

SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS, JANUARY, 1931

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At Washington, D. C., Madison, Wis., and Lincoln, Nebr., the Weather Bureau has installed Marvin pyr-heliometers with which, when the sky is free from clouds, measurements of the intensity of direct solar radiation are obtained.

At Washington the measurements are made on the campus of the American University, about 5½ miles northwest of the United States Capitol, 3 miles northwest of the Central Office of the Weather Bureau, and 1½ miles northwest of the United States Naval Observatory. There are no manufacturing establishments within a radius of about 3 miles, but the suburb about the university is rapidly building up, principally with detached houses. The pyr-heliometer is exposed on a shelf outside a window, in the morning on the southeast side of the building and in the afternoon on the southwest side. At times, with southeast or east winds, city smoke is brought over the university. The pyr-heliometer is at latitude 38° 56' north, longitude 77° 05' west, altitude 397 feet.

At Madison the pyr-heliometer is installed in North Hall, University of Wisconsin, and exposed on a shelf outside a window facing east in the morning and west in the afternoon. North Hall is on a bluff in the upper campus, a short distance from the south shore of Lake Mendota. Most of the manufacturing plants are in the eastern part of the town, but railroad tracks and the heating plant of the university are to the Southwest. With a northwest wind the air is free from smoke, but with the wind from other directions considerable smoke is brought over the campus. The latitude of North Hall is 43° 05' north, longitude 89° 23' west, altitude 974 feet.

At Lincoln the pyr-heliometer is exposed in the experi-ment station building, on the farm campus, State Uni-versity Farm. It is 2½ miles northeast of the center of the business section of the city, but there is some smoke from buildings on the farm campus and from railroads and shops not far to the north. Under certain conditions the city smoke cloud covers the farm campus, but with a west to northwest wind the atmosphere is very clear. The latitude of the farm campus is 40° 50' north, longitude 96° 41' west, altitude of pyr-heliometer above sea level 1,225 feet.

When observing, the pyr-heliometer is exposed on a shelf outside a south dormer window.

Continuous records of the intensity of the solar radi-ation received on a horizontal surface, including that received diffusely from the sky, are obtained by the Weather Bureau at Madison, Wis., and Lincoln, Nebr., by means of Callendar pyr-heliometers. The registers are installed in the rooms with the auxiliary apparatus used with the Marvin pyr-heliometers, and the geographical co-ordinates for the two stations are as already given. The Callendar pyr-heliometers are exposed on the roofs of the buildings occupied—at Madison at an elevation of 1,009 feet and at Lincoln of 1,250 feet above sea level. Both these pyr-heliometers have practically unobstructed exposure to the sky down to the horizon in every direction.

A summary of continuous records obtained by means of a Callendar recording pyr-heliometers is received each month for publication in the MONTHLY WEATHER RE-view from Mr. O. J. Sieplein, director of the Belle Isle Observatory, University of Miami, Miami, Fla., at

latitude 25° 41' north, longitude 80° 12' west, altitude but a few feet above sea level. A similar summary is received from the Scripps Institution of Oceanography, La Jolla, Calif., latitude 32° 50' north, longitude 117° 15' west, altitude 85 feet above sea level; but at this latter station a Weather Bureau thermoelectric pyr-heliometer recording on an Engelhard microammeter is employed.

Records are also obtained at the American University, D. C., the Weather Bureau stations at Chicago, Ill., New York, N. Y., Pittsburgh, Pa., and Fresno, Calif., at Twin Falls, Idaho, through cooperation with the Bureau of Entomology, Department of Agriculture, and at Gainesville, Fla., through cooperation with the department of physics, University of Florida. Fresno and Gainesville employ Moll thermoelectric pyr-heliometers, the former recording on an Engelhard, the latter on a Richard mi-croammeter. The other stations employ the Weather Bureau type of thermoelectric pyr-heliometers and Engel-hard recording microammeters. In New York City the radiation apparatus is exposed at the New York Meteor-ological Observatory, Central Park, and in Chicago on the tower of Rosenwald Hall, on the University of Chicago campus.

Coordinates of these stations are as follows:

Station	Latitude	Longitude	Altitude
	° /	° /	<i>Feet</i>
Chicago, Ill.	41 47 N.	87 35 W.	688
New York City.....	40 46 N.	73 53 W.	156
Pittsburgh.....	42 26 N.	80 00 W.	1114
Fresno.....	36 43 N.	119 49 W.	350
Twin Falls.....	42 29 N.	114 25 W.	4300
Gainesville.....	29 39 N.	82 21 W.	233

At Chicago the pyr-heliometer is exposed to the south of the tower on which the wind instruments are exposed and which shades it from a part of the north sky. The same is true of the exposure in New York to a lesser extent and also at Fresno. At Washington the roof of the Chemical Laboratory, about 300 feet to the north, cuts off a small section of the sky near the horizon.

All pyr-heliometers from which records are summarized in Tables 1 and 2 have been standardized by comparison with Marvin No. 3, except the Callendar instrument at Miami, which has a standardization certificate furnished by the English manufacturer. Quite probably this certificate gives radiation intensities in the Angström scale, but I have been unable to obtain definite informa-tion on this point. Marvin No. 3 is checked with Smith-sonian substandards from time to time through Smith-sonian No. 1, which is owned by the Weather Bureau.

Table 1 shows that solar radiation intensities averaged above the normal intensity for January at Washington, D. C., and slightly below normal at Madison, Wis., and Lincoln, Nebr.

Table 2 shows an excess in the total solar radiation received on a horizontal surface directly from the sun and diffusely from the sky at all stations except Madison, for which there was a pronounced deficiency.

Skylight polarization measurements were obtained at Washington on five days and give a mean percentage of 56, with a maximum of 59 on the 2d and 13th. These are below the corresponding averages for Washington in January. No measurements were obtained at Madison during this month, as the ground was continuously covered with snow.

TABLE 1.—Solar radiation intensities during January, 1931
[Gram-calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance											Local mean solar time
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon	
	Air mass											
	A. M.					P. M.						
	e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.	
	<i>mm.</i>	<i>cal.</i>	<i>mm.</i>									
Jan. 2	1.96	0.98	1.10	1.22	1.38			1.27	1.11	0.98	2.06	
Jan. 7	2.16	0.66	0.78		1.16			1.09			2.16	
Jan. 9	2.26		0.63	0.78	0.98			0.90			2.87	
Jan. 13	4.75				1.20						2.62	
Jan. 15	1.24		1.10	1.21	1.31			1.11	0.98	0.75	1.52	
Jan. 16	1.78		0.86	0.98							2.06	
Jan. 17	3.45			1.07	1.26			1.08	0.94	0.82	3.45	
Jan. 20	2.87		0.89					1.14	0.99	0.81	2.62	
Jan. 22	1.12				1.06						1.52	
Jan. 28	4.95			0.84	1.03		1.01				4.17	
Jan. 30	3.30				0.97						2.36	
Means		(0.82)	0.89	1.02	1.15		(1.01)	1.10	1.06	0.84		
Departures		+0.09	+0.04	+0.01	-0.08		-0.22	+0.06	+0.12	+0.04		

Madison, Wis.											
Date	<i>mm.</i>	<i>cal.</i>	<i>mm.</i>								
Jan. 3	2.26	0.76	1.00	1.09				1.14			3.63
Jan. 9	3.15	0.97	1.07	1.17				1.30			2.87
Jan. 16	2.87	0.76	0.90	1.06				1.10			3.45
Jan. 22	1.78							0.96			1.78
Jan. 26	2.36	0.94	1.11	1.17	1.40						2.87
Means		0.88	1.02	1.12	(1.40)			1.12			
Departures		-0.07	-0.03	-0.08	+0.04			-0.08			

Lincoln, Nebr.											
Date	<i>mm.</i>	<i>cal.</i>	<i>mm.</i>								
Jan. 2	3.45	0.93	0.99	1.12							3.63
Jan. 4	3.00							1.21	1.07	0.97	3.63
Jan. 5	2.49	1.05	1.17								3.00
Jan. 14	1.02	1.04	1.08								1.07
Jan. 15	1.88							1.11	0.98	0.86	3.00
Jan. 16	2.36							1.02	0.86	0.80	3.81
Jan. 21	2.26		1.07	1.17				1.14			3.63
Jan. 26	3.30	1.04	1.13	1.21	1.40			1.14	1.04	0.93	3.63
Jan. 28	3.30				1.36						4.57
Jan. 29	3.63		0.82	1.15	1.30						4.37
Jan. 31	3.45		1.02	1.20	1.39		1.38	1.22	1.11	1.00	3.15
Means		1.02	1.04	1.17	1.36		(1.38)	1.14	1.01	0.91	
Departures		+0.08	-0.01	-0.01	-0.01		-0.03	-0.03	-0.03	-0.01	

¹ Extrapolated.

TABLE 2.—Total solar radiation (direct + diffuse) received on a horizontal surface
[Gram-calories per square centimeter]

Week beginning—	Average daily totals										
	Washington	Madison	Lincoln	Chicago	New York	Twin Falls	Pittsburgh	Galvesville	Fresno	La Jolla	Miami
1931	<i>cal.</i>	<i>cal.</i>	<i>cal.</i>	<i>cal.</i>	<i>cal.</i>	<i>cal.</i>	<i>cal.</i>	<i>cal.</i>	<i>cal.</i>	<i>cal.</i>	<i>cal.</i>
Jan. 1	175	105	189	68	113	183	115	276	128	220	262
Jan. 8	168	119	232	98	137	152	93	239	211	237	233
Jan. 15	196	149	202	95	146	220	190	216	227	279	145
Jan. 22	172	162	235	121	138	224	166	296	212	261	223
	Departures from weekly normals										
Jan. 1	+21	-20	+4	-12	+9	+2	+26	-2	-15	-13	
Jan. 8	+14	-28	+40	+15	+34	-40	+1	-4	+45	+10	
Jan. 15	+37	-12	+1	-2	+34	+18	+18	-16	+35	+49	
Jan. 22	-7	-26	+12	+8	-2	+27	+42	+26	-21	+21	
Accumulated departures on Jan. 28	+455	-644	+399	+63	+525	+49	+609	+28	+308	+462	

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, Yerkes, 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	Hellographic			Area		Total area for each day
		Diff. long.	Longitude	Latitude	Spot	Group	
1931							
	<i>h m</i>	<i>°</i>	<i>°</i>	<i>°</i>			
Jan. 1 (Naval Observatory)	11 14	No spots					
Jan. 2 (Naval Observatory)	11 18	No spots					
Jan. 3 (Naval Observatory)	11 49	No spots					
Jan. 4 (Naval Observatory)	11 4	-78.0	237.6	-18.0		62	62
Jan. 5 (Mount Wilson)	14 0	-51.0	249.8	-12.0	12	122	134
Jan. 6 (Mount Wilson)	13 15	-49.0	239.1	-19.0		129	
		-48.0	240.1	-10.0		5	134
Jan. 7 (Naval Observatory)	11 41	-35.0	240.8	-18.5		108	108
Jan. 8 (Naval Observatory)	11 41	-20.5	242.1	-19.5		77	77
Jan. 9 (Naval Observatory)	12 3	-9.0	240.2	-18.5		123	123
Jan. 10 (Naval Observatory)	11 49	+6.0	242.2	-19.0		62	62
Jan. 11 (Naval Observatory)	11 41	+18.0	241.1	-19.0		46	46
Jan. 12 (Mount Wilson)	14 10	+4.0	212.5	+8.0	20		
		+34.0	242.5	-19.0	32		62
Jan. 13 (Naval Observatory)	12 12	+19.0	215.5	+9.0		62	
		+45.0	241.5	-19.5	31		93
Jan. 14 (Naval Observatory)	13 12	+29.0	211.7	+7.0		123	
		+33.5	216.2	+7.0	46		169
Jan. 15 (Naval Observatory)	11 43	+40.0	210.4	+8.0		170	170
Jan. 16 (Naval Observatory)	14 14	+55.0	210.8	+8.5		463	463
Jan. 17 (Naval Observatory)	11 37	+67.6	211.6	+8.5		355	355
Jan. 18 (Mount Wilson)	13 25	-22.0	107.9	+5.0		71	
		+80.0	209.9	+8.0		337	406
Jan. 19 (Mount Wilson)	14 10	-70.0	46.4	+2.0	4		
		-5.0	111.4	+5.0		84	88
Jan. 20 (Naval Observatory)	11 54	-55.0	49.5	+2.0	19		
		+8.5	113.0	+6.5		123	142
Jan. 21 (Naval Observatory)	11 42	+20.0	111.4	+5.0		93	93
Jan. 22 (Naval Observatory)	13 18	+35.0	112.4	+6.5		154	154
Jan. 23 (Naval Observatory)	12 30	+9.0	74.6	+8.0	3		
		+48.0	113.6	+3.0		154	157
Jan. 24 (Naval Observatory)	12 43	+59.0	110.3	+5.0		139	139
Jan. 26 (Perkins Observatory)		No spots					
Jan. 27 (Naval Observatory)	11 19	No spots					
Jan. 28 (Naval Observatory)	11 21	+48.0	47.4	+3.0	31		31
Jan. 29 (Naval Observatory)	13 52	No spots					
Jan. 30 (Naval Observatory)	12 13	No spots					
Jan. 31 (Naval Observatory)	11 29	+10.0	329.9	+3.5	9		9
Mean daily area for January							109