high values being common in both sun and sky during the late spring and summer months. It is of interest to emphasize again that at low solar altitudes during the fall and winter months the amount of antirachitic radiation in sky radiation may equal or exceed that in direct sunshine.

The highest value for the antirachitic component in sunshine was 3,860 microgr.-cal. per sq. cm. per minute on May 30, 1934, at noon. The maximum value for the sky was obtained at noon on June 26, 1940, when the antirachitic component was equivalent to 972 microgr-cal. per sq. cm. per minute or 1.7 percent of the total energy at that time. Ives and Gill (5) measured the total antirachitic intensity from sun and sky in New Orleans on April 26, 1932, using an uranium photoelectric cell. Their noon value of 94.2 microwatts per sq. cm. (1,340 microgr.-cal. per sq. cm. per minute) was the highest obtained in their study of 14 American cities and is to be compared with our mean noon value of 1,272 microgr.-cal. per sq. cm. per minute for this month.

Measurement of the short wave-length limit of the solar spectrum with a Zeiss quartz spectrograph shows that it seldom extends to 300 mμ even at noon on very clear days. Analysis of the spectrograms taken during the 10-year period shows only one spectrogram with a wave-length limit shorter than 300 mμ. This was photographed on July 2, 1937, at noon and showed a short wave-length limit of 298 mμ. In general, the limit is about 304 mμ. during the spring, summer and fall months and above 306 mμ during the winter. It should be emphasized, however, that these are general trends and that even in June, July, and August there are many days when the spectrum does not extend below 308 or 310 mμ. and, likewise, there are clear days during the winter when the spectrum extends to 302 mμ.

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TABLE 1.—*Monthly mean intensities of direct solar radiation at normal incidence—1931–40*

[Gr. cal./sq. cm./min.]

	10 a. m.	12 m.	2 p. m.	Absolute maximum	Date
January	1.157	1.187	0.997	1.360	Jan. 14, 1931
February	1.046	1.159	0.985	1.380	Feb. 2, 1933
March	1.200	1.310	1.212	1.501	Mar. 7, 1931
April	1.107	1.178	1.042	1.210	Apr. 22, 1931
May	1.169	1.196	1.027	1.496	May 1, 1940
June	1.158	1.166	1.180	1.221	June 14, 1933
July	1.084	1.146	1.052	1.217	July 2, 1931
August	1.101	1.168	1.109	1.247	Aug. 12, 1940
September	1.079	1.076	1.114	1.198	Sept. 28, 1931
October	1.085	1.148	1.088	1.230	Oct. 12, 1936
November	1.057	1.099	0.994	1.178	Nov. 26, 1940
December	1.046	1.121	1.023	1.240	Dec. 20, 1939
Mean	1.107	1.163	1.069	----------	

TABLE 2.—*Hourly mean intensities of total radiation (direct and diffuse) received on a horizontal surface—All days, 1931–40*

[Gr. cal./sq. cm./min.].

Hour ending ing (apparent time)	7	8	9	10	11	12	1	2	3	4	5	6	Mean daily total (gr. cal./sq. cm.)
January	0.003	0.045	0.164	0.323	0.460	0.542	0.555	0.501	0.394	0.248	0.102	0.012	201.0
February	.005	.068	.220	.403	.530	.614	.628	.611	.509	.343	.171	.041	247.8
March	.027	.153	.346	.551	.704	.796	.804	.749	.623	.448	.236	.075	325.1
April	.066	.251	.469	.656	.810	.884	.902	.844	.706	.532	.324	.137	388.3
May	.126	.325	.547	.731	.867	.929	.930	.848	.749	.580	.376	.167	430.5
June	.206	.408	.627	.775	.910	.967	.941	.882	.737	.570	.434	.195	459.1
July	.166	.374	.569	.705	.806	.849	.820	.738	.619	.472	.330	.202	398.7
August	.126	.334	.544	.701	.780	.792	.790	.736	.633	.488	.316	.158	385.1
September	.091	.287	.523	.698	.800	.866	.846	.771	.643	.454	.265	.102	379.8
October	.047	.210	.442	.639	.780	.856	.812	.730	.573	.370	.162	.036	337.7
November	.011	.125	.301	.489	.621	.690	.681	.596	.437	.242	.076	.008	256.5
December	.002	.052	.177	.336	.474	.533	.532	.469	.373	.200	.058	.002	190.5
Mean	.078	.225	.417	.589	.716	.780	.774	.720	.587	.420	.245	.091	333.3

TABLE 3.—*Maximum intensities (direct and diffuse) as received on a horizontal surface*

Year	Highest hourly mean		Highest daily total	
	Date	Gr.cal./sq. cm./min.	Date	Gr.cal./sq. cm./min.
1931	May 24, 12 m.–1 p. m.	1.312	Aug. 12	564.6
1932	Oct. 6, 11 a. m.–12 m.	1.227	Oct. 6	549.0
1933	June 10, 11 a. m.–12 m.	1.345	June 18	651.0
1934	Apr. 24, 12 m.–1 p. m.	1.418	July 4	654.1
1935	Sept. 2, 11 a. m.–12 m.; Sept. 4, 1 p. m.–2 p. m.	1.386	Apr. 13	627.0
1936	June 16, 11 a. m.–12 m.	1.624	June 16	857.8
1937	May 5, 12 m.–1 p. m.; May 8, 11 a. m.–12 m.; May 14, 12 m.–1 p. m.	1.470	May 3	678.1
1938	August 18, 11 a. m.–12 m.	1.620	May 11	645.4
1939	Apr. 20, 12 m.–1 p. m.	1.561	May 3	680.6
1940	May 13, 11 a. m.–12 m.	1.508	May 2	673.1

TABLE 4.—*Mean percentage distribution of energy. Direct solar radiation at normal incidence—1931–40*

Month	10 a. m. Total	<400mμ	400–620mμ	620–1.4μ	>1.4μ
	Gr. cal./sq. cm./min.	%	%	%	%
January	1.157	2.2	34.1	40.2	23.5
February	1.046	1.7	34.9	37.6	25.8
March	1.201	2.8	35.3	33.3	28.6
April	1.107	2.9	34.9	34.2	28.0
May	1.169	2.7	35.7	34.0	27.6
June	1.158	3.0	34.0	33.9	29.1
July	1.084	2.3	35.7	34.5	27.5
August	1.101	3.2	36.3	31.2	29.3
September	1.079	2.9	36.6	32.9	27.6
October	1.085	3.3	33.0	33.6	30.1
November	1.057	3.1	31.2	33.8	31.9
December	1.046	3.0	36.9	34.2	25.9
Mean	1.107	2.8	34.9	34.4	27.9

Month	12 m. Total	<400mμ	400–620mμ	620–1.4μ	>1.4μ
	Gr. cal./sq. cm./min.	%	%	%	%
January	1.187	2.0	34.4	39.3	24.3
February	1.159	2.1	33.0	35.5	29.4
March	1.310	2.5	35.6	34.0	27.9
April	1.178	3.0	36.6	33.2	27.2
May	1.196	2.9	35.2	32.9	29.0
June	1.166	2.9	36.5	33.8	26.8
July	1.146	2.9	35.6	31.3	30.2
August	1.168	3.1	37.6	30.0	29.3
September	1.076	3.2	36.3	32.1	28.4
October	1.148	2.6	34.4	33.3	29.7
November	1.099	2.9	33.1	35.9	28.1
December	1.121	2.6	33.5	36.9	27.0
Mean	1.163	2.6	35.5	33.9	28.0

Month	2 p. m. Total	<400mμ	400–620mμ	620–1.4μ	>1.4μ
	Gr. cal./sq. cm./min.	%	%	%	%
January	0.997	2.4	33.2	42.4	22.0
February	0.985	1.7	30.9	35.7	31.7
March	1.212	3.0	35.1	33.6	28.3
April	1.042	2.6	35.3	37.0	25.1
May	1.027	2.5	34.6	31.7	31.2
June	1.180	3.2	35.2	31.4	30.2
July	1.052	2.8	36.7	31.1	29.4
August	1.109	3.0	40.6	28.6	27.8
September	1.114	3.0	36.4	32.3	28.3
October	1.088	2.0	35.1	32.2	30.7
November	0.994	3.0	34.3	32.4	30.3
December	1.023	2.6	36.1	31.8	29.5
Mean	1.069	2.6	35.3	33.4	28.7

TABLE 5.—*Percentage distribution of total (direct and diffuse) radiation as received on a horizontal surface—Monthly means: 1931–40*

Month	10 a. m. Total	<400 mμ	400–620 mμ	>620 mμ
	Gr. cal./sq. cm./min.	%	%	%
January	0.768	10.9	17.1	70.9
February	0.781	9.6	16.0	74.4
March	0.953	12.7	15.9	72.7
April	1.104	13.0	18.2	68.8
May	1,180	10.0	13.3	76.7
June	1.304	7.9	11.9	80.2
July*				
August	1.212	6.4	14.7	78.9
September	1.134	7.4	13.8	78.8
October	1.068	8.6	14.7	75.7
November	.864	8.3	12.7	78.5
December	.637	8.1	12.2	79.7
Mean	1.000	9.1	14.6	76.3

Month	12 m. Total	<400 mμ	400–620 mμ	>620 mμ
	Gr. cal./sq. cm./min.	%	%	%
January	0.958	9.3	13.6	77.1
February	1.036	9.4	14.9	75.7
March	1.180	9.3	13.6	77.1
April	1.268	9.9	17.1	73.0
May	1.396	7.8	12.9	79.3
June	1.397	8.1	13.5	78.4
July*				
August	1.304	8.1	16.2	75.7
September	1.165	8.1	13.8	78.1
October	1.134	8.6	13.7	77.7
November	.928	9.3	13.1	77.6
December	.871	9.1	13.5	77.4
Mean	1.149	8.8	14.2	77.0

Month	2 p. m. Total	<400 mμ	400–620 mμ	>620 mμ
	Gr. cal./sq. cm./min.	%	%	%
January	0.744	12.5	15.2	72.3
February	0.947	10.0	14.2	75.8
March	1.114	8.3	14.8	76.9
April	1.120	11.1	16.7	72.2
May	1.135	10.6	18.3	71.1
June	1.190	7.0	13.2	79.8
July*				
August	1.202	7.9	12.7	79.4
September	1.059	7.9	13.0	79.1
October	1.115	8.6	13.3	78.1
November	.719	10.5	13.7	75.8
December	.618	10.4	13.4	76.2
Mean	0.998	9.6	14.3	76.1

*Too few values to average.

TABLE 6.—*Monthly mean totals and percentage distribution of sky radiation as measured on a horizontal surface—1931–40*

Month	10 a. m. Total	<400mμ	400–620mμ	>620mμ
	Gr. cal./sq. cm./min.	%	%	%
January	0.081	48.5	38.0	13.5
February	.072	46.8	39.5	13.7
March	.078	45.5	32.7	21.8
April	.102	41.8	32.9	25.3
May	.108	38.0	31.9	29.1
June	.068	41.4	31.4	27.2
July	.142	39.3	37.6	23.1
August	.111	36.8	31.4	31.8
September	.095	38.0	31.1	30.9
October	.083	42.8	34.6	22.6
November	.073	42.8	34.0	23.2
December	.046	44.1	31.3	24.5
Mean	.090	42.2	33.9	23.9

Month	12 m. Total	<400mμ	400–620mμ	>620mμ
	Gr. cal./sq. cm./min.	%	%	%
January	0.078	44.3	35.7	20.0
February	.080	42.1	34.4	23.5
March	.101	41.0	31.9	27.1
April	.103	41.1	30.9	28.0
May	.101	36.2	29.9	34.9
June	.102	39.2	33.0	27.8
July	.164	38.0	34.1	27.9
August	.130	46.4	33.3	20.3
September	.101	37.4	32.1	30.5
October	.101	46.6	35.7	17.7
November	.088	47.6	35.8	16.6
December	.068	49.7	34.2	16.1
Mean	.101	42.5	33.3	24.2

Month	2 p. m. Total	<400mμ	400–620mμ	>620mμ
	Gr. cal./sq. cm./min.	%	%	%
January	0.076	49.2	37.6	13.2
February	.080	42.0	32.7	25.4
March	.092	47.3	34.7	18.0
April	.104	45.6	33.2	20.9
May	.103	44.3	34.9	20.9
June	.079	44.0	34.7	21.3
July	.130	45.9	36.8	17.3
August	.104	44.7	31.7	23.6
September	.092	46.6	33.2	20.2
October	.082	47.1	37.1	16.0
November	.080	49.4	35.7	16.7
December	.^054	49.8	38.8	11.4
Mean	.090	46.3	35.0	18.7

TABLE 7.—*Monthly means showing the annual variation in the ultra-violet (<400 mμ) intensities in the total (sun and sky) and sky radiation as received on a horizontal surface—1931–40*

[Gr. cal./sq. cm./min.]

Month	10 a.m.				12 m.				2 p.m.			
	Sun and sky	Sky	Sun	Sun/Sky sky=100	Sun and sky	Sky	Sun	Sun/Sky sky=100	Sun and sky	Sky	Sun	Sun/Sky sky=100
January	.0837	.0393	.0444	1.13	.0891	.0346	.0545	1.58	.0930	.0374	.0556	1.50
February	.0750	.0337	.0413	1.23	.0974	.0337	.0637	1.90	.0947	.0336	.0611	1.82
March	.1210	.0355	.0855	2.41	.1097	.0414	.0683	1.65	.0925	.0435	.0490	1.13
April	.1435	.0426	.1009	2.37	.1255	.0423	.0832	1.96	.1243	.0474	.0769	1.62
May	.1180	0410	.0770	1.90	.1089	.0366	.0723	1.98	.1203	.0456	.0747	1.63
June	.1030	.0282	.0748	2.65	.1132	.0400	.0732	1.83	.0833	.0348	.0485	1.40
July *	-----	-----	-----	------	-----	-----	-----	------	-----	-----	-----	------
August	.0776	.0408	.0368	0.90	.1156	.0603	.0553	0.91	.0960	.0465	.0495	1.06
September	.0839	.0361	.0478	1.33	.0954	.0378	.0576	1.53	.0837	.0429	.0408	0.95
October	.0918	.0355	.0563	1.59	.0942	.0507	.0435	0.86	.0959	.0386	.0573	1.49
November	.0717	.0312	.0405	1.30	.0863	.0419	.0444	1.06	.0755	.0395	.0360	0.92
December	.0516	.0203	.0313	1.54	.0793	.0348	.0445	1.28	.0642	.0269	.0373	1.38
Mean	.0928	.0349	.0579	1.66	.1014	.0413	.0601	1.46	.0930	.0397	.0533	1.35

* Too few values to average.

TABLE 8.—*Annual variation in short ultra-violet (<313 mμ) intensities of solar radiation at normal incidence—Monthly means: 1931–40*

[Microgr. cal./sq. cm./min.]

	January	February	March	April	May	June	July	August	September	October	November	December	Mean
10 a. m.	322	473	587	559	355	649	503	485	477	534	286	80	443
12 m.	507	508	621	561	704	726	695	521	511	593	520	588	588
2 p. m.	146	299	469	556	481	391	591	498	559	364	225	67	389
Mean	325	427	559	528	513	589	596	501	515	497	344	245	470

TABLE 9.—*Monthly means showing the annual variation in short ultraviolet (<313μ) intensities in the total (sun and sky) and sky radiation received on a horizontal surface—1931–40*

[Microgr. cal./sq./min.]

Month	10 A. M.				12 M.				2 P. M.			
	Sun and Sky	Sky	Sun	Sun/Sky sky=100	Sun and Sky	Sky	Sun	Sun/Sky sky=100	Sun and Sky	Sky	Sun	Sun/Sky sky=100
January	596	190	406	2.1	1,149	489	660	1.4	642	324	316	0.97
February	825	270	555	1.9	1,078	236	842	3.6	869	262	607	2.3
March	1,266	-----	-----	------	1,317	282	1,035	3.7	977	350	627	1.8
April	1,114	175	939	5.4	1,272	263	1,009	3.8	1,370	331	1,039	3.1
May	2,628	271	2,357	8.7	2,330	225	2,105	9.4	1,499	252	1,247	4.9
June	1,588	203	1,385	6.8	1,904	515	1,389	2.7	1,502	312	1,190	3.8
July	1,750	241	1,509	6.3	-----	636	-----	------	-----	611	-----	------
August	1,830	208	1,622	7.8	1,867	268	1,599	6.0	-----	317	-----	------
September	1,243	250	993	4.0	1,690	475	1,215	2.6	1,204	376	828	2.2
October	631	379	252	0.7	1,051	213	838	3.9	887	291	596	2.0
November	563	303	260	0.9	913	159	764	4.8	785	391	394	1.0
December	330	109	221	2.0	1,089	133	959	7.2	426	135	291	2.2
Mean	1,197	283	914	3.2	1,424	325	1,099	3.4	1,016	329	687	2.1

NOTES AND REVIEWS

H. U. SVERDRUP. *Oceanography for Meteorologists.* New York (Prentice-Hall), 1942. 246 pp., illus.

The interactions between the atmosphere and the oceans exert important influences on many meteorological phenomena; during recent years they have been involved to an increasing extent in current meteorological research, and it has become more and more necessary for both the theoretical and the practical meteorologist to be familiar with many topics from physical oceanography. This book, written by an authority on both meteorology and oceanography, has been prepared expressly to meet the need for a source of information for the purposes of the meteorologist.

The introductory chapters are devoted to radiation and absorption by the atmosphere and the oceans, and the heat balance of the earth as a whole; the physical properties of sea water; and the nature and technique of oceanographic observations, including descriptions of the instruments that are used.

The next few chapters discuss the general principles of physical oceanography—the processes of the heating and cooling of the oceans; the distribution of salinity, temperature, and density over the surface of the oceans and in the subsurface waters; the physical theories of ocean currents, wind currents, and wind waves; and the thermodynamics of ocean currents.

The final chapters describe the water masses and currents of the various oceans of the world; and the existing oceanic influences on the weather and climate of different regions of the globe.

A rare halo phenomenon.—On April 22, 1942, from 10:30 to 11:15 E. S. T. the upper half of an ordinary halo of 22° was observed at State College, Pa. The colors were very brilliant. At 15:10 E. S. T. the small ring again appeared and at 15:15 the two parhelia and the upper tangent arc of the small ring were seen. At 15:30 a parhelic circle was added to the display, complete except for the interior of the small ring. The width of the parhelic circle was measured at 1.5°; the parhelia were at an angular distance of 26.3° from the center of the sun. The inner red rim of the common ring had a radius of 21.9°. The sun's altitude corresponding to these measurements was 37.7°. At 15:55 E. S. T. the parhelic circle had disappeared leaving only the small ring, its upper tangent arc and the two parhelia. At 17:00 only the parhelia were left, which faded away by 17:20.

As evidence of the rarity of the full parhelic circle, it may be mentioned that during the period from January 1934 to date, the writer has systematically observed halo phenomena and accumulated in this time records for 954 days with halo phenomena, corresponding to an average of 115 days a year. Among all these observations the display seen on April 22 is the first complete parhelic circle seen.

—*H. Neuberger, State College, Pa.*