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SOLAR OBSERVATIONS

[Meteorological Research Division, EDGAR W. WOOLARD in charge]

SOLAR RADIATION OBSERVATIONS, AUGUST 1939

By CHARLES M. LENNAHAN

Measurements of solar radiant energy received at the surface of the earth are made at eight stations maintained by the Weather Bureau, and at nine cooperating stations maintained by other institutions. The intensity of the total radiation from sun and sky on a horizontal surface is continuously recorded (from sunrise to sunset) at all these stations by self-registering instruments; pyrheliometric measurements of the intensity of direct solar radiation at normal incidence are made at frequent intervals on clear days at three Weather Bureau stations (Washington, D. C., Madison, Wis., Lincoln, Nebr.) and at the Blue Hill Observatory at Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau stations at Washington and Madison.

The geographic coordinates of the stations, and descriptions of the instrumental equipment, station exposures, and methods of observation, together with summaries of the data, obtained up to the end of 1936, will be found in the MONTHLY WEATHER REVIEW, December 1937, pp. 415 to 441; further descriptions of instruments and methods are given in Weather Bureau Circular Q.

Table 1 contains the measurements of the intensity of direct solar radiation at normal incidence, with means and their departures from normal (means based on less than 3 values are in parentheses). At Madison and Lincoln the observations are made with the Marvin pyrheliometer; at Washington and Blue Hill they are obtained with a recording thermopile, checked by observations with a Marvin pyrheliometer at Washington and with a Smithsonian silver disk pyrheliometer at Blue Hill. The table also gives vapor pressures at 8 a. m. (75th meridian time) and at noon (local mean solar time).

Table 2 contains the average amounts of radiation received daily on a horizontal surface from both sun and sky during each week, their departures from normal and the accumulated departures since the beginning of the year. The values at most of the stations are obtained from the records of the Eppley pyrheliometer recording on either a microammeter or a potentiometer.

Direct radiation intensities averaged above normal for August at Madison and Lincoln, and slightly below normal at Washington.

Total solar and sky radiation was above normal at all stations except Miami and Riverside. Data for four of the regular reporting stations are not included because for various reasons the data were not available. These data will be published as soon as they are available.

TABLE 1.—*Solar radiation intensities during August 1939*

[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	2.0	3.0	4.0	5.0	e
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Aug. 1	15.11	------	0.62	0.71	0.90	1.24	------	------	------	------	16.79
Aug. 2	16.20	------	------	.28	.54	------	------	------	------	------	17.37
Aug. 3	17.96	------	------	.52	.72	------	------	------	------	------	17.96
Aug. 5	10.59	------	.64	.76	------	------	------	------	------	------	11.38
Aug. 7	15.11	------	.61	.70	------	------	------	------	------	------	12.68
Aug. 10	12.68	------	.65	.82	1.05	1.29	------	------	------	------	10.59
Aug. 11	13.13	------	------	.75	.88	1.14	------	------	------	------	14.10
Aug. 12	17.37	------	------	------	.68	------	------	------	------	------	15.65
Means	------	------	.64	.64	.78	1.22	------	------	------	------	------
Departures	------	------	−.04	−.12	−.16	−.03	------	------	------	------	------

MADISON, WIS.

Aug. 3	10.97	0.60	0.71	0.92	1.13	1.33	1.10	------	------	------	9.83
Aug. 4	9.14	.77	.84	1.02	1.18	------	------	------	------	------	8.18
Aug. 9	8.48	.84	.95	1.06	1.24	1.37	1.10	------	------	------	7.57
Aug. 14	12.68	.61	.71	.84	1.03	1.30	.94	------	------	------	12.24
Aug. 16	13.61	.68	.61	.80	1.02	1.22	------	------	------	------	12.68
Aug. 23	9.83	------	------	.96	1.15	1.35	------	------	------	------	10.21
Aug. 24	9.83	------	.91	1.07	1.21	1.37	------	------	------	------	10.21
Aug. 25	11.38	------	.84	1.01	1.18	1.38	------	------	------	------	12.24
Aug. 26	11.81	------	.77	.95	1.14	1.33	------	------	------	------	11.81
Means	------	.70	.79	.96	1.14	1.33	1.05	------	------	------	------
Departures	------	−.03	−.01	.03	.04	.04	.00	------	------	------	------

LINCOLN, NEBR.

Aug. 2	16.20	------	0.84	0.95	1.15	------	1.22	1.08	0.95	------	9.47
Aug. 3	10.59	------	.94	1.07	1.25	------	1.06	.96	.84	------	7.57
Aug. 4	10.97	------	.90	1.02	1.20	------	1.17	.96	------	------	8.48
Aug. 17	13.13	0.63	.73	.87	1.08	------	------	------	------	------	13.13
Aug 18	12.24	------	.73	.88	1.07	------	1.20	1.03	.90	0.77	10.97
Aug. 21	7.29	.85	.98	1.13	1.25	------	1.22	1.02	.90	.77	6.76
Aug. 22	8.48	------	------	------	------	------	1.28	------	------	------	8.18
Aug. 23	7.87	.79	.90	1.04	1.19	------	1.02	------	------	------	7.87
Aug. 24	9.14	------	------	------	------	------	.92	------	------	------	11.38
Aug. 26	11.38	------	------	------	.70	------	------	------	------	------	15 11
Aug. 29	12.24	.50	.63	.77	.98	------	------	------	------	------	14.60
Aug. 30	13.13	.52	.65	.84	1.04	------	.99	.74	.59	.45	12.68
Means	------	.66	.81	.95	1.09	------	1.12	.96	.84	.66	------
Departures	------	−.02	.03	.04	.00	------	.05	.08	.11	.01	------

* 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	Cambridge	Fairbanks	Miami	New Orleans	Riverside	Blue Hill	San Juan	Newport
	Gram-calories per square centimeter													
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
July 30	664	614	582	599	433	666	492	400	417	412	466	492	636	608
Aug. 6	629	481	526	493	458	681	569	291	361	467	503	617	593	585
Aug. 13	478	504	476	462	361	635	440	355	476	301	488	428	610	486
Aug. 20	555	458	567	515	385	612	398	246	355	436	483	419	448	396
Aug. 27	516	473	428	470	363	618	366	275	344	476	506	390	567	345
	Departures of daily totals from normals													
July 30	+183	+138	+57	+189	+2	−1	--------	+56	−61	+18	−95	−38	+59	+80
Aug. 6	+183	+22	+23	+90	+78	+37	--------	−24	−125	+73	−29	+110	+58	+73
Aug. 13	+34	+57	−17	+54	−15	+6	--------	+60	+10	−57	−40	−82	+77	+15
Aug. 20	+136	+13	+75	+97	+49	+16	--------	−33	−112	+58	−28	−79	−85	−36
Aug. 27	+94	+62	−18	+105	+6	+37	--------	+33	−117	+77	+17	−21	+16	−87
	Accumulated departures since Jan. 1													
	+14,224	+8,736	+5,145	+14,252	+5,682	+987	--------	+595	−3,535	+4,893	−3,045	+2,156	+7,159	+2,142

POSITIONS AND AREAS OF SUN SPOTS

Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.) Superintendent, U. S. Naval Observatory. Data from measurements at the U. S. Naval Observatory from plates obtained at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's visible hemisphere. For each day, below longitude, latitude, area of spot or groups, and spot count, are given respectively the assumed longitude of the center of the disk, assumed latitude of the center of the disk, total area of spots and groups, and total spot count]

Date	Eastern standard time		Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1939	*h*	*m*		°	°	°	°				
Aug. 1	11	23	6557	−75	314	+12	74	776	15	VG	U. S. Naval.
			6556	−52	337	−17	55	242	35		
			6553	−39	350	+5	40	12	12		
			6553	−29	0	+7	30	582	9		
			6555	+29	58	−21	39	36	8		
			6552	+34	63	−21	44	36	5		
			6550	+42	71	−23	50	121	10		
					(29)	(+6)		1,805	94		
Aug. 2	11	35	6557	−62	314	+12	61	970	25	VG	Do.
			6556	−38	338	−16	45	339	20		
			6558	−19	357	+12	20	97	10		
			6553	−16	0	+8	17	485	1		
			6553	−15	1	+5	17	97	9		
			6555	+40	56	−21	48	36	3		
			6552	+45	61	−21	50	61	6		
			6550	+55	71	−24	61	61	2		
					(16)	(+6)		2,146	76		
Aug. 3	11	30	6557	−48	315	+12	49	970	62	VG	Do.
			6556	−24	339	−16	27	242	53		
			6558	−4	359	+14	10	339	41		
			6553	−2	1	+8	3	485	9		
			6553	−1	2	+5	4	24	8		
			6553	−1	2	+10	3	24	8		
					(3)	(+6)		2,084	181		
Aug. 4	10	58	6557	−35	315	+12	35	970	30	F	Do.
			6556	−11	339	−16	24	291	21		
			6558	+10	0	+14	13	339	48		
			6553	+11	1	+8	12	485	2		
			6553	+11	1	+5	11	24	5		
					(350)	(+6)		2,109	106		
Aug. 5	11	2	6557	−22	314	+12	22	921	61	VG	Do.
			6556	+3	339	−16	23	436	34		
			6560	+15	351	−9	20	12	3		
			6560	+19	355	−4	22	6	2		
			6555	+24	0	+14	25	436	64		
			6553	+24	0	+10	25	6	1		
			6553	+25	1	+8	25	485	11		
					(336)	(+6)		2,302	176		
Aug. 6	11	55	6561	−73	250	−15	74	194	10	G	Mt. Wilson.
			6557	−13	310	+12	14	388	8		
			6557	−3	320	+12	7	485	32		
			6556	+16	339	−14	25	436	63		
			6560	+24	347	−8	20	24	4		
			6559	+28	351	−4	30	6	3		
			6558	+37	0	+15	39	388	30		
			6553	+39	2	+8	39	485	1		
					(323)	(+6)		2,406	151		

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time		Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1939	*h*	*m*		°	°	°	°				
Aug. 7	10	58	6565	−89	221	−12	89	242	1	VG	U. S. Naval.
			6566	−89	221	+17	89	242	2		
			6561	−58	252	−16	62	388	15		
			6564	−50	260	+5	50	12	2		
			6563	−33	277	−10	37	12	3		
			6557	0	310	+13	7	436	15		
			6557	+10	320	+13	12	436	27		
			6556	+30	340	−16	36	436	24		
			6560	+38	348	−9	41	6	2		
			6553	+41	351	+7	42	36	6		
			6558	+50	0	+14	50	291	2		
			6553	+51	1	+8	51	485	15		
					(310)	(+6)		3,022	114		
Aug. 8	10	49	6565	−75	222	−12	76	436	3	VG	Do.
			6566	−74	223	+17	73	242	12		
			6561	−45	252	−16	50	485	45		
			6564	−35	262	+4	35	97	22		
			6563	−17	280	−10	23	24	7		
			6562	+7	304	−8	15	97	20		
			6557	+12	309	+13	14	388	25		
			6557	+23	320	+13	25	533	50		
			6556	+43	340	−16	49	242	30		
			6553	+55	352	+7	54	6	1		
			6553	+65	2	+8	64	533	2		
			6558	+68	5	+14	68	121	6		
					(297)	(+6)		3,204	223		
Aug. 9	11	0	6567	−88	196	−19	88	242	2	VG	Do.
			6566	−61	223	+17	61	218	2		
			6565	−60	224	−13	63	582	20		
			6561	−32	252	−16	38	436	42		
			6564	−22	262	+4	22	388	16		
			6562	+21	305	−8	25	218	20		
			6557	+26	310	+13	26	339	16		
			6557	+37	321	+13	37	436	33		
			6556	+56	340	−16	59	388	25		
			6553	+78	2	+8	79	582	2		
			6558	+80	4	+14	80	121	2		
					(284)	(+6)		3,950	180		
Aug. 10	10	53	6567	−80	190	−19	80	97	6	G	Do.
			6567	−70	200	−19	73	388	4		
			6565	−48	222	−13	51	242	15		
			6566	−47	223	+17	46	291	10		
			6565	−43	227	−12	45	291	4		
			6569	−40	230	+17	42	6	3		
			6561	−19	251	−17	29	485	41		
			6564	−7	263	+4	7	485	20		
			6563	+9	279	−11	19	12	5		
			6562	+35	305	−8	38	194	14		
			6557	+38	308	+13	37	291	15		
			6568	+46	316	−24	55	121	18		
			6557	+49	319	+13	48	436	18		
			6556	+68	338	−16	70	339	21		
					(270)	(+6)		3,678	194		