SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS DURING FEBRUARY 1933

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

Beginning with this issue, solar radiation intensities at normal incidence taken with a Smithsonian silver-disk pyrheliometer at the Harvard Meteorological Observatory, Blue Hill, Mass. (latitude 42°13′ N., longitude 71°07′ W., height 195 meters), will be regularly included in table 1.

Table 1 shows that solar radiation intensities averaged above normal for February at Washington, and close to normal at both Madison and Lincoln.

Table 2 shows an excess in the total solar radiation received on a horizontal surface at all stations except Miami and Gainesville. Miami is slightly below the February normal, while Gainesville shows a decided deficiency for the month.

Table 3 shows fairly low and uniform values of the turbidity factor, β, on February 2 and 24. On both of these dates clouds interfered with the regular readings at times throughout the day.

TABLE 1.—*Solar radiation intensities during February 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	2.0	3.0	4.0	5.0	e.
	mm	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm*
Feb. 2	6.02						1.15	0.93	0.76	0.63	5.36
Feb. 3	2.87		.91	0.99	1.29						2.49
Feb. 9	.96			1.26	1.41		1.31	1.17	1.00	.84	.86
Feb. 16	2.16			1.16	1.34						2.36
Feb. 21	3.45	0.87	1.02	1.19	1.38						1.78
Feb. 24	4.16	.46	.58	.75	.96						3.15
Feb. 27	1.78		.89	1.10	1.35		1.33	1.19	1.12	.97	1.88
Feb. 28	1.96		1.05	1.12	1.36		1.30	1.11			2.16
Means		.77	.91	1.08	1.30		1.27	1.10	.96	.81	
Departures		+.04	+.08	+.09	+.12		+.07	+.12	+.11	+.05	

Madison, Wis.

Feb. 8	0.51									1.23	0.58
Feb. 10	.64		1.10								.96
Feb. 15	1.19		1.06	1.20	1.40						1.19
Feb. 17	1.45						1.29				2.06
Feb. 18	2.26			1.10							2.06
Feb. 20	3.00						1.36				3.63
Feb. 21	1.12		1.14								1.45
Feb. 23	4.16						1.36				3.81
Feb. 24	4.37			1.09							4.17
Feb. 28	3.63			1.05	1.28						3.00
Means			1.10	1.11	(1.34)		1.34			(1.23)	
Departures			+.02	−.09	−.02		−.02			+.12	

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

Lincoln, Nebr.

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*
Feb. 5	0.79		1.04	1.23	1.41	1.63					1.96
Feb. 10	.66						1.36	1.10	0.88	0.75	1.19
Feb. 11	1.07	0.94	.98	1.14	1.33	1.49					1.24
Feb. 12	2.16						1.34	1.15	1.00	.88	2.87
Feb. 14	1.37							1.25	1.15	1.04	1.88
Feb. 15	1.78	.79	.98	1.15	1.37	1.63					2.74
Feb. 17	3.15				1.39	1.59	1.44	1.30	1.16	1.06	2.74
Feb. 18	3.00	1.02	1.12	1.26	1.41	1.57					3.30
Feb. 21	3.45	.87	1.03	1.19	1.39	1.61					2.26
Feb. 23	2.26	.89	.99	1.13	1.36	1.63		1.13	.98	.89	3.99
Feb. 25	2.87				1.43	1.49	1.40	1.28	1.09	1.00	4.62
Feb. 28	3.15	.82	.93	1.04	1.23	1.40	1.23	1.03	.88	.77	2.74
Means		.87	1.01	1.16	1.37	1.56	1.35	1.18	1.02	.91	
Departures		−.04	±.00	−.02	±.00		±.00	+.01	−.01	−.01	

Blue Hill, Mass.

1932											
Nov. 25	4.6				1.33						4.4
Nov. 27	1.6							1.21	1.16		1.7
Dec. 3	7.0							.81	.73		6.9
Dec. 5	3.9			1.00							3.8
Dec. 8	3.2		1.13	1.27	1.42						2.5
Dec. 9	2.2			1.05				1.03			3.2
Dec. 16	1.1		1.20	1.34	1.49			1.28	1.17		1.2
Dec. 22	2.9							1.11	1.02		3.0
Means			(1.17)	1.16	(1.46)			1.06	.97		
1933											
Jan. 1	3.6			1.32				1.29	1.16	1.05	3.6
Jan. 5	3.1		.85	1.07				1.14			2.6
Jan. 6	1.1							1.18			1.5
Jan. 10	1.3			1.34				1.13			1.3
Jan. 15	5.2			1.14							3.4
Jan. 18	3.9			1.18	1.40			1.21			3.6
Jan. 21	3.4							.90			4.2
Jan. 23	4.4							1.19	1.03		4.5
Jan. 24	3.6		1.06	1.20				1.20	1.06		2.0
an. 30	3.2			1.19			1.32	1.19	1.00		3.4
Jan. 31	3.1		1.03		1.37		1.38	1.18	1.01		3.3
Means			.98	1.21	1.39		1.35	1.16	1.05	(1.05)	
Feb. 1	3.8	0.65	.79	.97	1.20	1.47					3.7
Feb. 2	6.6	.75	.88	1.02	1.22	1.50	1.19				5.4
Feb. 3	3.1					1.44	1.23	1.05	.90	.78	3.2
Feb. 9	.9	.98	1.13	1.30	1.43	1.53	1.33	1.20			1.4
Feb. 10	1.3			1.03	1.22	1.46					1.2
Feb. 12	1.4			1.28	1.45	1.63	1.43				1.2
Feb. 13	2.0	.80	.92	1.06	1.21	1.38					3.3
Feb. 16	1.7			1.27	1.38	1.50					2.2
Feb. 18	3.8				.76		.88				3.6
Feb. 19	3.2				1.01		1.23				4.0
Feb. 22	3.4				1.28	1.38	1.21				4.2
Feb. 23	4.6					1.32	1.15	.96			4.4
Feb. 24	3.0				1.27		1.29				2.9
Feb. 27	2.8				1.28		1.32				2.6
Means		.80	.93	1.13	1.23	1.46	1.23	1.07	(.90)	(.78)	

* Extrapolated.

Polarization measurements made on 6 days at Washington give a mean of 52 percent with a maximum of 56 on the 9th. These are slightly below normal for the month. No polarization readings were obtained at Madison due to the continued presence of ice and snow.

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
	Gram calories per square centimeter												
1933	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*
Jan. 29	236	143	246	124	188	245	115	14	222	254	124	349	149
Feb. 5	294	246	299	222	205	362	178	31	249	268	130	320	188
Feb. 12	232	255	335	198	218	284	201	68	311	315	195	382	228
Feb. 19	308	262	380	269	231	417	226	123	270	309	264	372	232
	Departures from weekly normals												
Jan. 29	+37	−44	+18	+6	+45	+14	−5	----------	+27	±0	−125	−3	----------
Feb. 5	+92	+38	+36	+90	+57	+94	+27	----------	+19	+14	−143	−43	----------
Feb. 12	+6	+26	+50	+46	+52	−28	+24	----------	+41	+36	−115	+11	----------
Feb. 19	+49	+10	+71	+89	+35	+63	+85	----------	−12	−12	−79	±0	----------
	Accumulated departures on Feb. 26												
	+1,736	−420	+1,281	+2,331	+2,142	+294	+1,120	----------	−98	−399	−5,523	−840	----------

TABLE 3.—*Solar radiation measurements, and determinations of atmospheric-turbidity factor, β, Washington, D.C., February 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.
Feb. 2			*gr. cal.*	*gr. cal.*	*gr. cal.*				
0:18 a	34-11	1.78	1.248	*0.936*	0.755	0.065		699	
0:13 a	34-09	1.78	1.244	.936	*.755*	.068			
1:24 p	30-56	1.94	1.148	.826	.661	.055			
1:30 p	30-22	1.96	1.155	*.818*	.655	.050	5		P=53.7.
3:34 p	15-08	3.79	.768	.570	*.424*	.040			
Feb. 3									
3:33 a	15-33	3.70	.879	*.756*	.641	.085		586	
3:25 a	16-48	3.43	.948	.764	*.644*	.065			
3:20 a	17-33	3.34	.954	*.770*	.647	.065			
3:08 a	19-18	3.03	.976	.779	*.656*	.070			
Feb. 8									
1:47 a	30-27	1.96	1.309	*958*	.749	.020	5	479	P=55.2.
1:42 a	31-36	1.90	1.306	.943	*.743*	.020			
0:49 a	34-52	1.75	1.233	*.923*	.718	.020			
0:44 a	35-09	1.70	1.301	.921	*.714*	.023			
Feb. 9									
1:15 a	33-37	1.80	1.416	1.058	*.850*	.030		420	
1:11 a	33-58	1.79	1.431	*1.058*	.850	.025			
0:31 a	35-58	1.70	1.448	1.060	*.861*	.030			
0:26 a	36-06	1.69	1.459	*1.058*	.862	.025			
1:39 p	31-26	1.92	1.331	.982	*.797*	.035	6		P=56.3.
1:42 p	31-22	1.92	1.333	*.979*	.797	.035			
2:53 p	23-12	2.53	1.249	*.905*	.727	.020			
2:59 p	22-07	2.65	1.236	.900	*.721*	.020			
3:27 p	17-54	3.24	1.143	.844	*.692*	.020			
3:33 p	17-45	3.26	1.129	*.838*	.688	.020			
3:43 p	15-23	3.74	1.049	*.783*	.673	.030			
3:47 p	14-45	3.89	1.024	.779	*.662*	.030			
Feb. 16									
3:46 a	16-16	3.54	1.102	*.761*	.745	.040		284	
3:42 a	17-16	3.34	1.108	.858	*.749*	.045			
3:28 a	19-30	2.98	1.160	.904	*.753*	.040			
3:23 a	20-18	2.86	1.204	*.906*	.754	.035			
2:48 a	25-32	2.31	1.294	*.970*	.797	.030			
2:43 a	26-14	2.26	1.304	.970	.795	.030	4		P=50.2.
1:17 a	35-40	1.71	1.378	*.974*	.788	.025			
1:13 a	36-00	1.70	1.371	.974	*.785*	.025			
1:09 a	36-18	1.69	1.388	*.971*	.764	.020			
1:00 p	38-40	1.60	1.473	*1.012*	.842	.020			
1:03 p	38-30	1.61	1.475	1.011	*.841*	.020			
1:24 p	36-52	1.67	1.440	*.995*	.792	.020			
1:28 p	36-32	1.68	1.440	.991	*.791*	.020			
1:47 p	34-45	1.74	1.414	*.983*	.782	.020			
1:50 p	34-24	1.76	1.402	.982	*.779*	.020			
Feb. 24									
3:39 a	19-46	2.94	.779	*.620*	.512	.100		420	
3:36 a	20-22	2.86	.795	.617	*.514*	.095			
3:08 a	24-51	2.37	.888	.671	*.547*	.090			
3:03 a	25-34	2.31	.091	*.668*	.549	.085	4		P=49.2.
1:05 a	39-20	1.58	1.056	*.752*	.567	.070			
1:01 a	39-36	1.57	1.066	.733	*.568*	.065			

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

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.
Feb. 28									
4:29 a	12-30	4.54	1.041	0.849	*0.715*	0.030		254	
4:24 a	13-24	4.33	1.086	*.852*	.718	.025			
4:18 a	14-29	3.94	1.133	.900	*.756*	.020			
4:13 a	15-23	3.73	1.161	*.903*	.739	.020			
3:55 a	21-44	2.69	1.262	*.952*	.749	.020			
3:30 a	22-44	2.58	1.277	.955	*.752*	.020			
2:17 a	33-40	1.80	1.401	1.003	*.806*	.020	5		P=50.2.
2:12 a	34-19	1.78	1.398	*1.003*	.809	.020			
0:47 a	43-02	1.46	1.466	*1.034*	.826	.020			
0:43 a	42-14	1.49	1.467	1.034	*.826*	.020			

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, 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: Diff. long.	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day
1933	*h. m.*	°	°	°			
Feb. 2 (Naval Observatory)	11 20	−62.0	303.3	+13.0	------	1173	------
		−45.0	320.3	+10.0	------	46	------
		−36.0	329.3	+10.0	77	------	------
		+15.0	20.3	+6.0	------	216	1,512
Feb. 3 (Naval Observatory)	14 31	−48.0	302.4	+13.0	------	1111	------
		−21.0	329.4	+10.0	77	------	------
		+30.0	20.4	+6.0	------	185	1,373
Feb. 4 (Mount Wilson)	12 30	−35.0	303.3	+13.0	------	1091	------
		−8.0	330.3	+11.0	80	------	------
		+48.0	26.3	+8.0	114	------	1,285
Feb. 5 (Naval Observatory)	12 53	−22.0	303.0	+13.0	------	1173	------
		+4.0	329.0	+10.0	77	------	------
		+62.0	27.0	+6.0	123	------	1,373
Feb. 6 (Naval Observatory)	10 55	−9.0	303.9	+13.0	------	957	------
		+16.0	328.9	+10.0	62	------	------
		+74.0	26.9	+6.0	154	------	1,173
Feb. 7 (Naval Observatory)	10 20	+2.0	302.0	+13.0	------	1049	------
		+29.0	329.0	+10.0	77	------	------
		+70.0	10.0	−12.0	------	46	1,172
Feb. 8 (Naval Observatory)	10 43	+16.0	302.6	+13.0	------	710	------
		+43.0	329.6	+9.0	62	------	772
Feb. 9 (Naval Observatory)	10 32	+29.0	302.6	+13.0	------	741	------
		+56.0	329.6	+9.0	93	------	834