SECTION I.—AEROLOGY.

SOLAR RADIATION INTENSITIES AT MOUNT WEATHER, VA., DURING APRIL, MAY, AND JUNE, 1914.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated Mount Weather, Va., July 16, 1914.]

In Table 1 are summarized the solar radiation measurements made at Mount Weather, Va., with a Marvin pyrheliometer, during April, May, and June, 1914. Measurements have been made with the sun at approximately the following zenith distances, whenever it was unobscured by clouds: 80.7°, 79.8°, 78.7°, 77.4°, 75.7°, 73.6°, 70.7°, 66.5°, 60.0°, and 48.3°, with an additional observation as near noon as possible, at which time the sun's zenith distance has varied from 33° in April to 18° in June.

For details relative to the standardization of the Marvin pyrheliometer, and the interpolation of readings to the air masses given in the heading of Table 1, see page 138 of the current volume of this REVIEW.

Both the maximum and the mean radiation intensities measured in April and June, 1914, equal those of corresponding months in previous years, and exceed those of 1913, and of June, 1912. From May 19 to May 27, inclusive, the radiation intensity was considerably below the average, probably on account of the smokiness of the atmosphere, due to forest fires in States north and west of Virginia. Through the courtesy of the Chief of Forest Service we are able to quote the following from the manuscript report by K. W. Woodward, Forest Inspector:

> On account of the long-continued dry weather the fire situation is very serious throughout the Southern Appalachians and White Mountains. At the present time large fires are burning near Government land in the White Top, Unaka, and Smoky Mountain areas. Ordinarily there would be no damage from fire in the Southern Appalachians this season of the year, because normally the foliage is completely out by this time. But, in most cases, there has been no rain to speak of since the 1st of May.

TABLE 1.—*Solar radiation intensities at Mount Weather, Va., during April, May, and June, 1914.*

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

Date.	Air masses.										
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0.	5.5	6.0
1914. A. M.	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*
Apr. 6	1.41	1.27	1.14	1.02	0.93	0.85	0.80	0.75	0.69	0.65	0.63
10	1.40	1.29	1.17	1.07	0.97	0.86	0.79	0.71	0.66	0.61	0.57
13	1.51	1.32	1.21	1.10	1.01	0.93	0.86	0.80	0.75	0.70	0.67
17	1.14	1.04	0.94								
18	1.24	1.14									
21	1.47										
22		1.33	1.22			0.92	0.86	0.80	0.75	0.69	
30			0.93	0.84	0.74	0.62	0.53	0.49	0.41		
Means	1.36	1.23	1.10	1.01	0.91	0.84	0.77	0.71	0.65	0.66	0.62
P. M.											
Apr. 9		1.29									
10		1.26	1.12								
11		1.04									
12		1.27	1.12	1.00	0.89	0.83	0.76	0.72	0.68		
13		1.31	1.14	1.01	0.91	0.82	0.74	0.68	0.62		
21		1.28	1.17	1.08	0.99	0.90	0.82	0.77	0.73	0.67	
22		1.27	1.14	1.07							
28	1.23	1.10	0.91	0.74	0.63	0.53					
Means	(1.23)	1.23	1.10	0.98	0.86	0.77	0.77	0.72	0.67	(0.67)	

TABLE 1.—*Solar radiation intensities at Mount Weather, Va., during April, May, and June, 1914*—Continued.

Date.	Air masses.										
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0.	5.5	6.0
1914. A. M.	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*
May 11		1.17									
14	1.31	1.20	1.07	0.92							
15	1.10	1.00	0.98	0.80	0.73						
16	1.27	1.08	0.92	0.81	0.71	0.61	0.52	0.46	0.42	0.38	0.33
18	1.28	1.09	0.93	0.79							
19	1.10	1.01	0.88	0.79	0.70	0.63	0.57	0.52	0.47	0.42	
20	0.99	0.86	0.68	0.58	0.50	0.42	0.36	0.31	0.27		
21	1.12	0.85	0.70	0.61	0.54	0.48	0.43	0.38	0.32		
23			0.91								
25		0.87									
26	1.02	0.76	0.62								
27					0.66	0.56					
Means	1.15	0.99	0.85	0.76	0.64	0.54	0.47	0.42	0.37	(0.40)	(0.33)
P. M.											
May 7		1.24									
12	1.33	1.07									
16		1.06	0.89	0.75	0.66	0.58	0.50	0.45	0.43		
17			0.76	0.68	0.60	0.53	0.47	0.42	0.38		
18		1.10	0.95	0.83	0.73	0.65	0.58	0.52	0.47	0.43	
19		0.91	0.80	0.70	0.58	0.52	0.48				
20		0.87	0.68	0.53	0.47	0.38	0.33				
21		0.88	0.56								
31		1.28	1.12	1.01	0.91	0.84	0.77				
Means	(1.33)	1.05	0.82	0.75	0.66	0.58	0.52	0.46	0.43	(0.43)	
A. M.											
June 2	1.40	1.28									
3	1.19	1.02									
7	1.29	1.10									
10	1.28	1.18	1.00								
11	1.24										
12	1.30	1.12									
13	1.40	1.32									
15		1.05	0.75		0.46	0.44	0.41				
16	1.47	1.35	1.24	1.16	1.10						
17						0.98	0.89	0.81			
20		1.39	1.26	1.13	1.05	0.98	0.93	0.88	0.83		
24	1.32	1.21	1.13	0.99	0.86	0.80	0.74	0.68	0.63		
26	1.18	1.09									
29		1.20	1.10	1.01	0.94	0.86	0.79	0.71	0.63		
30	1.42	1.36	1.27	1.17	1.08	1.01	0.95	0.90			
Means	1.32	1.21	1.11	1.09	0.92	0.84	0.78	0.80	0.70		
P. M.											
June 2		1.12	1.03	0.89							
12		0.92									
30		1.21	1.07	0.95	0.83						
Means		1.08	(1.05)	(0.92)	(0.83)						

TABLE 2.—*Radiation intensities at Mount Weather, Va., expressed in scale readings of the Callendar horizontal recording pyrheliometer.*

Date.	Sun's zenith distance.							
	19.2°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°
	SOLAR RADIATION. (*Scale divisions.*)							
1914. A. M.								
May 20	36.6	22.8	13.6	7.8	6.0	4.7	2.9	2.5
May 26	34.0	20.1	11.9	7.6	4.9	3.0	2.0	1.6
June 30	47.2	33.2	23.7	16.7	13.0	9.9	7.5	6.3
	SKY RADIATION.							
May 20	11.1	10.0	8.4	7.1	6.3	5.3	5.2	5.0
May 26	12.0	10.6	8.7	7.1	6.1	5.1	4.6	4.0
June 30	5.1	3.7	3.6	3.3	3.2	3.0	2.8	2.6
	TOTAL RADIATION.							
May 20	47.7	32.8	22.0	14.9	12.3	10.0	8.1	7.5
May 26	46.0	30.7	20.6	14.7	11.0	8.1	6.6	5.6
June 30	52.3	36.9	27.3	20.0	16.2	12.9	10.3	8.9

The decrease in direct solar radiation was accompanied by an increase in diffuse sky radiation, as is shown by the Callendar pyrheliometer measurements given in Table 2. May 20 and 26 were smoky days, and June 30 was an unusually clear day. There were practically no clouds on these three days before noon. The measurements were obtained as described and illustrated on pages 139 and 140 of the current volume of this Review.

The Callendar records indicate that from sunrise to noon on June 30 the sky radiation was 12 per cent of the total radiation, while on May 20 and 26 it was 32 per cent and 36 per cent, respectively.

The skylight polarization, measured at a point 90° from the sun and in the same vertical circle, with the sun at zenith distance 60°, was 31 per cent on May 20, 26 per cent on May 26, and 63 per cent on June 30.

It is no doubt due to the hygroscopic character of the particles constituting the smoke that its depleting effect on solar radiation was more marked during the morning, when the air temperature was low, than during the afternoon, when the air was warmer.

PHOTOMETRIC MEASURES OF THE ZODIACAL LIGHT.

By MAXWELL HALL.

[Dated Jamaica, W. I., June 5, 1914.]

1. In a former article on the zodiacal light [1] it was stated that a few observations had been made of the intensity of the light at different distances from the sun, as compared with the light of the sky at the same zenith distance at places as free from stars as possible; more observations of this character were made this year between February 19 and April 26, 1914, when the appearance of the young moon in the west and the commencement of the "May rains" put an end to the series which included both the clearest nights and the greatest brilliancy of the eastern branch of the zodiacal light, as seen in the evening in the west.

The reduction of the observations was commenced about the beginning of April, and although the measures forming any set were as a rule as uniform as could be expected, yet the resulting illuminations were discordant. However, by going through the original observations carefully, by striking out two sets which should not have been made, and by giving weights to all the remaining sets, results were obtained sufficiently good to compare with theory.

The instrument used was a dark-glass wedge about 4½ inches in length attached to the end of a small brass tube about 3½ inches in length and an inch in diameter; the tube was, of course, blackened inside, with a diaphragm near the wedge end so that the field in looking through the other end was as much as 6° in diameter; this reduced the light of the sky at night to a circular patch apparently no larger than the full moon near the zenith. The sharp edge of the tube completely enclosed the eye, thereby cutting off all side light, and the wedge could be easily moved by hand; light was required to read on a scale the position of the wedge which gave extinction of the circular patch, and repeated readings were alternately taken of the zodiacal light at a certain point in its axis, and of the light of the sky about the same altitude as free from the brighter stars as possible.

[1] Bulletin, Mount Weather Observatory, Washington, 1914, 6, pt. 3, p. 69.

Let m and m' be the magnitude of two stars at the same zenith distance, so that their reduction to the zenith is the same; let l and l' be their light, and r and r' their extinction readings on the wedge photometer; then

$$m'-m=c(r-r')=2.5\log\frac{l}{l'},$$

where c is constant for the particular instrument used. Thus

$$\log\frac{l}{l'}=0.4c(r-r');$$

and by observations made of several pairs of stars it was found that $0.4c=0.18$.

Let S_0 be the light of the sky at 30° or more above the horizon on an average fine dark starlight night and r_0 its extinction reading; let S be the light at any time and r_s its reading; then

$$\log\frac{S}{S_0}=0.18\ (r_s-r_0).$$

We shall take S_0 as unity and measure all such light in terms of S_0. The corresponding value of r_0 was taken to be 5.7.

Let L be the illumination at any point in the central axis of the zodiacal light, reduced to the zenith, and let R be the reducing factor; so that $\frac{L}{R}$ is the apparent light at the point in question and $\frac{L}{R}+S$ is the whole illumination of the field of view. We thus get

$$\log\left(\frac{\frac{L}{R}+S}{S}\right)=0.18(r-r_s),$$

where r is the extinction reading of the zodiacal light. This may be written

$$\log\left(\frac{L}{RS}+1\right)=0.18(r-r_s),$$

and we thus get $\frac{L}{RS}$, or N, a known quantity. Finally,

$$\log L=\log N+\log R+\log S \qquad (1)$$

For $\log R$, Seidel's table of the extinction of light by the atmosphere [2] increased by $\frac{1}{6}$ is used; this gives the magnitudes of stars down to 3° or 4° above the horizon to the nearest tenth of a magnitude (using the Revised Harvard Photometry) by a highly refined method adopted at Kempshot, so that it is absolutely correct for the present rough measurements, and, of course, $\log S=0.18(r_s-5.7)$.

The observations and their reductions will be found at the end of this article as formed into groups at different angular distances from the sun. The following are the general results:

Distance from sun. α	Light. L.
35°	7.2 ±0.7
50°	2.4 ±0.3
75°	1.1 ±0.1
100°	0.71±0.2
155°	0.25±0.03
180°	0.42±0.05

It is, however, important that we should obtain L along a line of sight as near the sun as possible, and the

[2] Phil. trans., London, 1873. Seidel's table enlarged is given as Table 5 at the end of this article.