SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING DECEMBER, 1918.

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[Dated: Weather Bureau, Washington, D. C., Jan. 28, 1919.]

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, 1918, **46**:2

The monthly means and departures from normal values in Table 1 show that solar radiation intensities averaged very close to normal values at Lincoln, Nebr., and somewhat below at Washington, D. C. At Madison, Wis., measurements were obtained on only one day, the 11th, and these were interrupted by clouds which obscured the sun by 10 a. m. The 27th was the only clear day during the month, and on that day there were some clouds in the morning.

As was to be expected under these cloudy conditions, Table 3 shows a deficiency of radiation for Madison amounting to 33 per cent of the normal amount for December. Lincoln shows a deficiency of 18 per cent, and Washington a deficiency of 14 per cent.

For the year, Washington shows a deficiency of 3,905 calories, or 3 per cent of the normal amount, of which 2,600 calories, or two-thirds of the total deficiency, was lost during the months of April and September. The only decided departure from normal radiation during the year at Madison is that for the month of December. The departures at Lincoln are less regular.

No radiation measurements were obtained at Santa Fe during the month due to a defect in the galvanometer.

Clouds prevented measurements of skylight polarization at Madison. At Washington, measurements on three different days give a mean of 58 per cent, with a maximum of 62 per cent on the 15th. These are close to the average values for Washington in December.

TABLE 1.—*Solar radiation intensities during December, 1918.*

[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. 2			1.15							
3			1.29							
5				1.11						
6			1.15	1.07	0.99	0.91	0.75	0.69	0.57	0.49
12				1.07						
17			1.27							
18			1.20	1.24		1.12	1.02	0.98	0.93	0.89
19				0.92	0.85	0.79	0.69	0.59	0.52	
30			1.13	1.07	0.98					
Monthly means			**1.20**	**1.08**	**0.94**	**0.94**	**0.82**	**0.75**	**0.67**	**(0.69)**
Departure from 11-year normal			**−0.03**	**−0.05**	**−0.11**	**−0.04**	**−0.07**	**−0.06**	**−0.07**	**+0.06**

TABLE 1.—*Solar radiation intensities during December, 1918*—Con.

Washington, D. C.—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
P. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Dec. 2				1.10	1.04	0.89				
6				1.00	0.75	0.66	0.59	0.53	0.48	0.42
12				1.05	0.96	0.81	0.74	0.68		
17				1.23	1.14	1.06	0.99	0.91	0.87	0.83
18				1.14	1.06	1.01	0.96	0.91	0.83	0.79
30				1.02	0.94	0.87	0.80	0.74	0.65	0.59
Monthly means				**1.09**	**0.98**	**0.88**	**0.82**	**0.75**	**0.71**	**0.66**
Departure from 11-year normal				**−0.05**	**−0.06**	**−0.06**	**−0.06**	**−0.10**	**−0.07**	**−0.07**

Madison, Wis.

A. M.										
Dec. 11						1.13	1.09	1.02	0.96	0.90
Monthly means						**(1.13)**	**(1.09)**	**(1.02)**	**(0.96)**	**(0.90)**
Departure from 9-year normal						**−0.02**	**−0.05**	**−0.03**	**+0.04**	**+0.01**

Lincoln, Nebr.

A. M.										
Dec. 10					1.22					
11					1.26	1.19	1.13	1.07	1.01	
14				1.34	1.30	1.24	1.17			
25				1.35	1.22	1.10				
29					1.17	1.08	1.00			
Monthly means				**(1.34)**	**1.23**	**1.15**	**1.10**	**(1.07)**	**(1.01)**	
Departure from 4-year normal				**+0.04**	**−0.01**	**+0.02**	**+0.07**	**+0.10**	**+0.13**	
P. M.										
Dec. 10								1.06		0.97
29						1.10	1.06	1.01	0.97	
Monthly means						**(1.10)**	**(1.06)**	**(1.04)**	**(0.97)**	**(0.97)**
Departure from 4-year normal						**−0.03**	**−0.02**	**−0.01**	**−0.01**	**+0.03**

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

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.		
Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.
1918.	*mm.*	*mm.*	1918.	*mm.*	*mm.*	1918.	*mm.*	*mm.*
Dec. 2	3.00	4.75	Dec. 11	4.17	4.57	Dec. 10	4.37	3.30
3	4.17	4.57				11	3.00	3.81
5	2.62	2.74				14	3.81	5.16
6	3.63	2.36				25	0.96	1.52
12	5.79	4.95				29	2.87	3.81
17	3.63	2.87						
18	1.96	2.62						
19	3.30	3.63						
30	2.16	3.30						

TABLE 3.—*Daily totals and departures of solar and sky radiation during December, 1918.*

(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.
Dec. 1	188	40	183	15	− 90	− 5	15	− 90	− 5
2	176	113	224	5	− 16	38	20	−106	33
3	189	57	242	20	− 72	58	40	−178	91
4	145	109	221	− 22	− 20	39	18	−198	130
5	188	117	241	23	− 11	61	41	−209	191
6	223	142	157	59	14	− 22	100	−195	169
7	128	145	158	− 35	17	− 20	65	−178	149
8	117	172	142	− 45	44	− 35	20	−134	114
9	139	17	40	− 22	−111	−136	− 2	−245	− 22
10	66	56	197	− 94	− 71	22	− 96	−316	0
11	14	101	244	−145	− 26	70	−241	−342	70
12	183	85	36	25	− 42	−137	−216	−384	− 67
13	39	32	60	−118	− 95	−112	−334	−479	−179
14	44	163	241	−112	36	70	−446	−443	−109
15	95	143	228	− 61	16	57	−507	−427	− 52
16	36	69	176	−120	− 59	5	−627	−486	− 47
17	183	140	29	27	12	−143	−600	−474	−190
18	244	54	23	88	− 75	−149	−512	−549	−339
Dec. 19	182	115	32	26	− 14	−140	− 486	− 563	− 479
20	167	19	20	10	−111	−153	− 476	− 674	− 632
Decade departure							− 380	− 358	− 632
21	140	18	66	− 17	−112	−107	− 493	− 786	− 739
22	20	23	117	−137	−108	− 57	− 630	− 894	− 796
23	195	28	53	38	−104	−121	− 592	− 998	− 917
24	20	37	198	−137	− 95	23	− 729	−1,093	− 894
25	178	158	272	21	25	97	− 708	−1,068	− 797
26	190	151	100	32	17	− 76	− 676	−1,051	− 873
27	122	144	136	− 36	9	− 41	− 712	−1,042	− 914
28	183	121	218	25	− 15	40	− 687	−1,057	− 874
29	185	45	266	26	− 92	86	− 661	−1,149	− 788
30	216	49	58	57	− 89	−124	− 604	−1,238	− 912
31	70	34	133	− 90	−106	− 51	− 694	−1,344	− 963
Decade departure							− 218	− 670	− 331
Excess or deficiency since first of year. gr.-cal							−3,905	−1,190	−1,513
Excess or deficiency since first of year. per cent							− 3.1	− 1.0	− 1.1

HALO PHENOMENA OBSERVED DURING DECEMBER, 1918.

By WILLIS RAY GREGG, Meteorologist.

Station.	Altitude.	Latitude.	Longitude.	Date.	Form observed.	Time of— Beginning.	Ending.	Theodolite readings. Time.	Radius inside.	Radius outside.	Length of arc.	Distance from sun or moon.	Altitude of sun or moon.
	m.	° ′	° ′						°	°	°	°	°
*Broken Arrow, Okla.	233	36 02	95 49	16	Solar halo, 22°	2:30 p. m.	4:15 p. m.	3:48 p. m.	21.5	23	360		12.5
				16	Lunar halo, 22°	6:30 p. m.	D. N.						
				17	Solar halo, 22°	8:00 a. m.	8:40 a. m.	8:30 a. m.	21	23	5		10
				17	Parhelion, right, 22°.	8:00 a. m.	8:40 a. m.						
				19	Lunar halo, 22°	D. N., a.	6:25 a. m.				360		
Canton, N. Y.	137	44 36	75 10	2	Solar halo, 22°	2:00 p. m.	2:30 p. m.						
				17	Lunar halo, 22°	10:00 p. m.	10:30 p. m.						
				20	Solar halo, 22°	2:00 p. m.							
				21	Solar halo, 22°	2:22 p. m.	3:00 p. m.						
Cincinnati, Ohio	191	39 06	84 30	7	Solar halo, 22°	10:00 a. m.	12:30 p. m.						
Dayton, Ohio	274	39 46	84 10	7	Solar halo, 22°	11:35 a. m.	12:15 p. m.						
*Drexel, Nebr.	396	41 20	96 16	3	Solar halo, 22°	8:28 a. m.	11:12 a. m.	9:48 a. m.	22	23	180		17.5
				6	Solar halo, 22°	8:20 a. m.	10:22 a. m.	8:49 a. m.	22	22.5	180		10
				6	Solar halo, 46°	8:46 a. m.	8:50 a. m.	8:49 a. m.	45.5	46	90		10
				7	Solar halo, 22°	10:17 a. m.	11:38 a. m.	10:32 a. m.	22	23	210		21
				7	Solar halo, 46°	10:28 a. m.	11:05 a. m.	10:32 a. m.	45.5	46.5	45		21
				11	Solar halo, 22°	2:38 p. m.	4:18 p. m.	3:03 p. m.	22.5	23	190		15
				13	Lunar halo, 22°	6:42 p. m.	6:59 p. m.	6:55 p. m.	22	23	360		55
				16	Solar halo, 22°	8:50 a. m.	9:30 a. m.	9:06 a. m.	21	22	160		11
				16	Lunar halo, 22°	7:30 p. m.	10:30 p. m.	7:45 p. m.	21	21.5	360		40
				24	Solar halo, 22°	9:40 a. m.	11:12 a. m.	9:58 a. m.	22	23	180		16
*Ellendale, N. Dak.	444	45 59	98 34	22	Solar halo, 22°	8:05 a. m.	1:00 p. m.	9:40 a. m.	22	23	240		10.5
				30	Solar halo, 22°	2:20 p. m.	4:15 p. m.	2:30 p. m.	22.5	23	275		16
*Groesbeck, Tex.	141	31 30	96 28	9	Lunar halo, 22°	10:00 p. m.					360		
				10	Solar halo, 22°	3:00 p. m.							
				16	Solar halo, 22°	1:00 p. m.							
				16	Lunar halo, 22°	9:00 p. m.					360		
				17	Lunar halo, 22°	8:00 p. m.							
				22	Solar halo, 22°	10:10 a. m.	11:00 a. m						
				25	Solar halo, 22°	10:55 a. m.	11:00 a. m.						
*Leesburg, Ga.	85	31 47	84 14	9	Solar halo, 22°	10:32 a. m.	12:00 m.				180		
				10	Lunar halo, 22°	6:00 p. m.	8:30 p. m.				360		
				13	Lunar halo, 22°	6:09 p. m.	9:07 p. m.						
				14	Lunar halo, 22°	9:55 p. m.	10:55 p. m.						
				17	Solar halo, 22°	9:27 a. m.	4:30 p. m.	10:00 a. m.			300		
				23	Solar halo, 22°	1:53 p. m.	4:25 p. m.	2:00 p. m.			180		
				23	Parhelion, right, 22°.	2:00 p. m.	2:15 p. m.						
				23	Parhelion, left, 22°	2:00 p. m.	2:10 p. m.						
				26	Solar halo, 22°	3:19 p. m.	3:22 p. m.				2		
				29	Solar halo, 22°	10:53 a. m.	11:27 a. m.	11:00 a. m.			180		
Madison, Wis.	297	43 05	89 23	4	Solar halo, 22°	1:30 p. m.	2:45 p. m.						
				4	Parhelion, right, 22°.	1:30 p. m.	1:35 p. m.						
				4	Parhelion, left, 22°.	1:30 p. m.	1:35 p. m.						
				5	Solar halo, 22°	9:50 a. m.	10:25 a. m.						
				7	Solar halo, 22°	9:45 a. m.	10:00 a. m.						
				12	Solar halo, 22°	10:00 a. m.	11:00 a. m.						
				12	Upper tangent arc.	10:15 a. m.	10:30 a. m.						
				17	Solar halo, 22°	10:30 a. m.	11:00 a. m.						
				17	Upper tangent arc.	10:30 a. m.	11:00 a. m.						
				17	Lunar halo, 22°	8:00 p. m.	9:00 p. m.						
				19	Lunar halo, 22°	D. N., a.	6:45 a. m.						
				19	Solar halo, 22°	8:15 a. m.	9:40 a. m.						
				25	Parhelion, left, 22°.	3:30 p. m.	4:10 p. m.						
				26	Solar halo, 22°	10:20 a. m.	1:40 p. m.						
Nashville, Tenn.	166	36 10	86 47	18	Solar halo, 22°	1:00 p. m.	1:10 p. m.						
				19	Solar halo, 22°	12:00 m.	2:00 p. m.						
				30	Solar halo, 22°	11:45 a. m.	12:15 p. m.						
*Royal Center, Ind.	225	40 53	86 29	17	Solar halo, 22°	7:58 a. m.	8:40 a. m.						
				17	Solar halo, 22°	11:00 a. m.	11:20 a. m.						
				17	Solar halo, 22°	2:45 p. m.	3:30 p. m.						

*Aerological station.