SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING NOVEMBER 1933

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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 November at Washington and Madison and close to normal at Lincoln.

Table 2 shows a deficiency in the total solar and sky radiation received on a horizontal surface at Washington and Pittsburgh, and an excess at all other stations for which normals have been computed.

Turbidity measurements were obtained on November 17th only, and these show that the sky was remarkably free from dry dust on that day.

Polarization measurements obtained at Washington on 5 days give a mean of 57 percent with a maximum of 63 percent on the 10th. At Madison, measurements on 2 days give a mean of 64 percent with a maximum of 65 percent on the 20th. The values for Washington are close to the November normals, while those at Madison are somewhat below normal.

TABLE 1.—*Solar radiation intensities during November 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*
Nov. 7	5.56	0.60									5.36
Nov. 15	1.32			1.19							1.19
Nov. 16	1.37	.85	1.02	1.15	1.28			1.19			1.32
Nov. 17	1.88	.79	.90	1.12	1.30						1.96
Nov. 20	4.37	.68	.80	.98	1.18						4.17
Nov. 25	3.99	.76	.87	1.01	1.24						4.17
Nov. 27	2.26	.98	1.10	1.25	1.35						2.06
Means		.77	.94	1.12	1.27			(1.19)			
Departures		+.01	+.07	+.11	+.08			+.19			

TABLE 1.—*Solar radiation intensities during November 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*	*mm*
Nov. 3	2.87			1.29							2.7
Nov. 16	1.07	1.06	1.18	1.35	1.43		1.40				577
Nov. 20	4.17				1.20			0.65			1.6
Nov. 27	3.15							1.10			5.1
Means		(1.06)	(1.18)	(1.32)	(1.32)		(1.40)	(.88)			4.4
Departures		+.28	+.16	+.17	+.02		+.04	−.25			

LINCOLN, NEBR.

Nov. 1	11.38	0.76	0.86	1.02	1.19						11.81
Nov. 2	4.75								1.16	1.04	3.81
Nov. 3	3.30	.82	.91	1.14	1.39		1.39	1.23	1.09	.99	4.37
Nov. 6	2.87	.79	.92	1.11	1.31		1.30	1.12	1.01	.84	3.30
Nov. 7	2.62	1.08	1.20	1.34					1.15		2.36
Nov. 8	3.81	.77	.91	1.04	1.37		1.38				4.37
Nov. 9	2.36						1.44	1.26	1.15	1.03	2.26
Nov. 10	3.99	.88	1.00	1.09	1.29			1.13	.99	.87	5.36
Nov. 11	4.95	.95	1.14	1.26							5.79
Nov. 14	3.81	1.06	1.18								3.30
Nov. 16	2.06	.97	1.08	1.21	1.36						2.62
Nov. 17	4.95						1.34	1.20	1.07	.97	3.81
Nov. 20	3.30	.96	1.05	1.19	1.37						4.57
Nov. 21	3.99	.84	.99	1.21							3.81
Nov. 27	3.15	.93	1.09	1.20				1.14	1.01	.92	4.37
Nov. 29	3.63			.95				1.00	.85	.73	5.16
Means		.90	1.03	1.15	1.33		1.37	1.15	1.05	.92	
Departures		±.00	+.01	−.02	−.01		−.02	−.03	+.01	±.00	

BLUE HILL, MASS.

Nov. 1	4.8			1.11	1.28		1.30	1.20			4.5
Nov. 2	5.0			.97	1.15						6.3
Nov. 4	3.9				1.40		1.39	1.21			2.7
Nov. 5	2.0			1.26	1.40		1.42		1.09		1.5
Nov. 8	4.6							1.12			2.5
Nov. 11	2.4						1.30				1.9
Nov. 12	3.4				1.30		1.30	1.23			1.6
Nov. 15	1.6				1.36						1.1
Nov. 16	1.3			1.39	1.42		1.41	1.27	1.12		1.0
Nov. 17	1.8				1.35						1.5
Nov. 19	2.3						1.38	1.29	1.12		1.8
Nov. 20	3.9							1.20	1.05		2.3
Nov. 21	1.4						1.28	1.22			3.1
Nov. 23	4.2				1.22						4.4
Nov. 25	3.4			1.11	1.22						3.2
Nov. 27	4.0						1.18	1.01	.86	0.73	2.2
Nov. 29	3.7						1.26				3.5
Nov. 30	4.8			.80	.94						5.7
Means				1.11	1.28		1.31	1.19	1.05	(.73)	

[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	Blue Hill
	Gram calories per square centimeter														
1933	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Oct. 29	255	202	273	237	213	303	158	54	173	363	221	328	221	311	281
Nov. 5	117	107	271	78	141	355	69	29	295	389	284	411	293	359	184
Nov. 12	190	171	229	140	162	299	103	23	257	273	332	371	283	310	66
Nov. 19	163	139	200	162	131	289	188	20	227	315	262	338	[1] 228	314	168
Nov. 26	200	130	166	112	155	256	103	18	206	259	278	247	245	232	160
	Departures from weekly normals														
Oct. 29	+5	+16	+32	+96	+35	−19	+2		−42	+34	−17	−16			
Nov. 5	−111	−57	+29	−41	−10	+61	−59		+97	+57	+33	+68			
Nov. 12	−7	+34	+16	+34	+32	+32	−19		+86	−45	+112	+19			
Nov. 19	−25	+10	−10	+60	+12	+45	+63		+71	−1	+51	+13			
Nov. 26	+29	+2	−27	+16	+45	+41	−4		+61	−43	+65	−50			
	Accumulated departures on Dec. 2														
	+6,804	−1,407	+5,796	+14,805	+9,884	+10,710	−1,778		+2,520	+9,261		−4746			

[1] 6-day mean.

TABLE 3.—*Solar radiation measurements, and determinations of atmospheric turbidity factor, β, Washington, D.C., November 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	Notes: (skylight polarization, P.) clouds, etc.)
Nov. 17			*gr. cal.*	*gr. cal.*	*gr. cal.*			
3:47 a.	11–28	4.91	0.799	*0.648*	0.549	0.030		
3:43 a.	12–06	4.68	.815	.652	*.551*	.030		
3:35 a.	13–22	4.26	.840	*.684*	.577	.040		
3:30 a.	14–05	4.05	.888	.686	*.580*	.030		
3:20 a.	15–35	3.68	.969	.734	*.621*	.020		
3:16 a.	16–10	3.55	.981	*.737*	.624	.020		
2:10 a.	24–37	2.39	1.181	*.827*	.691	.020		
2:06 a.	25–01	2.37	1.181	.844	*.692*	.020		
0:19 a.	31–56	1.89	1.308	.916	*.757*	.020		
0:14 a.	32–01	1.88	1.296	*.916*	.738	.020	5	P=57.5

Solar radiation measurements obtained at the Blue Hill Meteorological Observatory of Harvard University during November 1933

[I_m=intensity in the whole spectrum; I_y=intensity transmitted by yellow glass screen OG_1; I_r=intensity transmitted by red glass screen RG_2]

Date and solar hour angle	Solar altitude, *h*.		Air mass, *m*.	I_m	I_y	I_r	Sky conditions; clouds, haze (hz), smoke (smk), visibility (v), wind, etc.
Nov. 5	°	′		*gr.cal.*	*gr.cal.*	*gr.cal.*	
0:02, p.m.	32	04	1.88	1.390	1.017	0.810	Few Ci; v 8–9; WNW-4.
Nov. 8							
3:27, p.m.	14	20	3.99	.976	.747	.598	2 Ci, 1 Acu, 2 Stcu; v 9; W-6.
Nov. 11							
1:23, a.m.	27	23	2.17	1.300	.958	.777	1 Cu; v 8; W-5.
Nov. 12							
0:14, p.m.	29	58	2.00	1.197	.900	.742	Few Frcu; v 8–9; NW-5.
2:34, p.m.	20	22	2.85	1.238	.954	.770	Few Cist, few Frcu; v 8–9; NW-4.
2:48, p.m.	18	40	3.10	1.220	.950	.760	
Nov. 16							
1:35, a.m.	25	16	2.33	1.418	1.057	.864	Few Frcu; v 9; W-5.
0:15, p.m.	28	56	2.06	1.413	1.053	.842	No clouds; v 9; W-4.
3:03, p.m.	15	52	3.70	1.156	.904	.752	Few Cu; v 9; W-4.
Nov. 19							
2:56, p.m.	16	09	3.57	1.148	.914	.711	Few Ci, Frcu; v 9; W-4–5.
Nov. 21							
2:01, a.m.	19	39	2.96	1.287	.945	.747	Few Ci, 4 Acu; v 6–7; SE-2.
Nov. 23							
1:05, a.m.	24	21	2.42	1.107	.824	.762	Few Cu; hz; v 6–7; NNW-3.
Nov. 25							
1:04, a.m.	25	19	2.33	1.251	.918	.729	1 Ci, 1 Acu, 1 Stcu; v 8; W-1.
Nov. 27							
0:32, p.m.	26	03	2.28	1.089	.805	.657	2 Acu, 5 Stcu; lt. hz; WNW-6.
Nov. 28							
2:02, a.m.	20	30	2.84	.976	.747	.612	Few Acu; hz; v 7; WSW-3.
Nov. 29							
0:14, a.m.	26	13	2.26	1.202	.900	.711	1 Acu; hz; SW-1.
Nov. 30							
1:56, a.m.	20	42	2.81	.792	.612	.513	Few Ci; dense hz; SWW-7.
0:04, a.m.	26	07	2.27	.827	.634	.536	Few Cu; dense hz; SW-8.

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			Area		Total area for each day
			Diff. long.	Longitude	Latitude	Spot	Group	
1933	*h.*	*m.*	°	°	°			
Nov. 1 (Naval Observatory)	12	4	+78.0	90.6	+7.5		39	39
Nov. 2 (Naval Observatory)	12	30		No spots				
Nov. 3 (Naval Observatory)	12	53		No spots				
Nov. 4 (Naval Observatory)	11	15		No spots				
Nov. 5 (Mount Wilson)	11	3		No spots				
Nov. 6 (Naval Observatory)	13	50		No spots				
Nov. 7 (Mount Wilson)	11	12		No spots				
Nov. 8 (Naval Observatory)	12	18		No spots				
Nov. 9 (Mount Wilson)	11	19		No spots				
Nov. 10 (Naval Observatory)	11	9		No spots				
Nov. 11 (Naval Observatory)	10	53		No spots				
Nov. 12 (Naval Observatory)	10	47		No spots				
Nov. 13 (Mount Wilson)	11	24		No spots				
Nov. 14 (Naval Observatory)	10	41		No spots				
Nov. 15 (Naval Observatory)	12	50		No spots				
Nov. 16 (Naval Observatory)	12	0		No spots				
Nov. 17 (Naval Observatory)	11	56		No spots				
Nov. 18 (Mount Wilson)	10	14		No spots				
Nov. 19 (Mount Wilson)	11	10		No spots				
Nov. 20 (Naval Observatory)	12	20		No spots				
Nov. 21 (Naval Observatory)	13	10		No spots				
Nov. 22 (Naval Observatory)	11	46		No spots				
Nov. 23 (Naval Observatory)	10	58		No spots				
Nov. 24 (Mount Wilson)	11	20	+25.0	94.8	+8.0		7	7
Nov. 25 (Naval Observatory)	11	30		No spots				
Nov. 26 (Naval Observatory)	11	38		No spots				
Nov. 27 (Naval Observatory)	12	29		No spots				
Nov. 28 (Naval Observatory)	12	13		No spots				
Nov. 29 (Naval Observatory)	11	34		No spots				
Nov. 30 (Naval Observatory)	12	15		No spots				
Mean daily area for November								2

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR NOVEMBER 1933

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

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

November 1933	Relative numbers	November 1933	Relative numbers	November 1933	Relative numbers
1	10	11	0	21	0
2	0	12	0	22	
3	0	13		23	0
4	8	14	0	24	
5	0	15	0	25	
6	0	16	0	26	0
7	0	17	0	27	0
8	0	18	0	28	
9	0	19	0	39	0
10		20	0	30	0

Mean: 25 days=0.7.