
Sept. 8 (Naval Observatory).	10 41	−48.5	160.8	−6.0	6		
		−42.0	167.3	−10.0	34		
		−38.0	171.3	−3.5	3		
		−14.5	194.8	+20.5	40		
		+9.5	218.8	+13.5		25	
		+14.0	223.3	+2.0		6	
		+54.5	263.8	−5.0		170	
		+65.5	274.8	+9.0		28	312
Sept. 9 (Naval Observatory).	12 15	−33.5	161.7	−6.5	6		
		−28.0	167.2	−10.5		40	
		−22.0	173.2	+15.5	6		
		−1.0	194.2	+20.5	46		
		+22.5	217.7	+13.5		15	
		+69.0	264.2	−4.5		154	
		+80.5	275.7	+10.0	15		282
Sept. 10 (Naval Observatory).	11 20	−76.0	106.5	+5.5	62		
		−44.0	138.5	+23.0	6		
		−20.5	162.0	−6.0		12	
		−15.0	167.5	−10.0	12		
		−8.0	174.5	+15.0	6		
		+11.5	194.0	+21.0	31		
		+82.5	265.0	−4.0		139	268
Sept. 11 (Naval Observatory).	11 0	−63.0	106.5	+5.0	31		
		−2.0	167.5	−10.0	15		
		+24.0	193.5	+21.0	25		71
Sept. 12 (Naval Observatory).	10 52	−73.5	82.8	+15.5	15		
		−44.0	112.3	+5.0		62	
		−38.5	117.8	+38.5	3		
		+10.5	166.8	−10.5		9	
		+19.5	175.8	+16.0		18	
		+33.0	189.3	−16.0	3		
		+37.5	193.8	+21.0	18		
		+61.0	217.3	+5.0		6	134
Sept. 13 (Naval Observatory).	10 51	−86.5	56.6	−7.0	123		
		−59.0	84.1	+15.5	6		
		−31.5	111.6	+5.0		46	
		+25.0	168.1	−10.0	6		
		+32.5	175.6	+16.0		31	
		+51.0	194.1	+21.0	15		
		+77.0	220.1	+5.5	15		242
Sept. 14 (Naval Observatory).	10 38	−73.0	57.1	−8.0	62		
		−18.0	112.1	+4.5		9	
		+47.0	177.1	+15.5		9	80
Sept 15 (Naval Observatory).	11 18	−58.5	58.0	−7.5	68		
		−9.0	107.5	+5.5		25	
		+17.0	133.5	+20.0	3		
		+59.5	176.0	+15.5		31	127
Sept. 16 (Naval Observatory).	10 39	−80.0	23.6	−21.0	185		
		−46.0	57.6	−8.0	49		
		+8.5	112.1	+5.0		46	
		+51.5	155.1	+4.0	6		
		+72.5	176.1	+15.5		108	394
Sept. 18 (Naval Observatory).	11 1	−52.5	24.5	−21.0		154	
		−19.0	58.0	−8.0	46		200
Sept. 19 (Naval Observatory).	11 1	−39.5	24.3	−21.0		154	
		−6.0	57.8	−8.0	31		
		+25.0	88.8	+21.0	6		191
Sept. 20 (Naval Observatory).	10 40	−26.0	24.8	−21.0	154		
		+7.0	57.8	−8.0	22		
		+37.0	87.8	+21.0		37	
		+45.5	96.3	−14.0		62	275

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	
	h. m.	°	°	°			
Sept. 21 (Naval Observatory).	10 26	−27.0	10.8	+3.0		12	
		−26.5	11.3	−25.0		46	
		−13.0	24.8	−21.0	139		
		+3.0	40.8	−22.0	3		
		+20.5	58.3	−8.0	12		
		+50.5	88.3	+21.0		25	
		+59.5	97.3	−14.0		93	330
Sept. 22 (Harvard)	15 25	−9.0	13.0	−27.5	34		
		+6.0	28.0	−20.5	211		
		+75.5	97.5	−14.5		133	378
Sept. 23 (Naval Observatory).	12 10	+14.0	24.4	−21.5		154	
		+23.5	33.9	+9.5	3		
		+32.0	42.4	−12.0	6		163
Sept. 24 (Naval Observatory).	10 52	+17.5	15.4	+5.5	3		
		+26.5	24.4	−21.5		108	
		+46.5	44.4	+17.5	3		114
Sept. 25 (Naval Observatory).	10 33	+38.5	23.4	−22.0		52	52
Sept. 26 (Naval Observatory).	10 40	−68.0	263.6	+14.0	9		
		−57.0	274.6	+9.0		31	
		+53.5	25.1	−22.0	25		65
Sept. 27 (Naval Observatory).	10 33	−56.5	262.0	+12.0	9		
		−42.5	276.0	+9.0		46	
		−18.0	300.5	−9.0	3		58
Sept. 28 (Naval Observatory).	10 48	−86.0	219.2	+11.5	46		
		−41.5	263.7	+12.5	6		
		−29.0	276.2	+9.5		108	160
Sept. 29 (Naval Observatory).	10 38	−75.0	217.1	+11.5		62	
		−27.0	265.1	+12.5		6	
		−14.5	277.6	+10.0		123	191
Sept. 30 (Mount Wilson).	13 30	−60.0	217.3	+12.0		104	
		0.0	277.3	+11.0		254	358
Mean daily area for September							202

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

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

September, 1929	Relative numbers	September, 1929	Relative numbers	September, 1929	Relative numbers
1	9	11	39	21	55
2	17	12	31	22	[2] 44
3	31	13	53	23	35
4	28	14	25	24	13
5	[3] M 49	15	32	25	10
6	49	16	26	26	[3] E 23
7	[3] M 62	17	[4] 38	27	25
8	54	18	17	28	17
9	58	19	20	29	[4] 43
10	56	20	[3] W 43	30	[2] 40

Mean, 30 days=34.7.

[1] Dependent alone on observations at Zurich and its station at Arosa.
[2] = Passage of an averaged-sized 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 disk; 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.

AEROLOGICAL OBSERVATIONS

By RICHMOND T. ZOCH

Free-air temperatures were below normal at practically all levels at all of the aerological stations. (See Table 1.)

Free-air relative humidity departures were variable at all stations excepting Due West, where there was a pronounced positive departure. This is significant in that the total precipitation for the month at this station was the greatest ever recorded. Vapor pressure departures were mostly below normal except at Due West.

The resultant winds had a southerly component at all levels over the western and eastern parts of the country. (See Table 3.) Over the northern part of the country and over the Mississippi Valley the resultant winds had a northerly component.

Table 2 gives a summary of observations made at naval air stations. Those made at Washington, D. C., were formerly incorporated in Table 1, but as these data are now being computed by the naval air stations, they have been placed in a separate table. It should be noted there is close agreement between the free-air temperatures and relative humidities computed by the Weather Bureau and those computed by the naval air stations.