SOLAR RADIATION AND SUNSPOT DATA FOR JULY 1940

SOLAR RADIATION OBSERVATIONS

By HELEN CULLINANE

Measurements of solar radiant energy received at the surface of the earth are made at nine stations maintained by the Weather Bureau, and at 10 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 Lincoln the observations are made with the Marvin pyrheliometer; at Washington, Madison, and Blue Hill they are obtained with a recording thermopile, checked by observations with a Smithsonian silver-disk pyrheliometer at Washington and Blue Hill. The table also gives vapor pressures at 7:30 a. m. and at 1:30 p. m. (75th meridian 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 solar radiant energy averaged below normal at all stations, although the month contained an unusually large number of clear days at Blue Hill, Madison, and Washington.

There was an excess of total solar and sky radiation at every station with the exception of Fairbanks and Friday Harbor, where it was practically normal, and Blue Hill and Miami, where there was some deficiency.

Polarization measurements made at Madison on 10 days give a mean of 57.0, compared with a normal for July of 59 percent. The maximum was 66.3 on the 3d, very close to the July normal.

TABLE 1.—*Solar radiation intensities during July 1940*

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

Date	Sun's zenith distance										
	7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m.
	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.*
WASHINGTON, D. C.											
July 2	9.83					1.14					9.14
July 5	11.38	0.58	0.66	0.76	0.95	1.37					8.81
July 6	9.83	.50	.59	.72	.97	1.26					8.81
July 8	12.24	.49	.55	.68	.74	1.14					12.24
July 10	16.20				.58						14.10
July 15	12.24				1.14	1.20					12.68
July 18	16.79				.87						13.13
July 19	17.96	.54	.65	.80	.96	1.09					17.96
July 20	17.37	.52	.54	.55	.64	1.12					16.79
July 25	19.23		.44	.65	.74	1.03					19.23
July 26	21.28				.89	1.06					19.23
July 27	19.89	.49	.52	.58	.77	1.08					19.23
July 29	19.23				.69						18.59
July 30	18.59		.44	.54	.68	1.02					20.57
July 31	18.59			.68	.83						17.96
Means		.53	.57	.66	.89	1.14					
Departures		−.05	−.10	−.14	−.03	−.07					
LINCOLN, NEBR.											
July 13	7.87	0.64	0.75	0.88	1.09	1.39					7.87
July 18	16.79		.72	.82							13.61
July 19	13.61	.68	.80	.94	1.12	1.44	0.97				10.21
July 24	18.59	.67	.77	.90	1.12	1.44					11.81
Means		.67	.76	.88	1.11	1.40	(.97)				
Departures		−.02	−.03	−.04	+.02	+.06	−.10				
MADISON, WIS.											
July 2	8.81	0.83	0.91	1.04							8.81
July 3	10.59	.76	.91	1.03	1.22	1.34					9.14
July 5	10.97	.57	.71	.87	1.06	1.32					10.59
July 6	11.81	.61	.71	.87	1.02	1.20					9.83
July 8	15.65				1.06	1.25					12.68
July 10	16.79	.52	.61	.60	.74	1.23					13.61
July 12	8.48	.84	.95	1.07	1.22	1.45					9.14
July 13	7.87	.83	.92	1.02	1.14	1.40					6.76
July 15	13.61	.40	.49	.64	.81						9.83
July 17	9.14	.71	.81	.95	1.10						9.47
July 22	16.20		.69	.84	1.06	1.28					16.20
July 23	17.96	.49	.59	.75	1.01						15.11
Means		.66	.75	.88	1.04	1.31					
Departures		−.02	−.03	−.03	−.03	+.01					
BLUE HILL, MASS.											
July 1	8.8	0.86	0.96	1.06	1.20	1.33					8.6
July 2	9.6	.88	.97	1.03	1.22	1.38					8.6
July 3	8.8	.67	.76	.86	1.08	1.27					10.3
July 6	10.7	.76	.90	1.00	1.14	1.29	1.05	0.82	0.69		10.7
July 7	11.5	.68	.77	.88	1.07	1.30	.92	.72	.56		11.5
July 8	11.5					1.26	.91	.66	.51		10.3
July 9	14.3		.41	.72							14.7
July 10	15.3	.36	.47	.61	.76	1.11		.68	.53		12.8
July 14	9.2	.82	.91	1.03	1.22	1.34	1.12	.87	.73	0.60	9.6
July 15	10.3	.61	.70	.80	1.00	1.27	.92	.66			11.1
July 16	12.8	.44	.56	.70	.90	1.15					14.7
July 18	16.3					.86					16.4
July 19	16.4	.23	.35	.48	.73	1.19	.98	.81			15.8
July 21	18.6					1.21	.78				16.9
July 23	15.8							.61	.49	.40	16.9
July 27	19.5						.78	.63	.51		18.8
July 28	15.3				.92	1.18					15.3
July 31	16.9	.68	.80	.94	1.10	1.30					14.7
Means		.63	.72	.85	1.03	1.21	.93	.72	.58	(.50)	
Departures		+.01	−.03	−.02	−.02	−.05	−.08	−.14	−.14	−.17	

*Extrapolated.

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

[Gram-calories per square centimeter]

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Albuquerque	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	Newport	Friday Harbor	Ithaca	Cambridge
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
July 2	562	745	690	631	584	711	709	529	--------	484	477	360	628	548	602	707	560	571
July 9	570	627	625	545	485	727	712	507	--------	623	465	396	622	476	493	610	484	496
July 16	624	661	583	568	448	711	648	419	--------	631	498	544	660	392	400	627	479	433
July 23	633	408	538	512	437	708	634	354	--------	522	466	553	600	455	484	436	429	522
DEPARTURES FROM WEEKLY NORMALS																		
July 2	+44	+202	+60	+145	+106	−2	--------	+60	--------	−73	00	−45	+21	−42	+66	+126	+29	--------
July 9	+67	+81	+25	+70	+31	+27	--------	+32	--------	+31	−37	−3	+33	−48	−4	+21	+18	--------
July 16	+142	+131	+2	+96	+19	+15	--------	−15	--------	+60	−11	+122	+88	−109	−44	−13	−11	--------
July 23	+143	−104	−23	+37	+17	+14	--------	−80	--------	+24	−44	+156	+52	−9	−10	−160	+7	--------
ACCUMULATED DEPARTURES ON JULY 29, 1940																		
	+3,885	+3,962	−931	+3,787	+5,964	−889	--------	+2,639	--------	−4,571	+1,652	+5,574	−1,134	−4,151	−2,419	+5,810	--------	

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent, U. S. Naval Observatory.] All measurements and spot counts were made at the Naval Observatory from plates taken 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 hemisphere. For each day, under longitude, latitude, area of spot or group, and spot count, are included assumed longitude of center of the disk, assumed latitude of 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
1940	*h m*		°	°	°	°				
July 1	11 1	6893	−74	215	+9	74	242	3	G	U. S. Naval.
		(*)	−33	256	−5	34	24	4		
		6892	−11	278	−21	26	24	5		
		6888	+19	308	−15	26	145	15		
		6887	+21	310	+2	21	61	1		
		6888	+28	317	−14	33	194	1		
		6891	+32	321	−1	32	6	2		
		6889	+38	327	+9	38	145	19		
		6878	+78	7	−11	79	12	1		
		6877	+81	10	−18	81	291	1		
				(289)	(+3)		1,144	52		
July 2	11 49	6894	−80	195	−26	80	206	1	F	Do.
		6893	−61	214	+10	61	145	4		
		6888	+31	306	−16	36	121	7		
		6887	+34	309	+2	34	61	1		
		6888	+41	316	−15	45	194	3		
		6889	+52	327	+8	52	145	6		
				(275)	(+3)		872	22		
July 3	10 38	6897	−79	183	−9	79	48	1	P	Mt. Wilson.
		6894	−67	195	−24	70	97	1		
		6893	−48	214	+11	49	145	4		
		6896	+1	263	−8	11	24	3		
		6895	+7	269	+6	8	48	4		
		6888	+45	307	−16	49	97	7		
		6887	+48	310	+2	48	48	1		
		6888	+56	318	−15	60	145	3		
		6889	+66	328	+8	66	97	6		
				(262)	(+3)		749	30		
July 4	14 33	6897	−62	185	−11	64	61	1	G	U. S. Naval.
		6894	−51	196	−25	59	85	1		
		6893	−33	214	+11	34	97	7		
		6896	+14	261	−8	18	12	1		
		(*)	+25	272	−5	27	24	1		
		(*)	+32	279	+5	32	24	4		
		6887	+62	309	+2	62	24	1		
		6888	+69	316	−15	70	145	3		
		6889	+81	328	+9	81	48	1		
				(247)	(+3)		520	20		
July 5	10 57	6900	−51	185	+15	52	6	1	G	Do.
		6897	−50	186	−10	52	48	5		
		6899	−44	192	−15	49	61	6		
		6894	−39	197	−25	47	73	1		
		6898	−33	203	+12	34	73	9		
		6893	−20	216	+10	21	48	3		
		(*)	+51	287	+5	51	6	1		
		6887	+73	309	+2	73	12	1		
		6888	+82	318	−15	82	145	1		
				(236)	(+3)		472	28		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS—Con.

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
1940	*h m*		°	°	°	°				
July 6	10 49	6897	−36	187	−10	38	36	1	F	Mt. Wilson.
		6899	−31	192	−15	36	73	8		
		6894	−26	197	−25	37	73	1		
		6898	−19	204	+12	21	145	18		
		6893	−6	217	+11	10	12	1		
		(*)	+60	283	+5	60	24	5		
				(223)	(+3)		363	34		
July 7	9 10	6897	−31	179	−8	33	6	1	VG	Do.
		6901	−28	182	+18	32	6	1		
		6900	−26	184	+16	28	12	3		
		6897	−23	187	−9	26	36	4		
		6899	−15	195	−13	22	48	7		
		6894	−13	197	−25	31	73	1		
		6898	−7	203	+13	11	218	25		
				(210)	(+4)		399	42		
July 8	11 19	6903	−65	131	−13	67	6	1	G	U. S. Naval.
		6901	−15	181	+17	20	145	6		
		6897	−10	186	−9	16	24	1		
		6900	−10	186	+12	13	6	3		
		6899	−4	192	−12	15	48	5		
		6894	0	196	−25	29	73	1		
		6898	+9	205	+12	12	242	10		
		6902	+14	210	+18	21	66	11		
				(196)	(+4)		610	38		
July 9	10 57	6905	−89	94	+6	89	48	2	G	Do.
		6903	−56	127	−8	58	48	3		
		6904	−20	163	+22	26	24	6		
		6901	−1	182	+16	12	315	35		
		6897	+3	186	−9	13	6	4		
		6900	+3	186	+11	8	6	3		
		6899	+10	193	−12	19	97	7		
		6894	+13	196	−25	31	48	1		
		6898	+20	203	+12	22	97	13		
		6898	+25	208	+13	27	194	1		
		6902	+27	210	+18	31	582	24		
				(183)	(+4)		1,465	99		
July 10	10 56	6905	−76	94	+5	76	970	11	VG	Do.
		6903	−41	129	−11	43	109	13		
		6904	−6	164	+22	19	133	12		
		6901	+14	184	+15	18	194	31		
		6899	+24	194	−11	29	73	12		
		6894	+27	197	−24	39	24	1		
		6898	+34	204	+12	36	48	13		
		6898	+39	209	+12	40	194	1		
		6902	+42	212	+18	44	727	29		
				(170)	(+4)		2,472	123		
July 11	12 27	6905	−63	93	+5	63	921	8	G	Do.
		6903	−26	130	−11	30	170	11		
		6904	+9	165	+21	19	267	14		
		6901	+28	184	+15	22	170	20		
		6899	+40	196	−11	43	48	4		
		6894	+40	196	−24	48	24	1		
		6898	+49	205	+12	50	48	5		
		6898	+52	208	+12	53	194	1		
		6902	+55	211	+18	57	1,164	17		
				(156)	(+4)		3,006	81		