SPECIAL OBSERVATIONS.

SOLAR AND SKY RADIATION MEASUREMENTS DURING DECEMBER, 1919.

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[Dated: Solar Radiation Investigations Section, Washington, Jan. 29, 1920.]

For a description of instrumental exposures, and an account of the methods of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1919, 47:4.

The monthly means and departures from normal in Table 1 show that radiation measurements averaged very close to December normal values at all stations.

Table 3 shows a deficiency in the total radiation for December at Washington of about 4 per cent, and an excess at Madison and Lincoln of 7 per cent and 2 per cent, respectively. It will be noted from the table that all three stations show a deficiency of radiation for the year, ranging from 3 per cent at Lincoln to 6 per cent at Washington.

The skylight polarization measurements made at Washington on 4 days give a mean of 62 per cent, with a maximum of 66 per cent on the 3d. These are average values for Washington in December. No polarization measurements were obtained at Madison, as the ground was covered with snow throughout the month.

TABLE 1.—*Solar radiation intensities during December, 1919.*

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

WASHINGTON, D. C.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Dec. 1			1.27							
3	[1]1.56		1.42	1.33	1.24	1.15	1.08	1.05	1.02	0.96
4			1.13	1.04	0.93	0.84	0.76	0.69		
11			1.14	1.07	1.01	0.95	0.90	0.84	0.80	0.75
15					1.16	1.09	1.02	0.92	0.87	0.82
16			1.14	1.11	1.01	0.94	0.87	0.81	0.75	0.69
20				1.03						
21			0.94							
22			1.17							
30				1.01			0.76	0.72		
31				1.05	0.95	0.93		0.81	0.78	
Monthly means			1.17	1.09	1.05	0.98	0.90	0.83	0.84	0.80
Departure from 12-year normal			−0.05	−0.03	±0.00	±0.00	+0.01	+0.02	+0.08	+0.14
P. M.										
Dec. 1				1.19	1.13	1.05	0.99	0.93	0.87	0.83
3				1.30	1.20	1.12	1.04	0.99	0.95	0.91
4				1.02	0.93	0.86	0.79	0.65	0.58	0.53
10					1.06	0.94	0.92	0.80	0.76	0.72
21				0.83	0.76	0.68		0.61	0.57	
22				1.13	0.98	0.88	0.80	0.73	0.67	
Monthly means				1.09	1.01	0.92	0.91	0.78	0.73	0.75
Departure from 12-year normal				−0.04	−0.02	−0.02	+0.03	−0.06	−0.04	+0.02

MADISON, WIS.

Date.	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Dec. 2				1.38	1.28					
13				1.34						
15						1.22		1.04		
26				1.31						

[1] Extrapolated and reduced to mean solar distance.

TABLE 1.—*Solar radiation intensities during December, 1919*—Contd.

MADISON, WIS.—Continued.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal
Monthly means				1.34	(1.28)	(1.22)		(1.04)		
Departure from 10-year normal				+0.04	+0.07	+0.07		−0.01		
P. M.										
Dec. 2				1.36	1.36	1.28				
29						1.05	0.98			
Monthly means				(1.36)	(1.36)	(1.16)	(0.98)			
Departure from 10-year normal					+0.06	−0.03	−0.12			

LINCOLN, NEBR.

Date.	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
A. M.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Dec. 2				1.27	1.17	1.07				
9				1.40						
15						1.09				
26				1.35	1.28	1.21	1.17			
30				1.26	1.20	1.15	1.09		0.93	
Monthly means				1.32	1.22	1.13	(1.13)		(0.93)	
Departure from 5-year normal				+0.02	−0.02	±0.00	+0.08		+0.05	
P. M.										
Dec. 2				1.26	1.18	1.10	1.03	0.97	0.90	
9				1.35	1.30	1.23	1.17	1.10	1.05	0.99
15					1.11	1.03	0.93	0.88	0.84	
16				1.28		1.10	1.06	0.97	0.90	0.83
26				1.34	1.28	1.21	1.13	1.08	1.02	0.97
29				1.30	1.22	1.18	1.14			
30				1.32	1.26	1.21	1.16		1.06	
Monthly means				1.31	1.22	1.15	1.09	1.00	0.96	0.93
Departure from 5-year normal				+0.03	+0.02	+0.01	±0.00	−0.03	−0.01	−0.01

SANTA FE, N. MEX.

Date.	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
A. M.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Dec. 10					1.14					
13			1.56							
20					1.40	1.37				
22			1.45	1.42	1.38					
23			1.57							
26			1.52							
29			1.47	1.47	1.44	1.33	1.23			
31						1.17				
Monthly means			1.51	(1.44)	1.34	1.29	(1.23)			
Departure from 5-year normal			+0.01	+0.01	−0.02	−0.01	−0.01			
P. M.										
Dec. 12					1.41	1.33	1.26	1.19	1.13	
13				1.49	1.43	1.37	1.32	1.26	1.21	
23				1.46	1.25					
Monthly means				(1.48)	1.36	(1.35)	(1.29)	(1.22)	(1.17)	
Departure from 5-year normal				+0.07	+0.04	+0.08	+0.06	+0.06	+0.08	

TABLE 2.—*Vapor pressures at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.			Santa Fe, N. Mex.		
Date.	8 a.m.	8 p.m.	Date.	8 a.m.	8 p.m.	Date.	8 a.m.	8 p.m.	Date.	8 a.m.	8 p.m.
1919.	*mm.*	*mm.*	1919.	*mm.*	*mm.*	1919.	*mm.*	*mm.*	1919.	*mm.*	*mm.*
Dec. 1	2.62	3.30	Dec. 2	0.64	0.71	Dec. 2	0.96	1.07	Dec. 10	2.49	2.62
3	1.68	2.06	13	0.86	0.46	9	0.64	0.51	12	2.16	2.74
4	1.88	2.74	15	0.41	0.43	15	1.24	1.88	13	2.26	0.71
10	2.49	1.19	16	3.63	3.15	16	1.37	2.87	20	1.78	2.06
11	1.45	2.06	29	3.00	3.45	26	3.63	3.99	22	2.62	2.87
15	1.78	1.78				29	4.17	4.95	23	2.06	2.49
16	1.37	2.62				30	3.81	4.75	26	2.16	1.78
20	1.78	1.68							29	1.96	1.60
21	1.19	2.26							31	1.68	1.68
22	2.49	3.15									
30	2.87	2.49									
31	2.87	4.37									

TABLE 3.—*Daily totals and departures of solar and sky radiation during December, 1919.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.			Departures from normal.			Excess or deficiency since first of month.		
	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
1	249	86	105	77	− 46	− 86	77	− 46	− 86
2	141	222	291	− 29	91	102	48	45	16
3	266	202	252	98	72	65	146	117	81
4	240	68	215	74	− 62	30	220	55	111
5	161	178	106	− 63	49	− 77	157	104	34
6	32	54	93	−131	− 75	− 89	26	29	− 55
7	188	123	229	26	− 6	48	52	23	− 7
8	24	208	104	−137	79	− 76	− 85	102	− 83
9	32	132	319	−128	3	140	−213	105	57
10	198	204	280	38	75	102	−175	180	159
11	229	153	213	70	25	36	−105	205	195
12	68	126	188	− 90	− 2	12	−195	203	207
13	118	213	277	− 40	85	102	−235	288	309
14	100	206	264	− 57	78	90	−292	366	399
15	232	225	237	76	97	63	−216	463	462
16	247	91	232	91	− 37	58	−125	426	520
17	170	109	226	14	− 20	52	−111	406	572
18	100	92	198	− 56	− 37	24	−167	369	596
19	29	174	69	−127	44	−105	−294	413	491
20	218	63	76	62	− 68	− 98	−232	345	393
Decade departure.							− 57	165	234
21	196	59	143	40	− 72	− 30	−192	273	363
22	216	98	73	59	− 34	−100	−133	239	263
23	225	99	211	68	− 33	38	− 65	206	301
24	54	124	28	−103	− 9	−145	−168	197	156
25	228	138	67	71	4	−106	− 97	201	50
26	120	178	256	− 37	43	82	−134	244	132
27	91	103	75	− 67	− 33	−100	−201	211	32
28	78	176	196	− 80	39	20	−281	250	52
29	160	121	242	1	− 17	65	−280	233	117
30	195	174	249	36	35	70	−244	268	187
31	204	143	106	44	3	− 74	−200	271	113
Decade departure.							+ 32	− 84	−280
Excess or deficiency since first of year						Gr.-cal.	−7,389	−4,331	−4,435
						Per cent	−5.9	−3.6	−3.2

MEASUREMENTS OF THE SOLAR CONSTANT OF RADIATION AT CALAMA, CHILE.

By C. G. ABBOT.

[Dated: Astrophysical Observatory, Smithsonian Institution, Washington, Jan. 27, 1920.]

In continuation of preceding publications I give in the following table the results obtained at Calama, Chile, in November, 1919, for the solar constant of radiation. The reader is referred to this REVIEW for February, August, and September, 1919, for statements of the arrangement and meaning of the table.

The intensity of solar radiation during November was generally unusually high.

Date.	Solar constant.	Method.	Grade.	Transmission coefficient at 0.5 micron.	Humidity. ρ/ρ s.c.	Humidity. V. P.	Humidity. Relative humidity.	Remarks.
1919.	*cal.*					*cm.*	%	
A. M. Nov. 1	1.960	M_3	S−	0.860	0.634	0.18	19	Scattered cirri in east and west.
	1.950	M_2						
	1.966	$M_{1.5}$						
	1.957	W. M.						
2	1.957	$M_{1.45}$	S	.864	.797	.11	10	Cirri scattered about whole sky.
3	1.957	$M_{1.15}$	S−	.862	.746	.18	12	Scattered cirri about whole sky.
4	1.960	$M_{1.8}$	S−	.864	.766	.18	12	Scattered cirri about sky.
5	1.956	E_0	VG+	.862	.634	1.6	16	Cirri in west and northeast.
	1.971	M_3						
	1.977	M_2						
	1.966	$M_{1.5}$						
	1.969	W. M.						
P. M. 6	1.952	$M_{1.11}$	S−	.850	.764	.26	9	Cirri in east and west.
A. M. 7	1.939	M_3	S	.868	.734	.14	14	Thin cirri in north, east, and southwest.
	1.947	M_2						
	1.944	W. M.						
9	1.948	$M_{1.02}$	S−	.864	.756	.45	24	Cirri in north and east.
10	1.950	E_0	E−	.864	.560	.28	28	Some cirri low in east and north.
	1.968	M_3						
	1.950	M_2						
	1.961	$M_{1.5}$						
	1.960	W. M.						
11	1.966	$M_{2.15}$	S−	.846	.572	.26	23	Scattered cirri, especially in north and east.
12	1.957	M_3	S	.849	.498	.24	22	
	1.966	M_2						
	1.958	$M_{1.5}$						
	1.961	W. M.						
13	1.966	M_2	S	.846	.559	.29	21	Scattered cirro-cumuli in east and north.
	1.954	$M_{1.87}$						
	1.960	W. M.						
15	1.921	M_3	S	.848	.456	.29	26	Cirri in west and distant east.
	1.949	M_2						
	1.952	$M_{1.5}$						
	1.947	W. M.						
17	1.911	E_0	E−	.862	.526	.23	24	Cirri in east, north, and west, moving south.
	1.921	M_3						
	1.940	M_2						
	1.926	$M_{1.5}$						
	1.925	W. M.						
18	1.959	M_2	S	.858	.510	.24	22	Distant cirri in east and northwest.
	1.971	M_2						
	1.958	$M_{1.5}$						
	1.961	W. M.						
21	1.952	$M_{1.5}$	S	.850	.591	.34	24	Scattered cirri.
	1.956	$M_{1.69}$						
	1.954	W. M.						
22	1.950	$M_{1.5}$	S−	.849	.619	.30	22	Thin cirri in early a.m. gradually disappearing
	1.934	$M_{1.64}$						
	1.940	W. M.						
23	1.952	M_2	S+	.846	.552	.28	20	Cirri in east and north, and some in west.
	1.950	$M_{1.5}$						
	1.951	W. M.						
24	1.952	M_3	S−	.843	.546	.33	26	Cirri in north and east, moving rapidly south.
P. M. 25	1.944	$M_{1.12}$	S−	.854	.645	.44	17	Scattered cirri over whole sky.
A. M. 26	1.968	$M_{1.5}$	S−	.855	.632	.29	22	Cirri in north and east spreading west and moving south.
27	1.913	E_0	VG	.845	.464	.24	23	Distant cirri in north and east.
	1.949	M_3						
	1.964	M_2						
	1.928	$M_{1.5}$						
	1.936	W. M.						
28	1.958	M_2	S	.851	.601	.28	23	
	1.956	$M_{1.5}$						
	1.957	W. M.						
29	1.950	M_2	S	.854	.672	.15	14	
	1.953	$M_{1.5}$						
	1.952	W. M.						
30	1.955	M_2	S	.856	.638	.21	18	Some cirri in north and east.
	1.956	$M_{1.40}$						
	1.956	W. M.						