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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS DURING AUGUST 1933

By IRVING F. HAND, Assistant in Solar Radiation Investigations

For a description of instruments employed and their exposures, the reader is referred to the January 1932, REVIEW, page 26.

Table 1 shows that solar radiation intensities averaged above normal for August at all Weather Bureau stations where normal incidence measurements were made.

Table 2 shows an excess in the total radiation received on a horizontal surface at all stations except Pittsburgh and Twin Falls.

Table 3 shows slightly diminished turbidity for the month as a whole.

Polarization measurements obtained at Washington on 4 days give a mean of 57 percent with a maximum of 60 percent on the 5th. At Madison, observations on 11 days give a mean of 63 percent with a maximum of 74 percent on the 4th. The maximum at Madison is considerably above normal; the other values are close to normal.

TABLE 1.—*Solar radiation intensities during August 1933*

[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	1.0 [1]	2.0	3.0	4.0	5.0	e.
	mm	*cal*	*cal*	*cal*	*cal*	*cal*	*cal*	*cal*	*cal*	*cal*	*mm*
Aug. 2	20.57			0.78	0.98	1.30					17.96
Aug. 5	10.97		0.90	1.01	1.13	1.37					9.14
Aug. 7	14.10					1.23					12.24
Aug. 15	12.24				.90						9.47
Aug. 25	15.65	0.70	.83	.91	1.10	1.41	1.10				16.20
Aug. 30	10.59	.65	.83	.85	1.16						10.59
Means		(.68)	.85	.89	1.05	1.33	(1.10)				
Departures		+.05	+.16	+.13	+.12	+.10	+.07				

TABLE 1.—*Solar radiation intensities during August 1933*—Con.

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

MADISON, WIS.

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	1.0 [1]	2.0	3.0	4.0	5.0	e.
	mm	*cal*	*cal*	*cal*	*cal*	*cal*	*cal*	*cal*	*cal*	*cal*	*cal*
Aug. 1	16.79					1.40					9.83
Aug. 3	12.68					1.47					7.04
Aug. 4	10.59	0.89	0.99	1.11	1.27	1.49	1.18				8.81
Aug. 5	9.83		.88	1.01	1.18	1.41					7.87
Aug. 8	11.81			.78	.98	1.40					11.79
Aug. 11	15.65				1.05	1.42					10.97
Aug. 12	13.61	.66	.79	.97	1.08	1.28					12.68
Aug. 14	7.57	.79	.89	1.06	1.20	1.44					7.87
Aug. 15	8.48	.73	.86	1.03	1.23	1.43					9.14
Aug. 17	14.10				1.13	1.40					12.24
Aug. 18	10.59		.94								7.87
Aug. 19	9.14	1.03	1.12	1.19	1.23	1.40					7.29
Aug. 26	10.97			.81	.96	1.31					9.83
Aug. 28	10.59		.86	.99	1.16	1.44					8.18
Aug. 31	10.97					1.25					8.18
Means		.82	.92	.99	1.14	1.40	(1.18)				
Departures		+.04	+.08	+.05	+.04	+.08	+.10				

LINCOLN, NEBR.

Aug. 10	17.37								0.79	0.68	19.23
Aug. 11	12.24		0.90	1.00	1.16	1.46	1.14	0.95			10.97
Aug. 14	10.21							.91	.82	.66	14.10
Aug. 17	11.81		.88	1.02		1.36	1.16	.96	.86	.75	10.21
Aug. 18	7.87		.83								11.81
Aug. 24	15.65		.78	.91							13.13
Aug. 25	11.81		.96	1.08	1.24	1.45					11.38
Aug. 30	10.97			.94	1.12	1.31	1.14	.95	.78	.68	9.83
Aug. 31	10.97				1.09	1.27	1.10	.90	.72	.60	12.24
Means			.87	.99	1.15	1.37	1.16	.93	.79	.67	
Departures			+.09	+.08	+.06	+.06	+.08	+.05	+.03	−.02	

BLUE HILL, MASS.

Aug. 2	19.9						0.98				19.2
Aug. 6	9.1						1.18	0.95			7.9
Aug. 9	11.4						1.02	.98	0.86		11.4
Aug. 15	11.4						1.08	.91			11.4
Aug. 26	13.6			1.08	1.20	1.46	1.16	.97	.87	0.69	14.6
Aug. 27	16.8						1.05	.82	.58	.48	15.1
Aug. 30	10.2				1.32	1.47	1.22	1.09	.87	.79	9.5
Means				(1.08)	1.26	1.46	1.10	.95	.80	.65	

[1] Extrapolated.

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Pittsburgh	Fairbanks	Twin Falls	La Jolla	Gainesville	Miami	New Orleans	Riverside
	Gram calories per square centimeter													
1933	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
July 30	585	501	417	444	476	691	421	411	596	381	366	408	459	645
Aug. 6	476	469	468	438	438	661	403	280	586	364	505	563	345	558
Aug. 13	451	531	503	519	335	619	452	301	527	394	338	370	276	594
Aug. 20	306	495	365	458	242	618	359	334	565	431	407	493	443	517
Aug. 27	406	449	462	425	419	586	313	288	545	483	----------	490	343	530
	Departures from weekly normals													
July 30	+120	+37	+91	+54	+78	+63	−35	----------	+13	−16	−58	−127	----------	----------
Aug. 6	+30	+10	+24	+64	+70	+47	−19	----------	−8	−3	+93	+42	----------	----------
Aug. 13	+15	+86	−18	+134	−7	+25	+56	----------	−61	+20	−81	−135	----------	----------
Aug. 20	−103	+55	+120	+101	−82	+49	+3	----------	−4	+37	+21	−4	----------	----------
Aug. 27	−11	−34	−6	−68	+91	+47	−24	----------	−1	+105	----------	+5	----------	----------
	Accumulated departures on Sept. 2													
	+7,182	−2,422	+3,990	+12,397	+8,666	+7,098	+203	----------	−147	+8,939	----------	−4,802	----------	----------

TABLE 3.—*Solar radiation measurements, and determinations of atmospheric-turbidity factor, β, Washington, D.C., August 1933*

[Values in italics have been interpolated]

Date and solar-hour angle	Solar altitude, *h*.	Air mass, *m*.	I_m	I_y	I_r	β	Blueness of sky	Atmospheric dust particles per cubic centimeter	Notes: Skylight polarization, P., clouds, etc.
Aug. 2			*gr. cal.*	*gr. cal.*	*gr. cal.*				
0:39a	67–25	1.09	1.242	0.881	0.661	0.138	5	712	P=51.8%
0:35a	67–31	1.09	1.254	.885	.666	.135			
Aug. 5									
4:45a	25–01	2.37	1.082	.808	.628	.068		428	
4:42a	25–36	2.31	1.075	.809	.631	.070			
4:20a	29–51	2.01	1.123	.838	.654	.080	6		P=60.0%
4:16a	30–38	1.96	1.116	.841	.657	.090			
2:24a	51–46	1.27	1.276	.941	.714	.125			
2:19a	52–32	1.26	1.264	.947	.714	.140			
Aug. 7									
3:26a	40–00	1.55	1.108	.862	.648	.070		296	
3:19a	41–18	1.51	1.139	.868	.652	.060			
Aug. 25									
5:14a	15–39	3.68	.862	.652	.523	.060		376	
5:11a	16–14	3.55	.875	.657	.526	.060			
4:49a	20–32	2.84	.959	.714	.557	.065			
4:43a	21–40	2.69	.990	.717	.560	.065			
4:14a	27–20	2.17	1.035	.805	.623	[1].105			
4:05a	28–59	2.06	1.099	.812	.628	.080	6		P=59.6%
3:13a	38–47	1.60	1.250	.856	.646	.050			
3:09a	39–31	1.57	1.245	.860	.651	.060			
0:44a	60–12	1.15	1.318	.912	.699	.095			
0:41a	60–18	1.15	1.326	.917	.701	.090			
Aug. 30									
4:57a	17–54	3.23	.832	.673	.567	.125		498	
4:54a	18–26	3.14	.835	.676	.571	.120			
4:47a	19–50	2.93	.961	.708	.581	.070			
4:44a	20–24	2.85	.978	.711	.584	.070			
4:06a	27–45	2.14	1.105	.805	.635	.070			
4:03a	28–17	2.10	1.129	.809	.639	.065	6		P=59.8%

[1] Incipient cloudiness.

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	
1933	*h*	*m*	°	°	°			
Aug. 1 (Naval Observatory)	13	14	No spots			------	------	------
Aug. 2 (Naval Observatory)	11	22	+27.0	161.4	−15.0	------	22	22
Aug. 3 (Naval Observatory)	13	40	No spots			------	------	------
Aug. 4 (Naval Observatory)	14	22	No spots			------	------	------
Aug. 5 (Naval Observatory)	10	21	No spots			------	------	------
Aug. 6 (Naval Observatory)	11	21	No spots			------	------	------
Aug. 7 (Naval Observatory)	11	39	No spots			------	------	------

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*	°	°	°			
Aug. 8 (Naval Observatory)	11	46	No spots			------	------	------
Aug. 9 (Naval Observatory)	10	54	No spots			------	------	------
Aug. 10 (Mount Wilson)	8	58	No spots			------	------	------
Aug. 11 (Mount Wilson)	8	48	No spots			------	------	------
Aug. 12 (Naval Observatory)	10	38	No spots			------	------	------
Aug. 13 (Naval Observatory)	12	30	No spots			------	------	------
Aug. 14 (Naval Observatory)	14	42	No spots			------	------	------
Aug. 15 (Naval Observatory)	11	8	No spots			------	------	------
Aug. 16 (Mount Wilson)	9	55	+15.0	325.0	+10.0	2	------	2
Aug. 17 (Naval Observatory)	12	53	No spots			------	------	------
Aug. 18 (Naval Observatory)	12	54	No spots			------	------	------
Aug. 19 (Naval Observatory)	14	1	------	------	------	------	------	------
Aug. 20 (Mount Wilson)	9	25	No spots			------	------	------
Aug. 21 (Mount Wilson)	9	25	No spots			------	------	------
Aug. 22 (Mount Wilson)	9	19	No spots			------	------	------
Aug. 23 (Mount Wilson)	11	22	No spots			------	------	------
Aug. 24 (Naval Observatory)	13	35	No spots			------	------	------
Aug. 25 (Naval Observatory)	11	8	No spots			------	------	------
Aug. 26 (Naval Observatory)	11	20	No spots			------	------	------
Aug. 27 (Naval Observatory)	10	51	No spots			------	------	------
Aug. 28 (Naval Observatory)	12	55	No spots			------	------	------
Aug. 29 (Naval Observatory)	11	19	No spots			------	------	------
Aug. 30 (Naval Observatory)	14	25	No spots			------	------	------
Aug. 31 (Mount Wilson)	9	20	No spots			------	------	------
Mean daily area for August	------		------	------	------	------	------	1

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR AUGUST 1933

(Dependent alone on observations at Zurich and its station at Arosa)

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

August 1933	Relative numbers	August 1933	Relative numbers	August 1933	Relative numbers
1	0	11	0	21	0
2	0	12	7	22	0
3	0	13	0	23	0
4	0	14	0	24	0
5	0	15	0	25	0
6	0	16	0	26	0
7	0	17	0	27	0
8	0	18	0	28	0
9	0	19	0	29	0
10	0	20	0	30	0
				31	0

Mean: 31 days=0.2.