

SOLAR OBSERVATIONS.

SOLAR AND SKY RADIATION MEASUREMENTS DURING OCTOBER, 1923.

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For a description of instruments and exposures, and an account of the method of obtaining and reducing the measurements, the reader is referred to this REVIEW for April, 1920, 48:225, and a note in the REVIEW for November, 1922, 50:595.

From Table 1 it is seen that solar-radiation intensities averaged above normal values for October at all stations, but by only a slight amount at Washington.

Table 2 shows a slight deficiency in the total radiation received on a horizontal surface at Washington, Madison, and a slight excess at Lincoln.

Skylight polarization measurements obtained at Washington on 14 days give a mean of 55 per cent, with a maximum of 67 per cent on the 9th. At Madison, measurements obtained on 3 days give a mean of 64 per cent, with a maximum of 68 per cent on the 22d. These are slightly below average values for October at Madison and close to average at Washington.

A new solar radiation station at Chicago, Ill.—On September 24, 1923, a thermoelectric pyrheliometer¹ was installed just above the coping on the south side of the tower on Rosenwald Hall, University of Chicago. By means of an Engelhard recording millivoltmeter, continuous records are obtained of the total solar and sky radiation received on a horizontal surface. The horizontal receiving surface of the pyrheliometer is about 90 feet above the ground, and practically above all towers or other high objects on the university campus, except a steel tower which rises from the center of the tower on which the pyrheliometer is exposed, and which supports the anemometers and wind vanes. The station anemometer is 38 feet higher than the pyrheliometer.

This steel tower and the wind instruments can not shade the pyrheliometer from the sun, but they do intercept some radiation from the northern sky. When the sun is shining, this loss is probably counterbalanced by reflection of direct solar radiation from the tower to the pyrheliometer. During cloudy weather, however, the presence of the steel tower must cause a small percentage loss in the radiation.

The University of Chicago is about 1 mile west from the lake front, 3.5 miles southeast of the Union Stock Yards, and 5 miles northwest of the Pennsylvania Railroad station in South Chicago. Light winds from either of these latter districts increase the amount of smoke in the atmosphere at the university.

The latitude of the university is 41°47' north, the longitude 87°35' west, and the height of the pyrheliometer above sea level is 688 feet. The latitude is about 1½° less than that of Madison, Wis., and 1° more than that of Lincoln, Nebr. The elevation above sea level is about 320 feet less than that of the Callendar recording pyrheliometer at Madison and 560 feet less than that of the Callendar instrument at Lincoln.

Other things being equal, we would expect the daily totals of radiation at Chicago to fall between those for Madison and Lincoln. Table 2 shows that they average less than the average for Madison.

Figure 1 makes clear the reason for this deficiency. On it are reproduced the pyrheliometric records obtained at Chicago on October 22, 23, and 26. October 23 was a cloudless day, with a moderate wind from the northeast or from off the lake, which blew away the smoke. The total radiation for the day was 332 gram-calories per square centimeter, which is 4 per cent more than was recorded on any day in the last decade of October at Madison, and 22 per cent less than the maximum recorded on any day during the same decade at Lincoln. October 22 was also a cloudless day, but with a light wind from the northwest in the morning. Notes from the station record at the university read: "Dense city smoke present until 10:30 a. m. when it was swept away by the wind shifting to the northeast. Standing objects not visible at a distance much in excess of one-eighth of

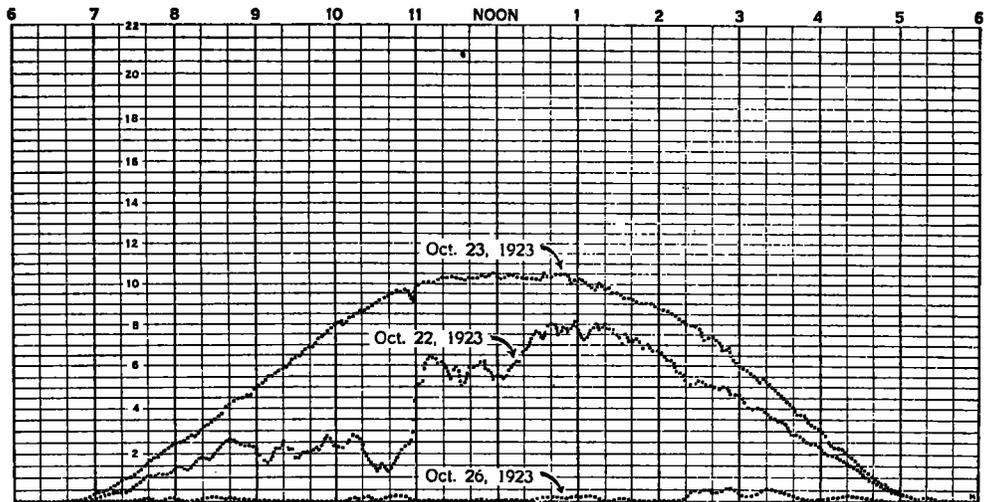


FIG. 1.—Thermoelectric pyrheliometer records, University Observatory, Chicago, Ill. (The time indicated is apparent, or true, solar time.)

a mile during the time of the smoke." Between 10 and 11 a. m., when the depression in the record is greatest, the hourly amount of radiation was only 24 per cent of what it was during the same hour on the 23d, while during the hour ending at 2 p. m. it was 79 per cent. With reference to October 26, the observer's notes read: "Dense city smoke present in the forenoon. Sky overcast throughout the day; alto-stratus, stratus, and stratocumulus clouds. Light rain began to fall at 2:43 p. m. and continued until after midnight."

The total for the day was 5.1 gram-calories, and is less than the minimum daily amount recorded at Washington, Madison, or Lincoln, in any month.

Conditions similar to those on October 22 prevailed on October 9, except that in this case the wind in the morning was from a westerly direction and shifted to easterly before noon. At 10:30 a. m. the intensity of direct solar radiation was about 1.20 gram-calories per square centimeter of normal surface per minute, and by noon it had dropped to about 0.70 gram-calory due to a piling up of the smoke at the time the wind changed direction.

¹ Kimball, Herbert H., and Hobbs, Hermann E. A new form of thermoelectric recording pyrheliometer. This REVIEW, May, 1923, 51:239.

² 90th meridian time, or 10:51 a. m., apparent, or true solar time.

The thermoelectric pyrheliometer was standardized by comparisons with a Marvin pyrheliometer in Washington during the earlier part of September, and with Smithsonian silver disk pyrheliometer No. 1 in Chicago on October 9, 10, and 11. The factor found to reduce scale readings on the record to gram-calories per minute per square centimeter is 0.087.

It is worthy of note that while the highest intensity of solar radiation at normal incidence measured at Chicago was 1.20 gram-calories, with an air mass of 1.5, the highest intensities measured at Madison and Lincoln in this same month, and with a greater air mass of about 1.8, were 1.38 and 1.48 gram-calories, respectively.

In this connection it is of interest to recall a decrease in solar radiation intensity from 1.43 calories to 1.17 calories at Lincoln, due to a smoke cloud that was brought over the university farm from the city by a change in wind direction. See this REVIEW for January, 1917, 45:4.

TABLE 1.—Solar radiation intensities during October, 1923.

[Gram-calories per minute per square centimeter of normal surface.]
Washington, D. C.

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.	
	75th mer. time.	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.		
Oct. 1.....	mm. 6.50	cal. 0.80								0.87	0.75	6.50
2.....	7.87											8.18
3.....	7.29											7.57
4.....	9.14		0.59	0.68	0.76							7.04
5.....	4.57	0.95	1.06	1.17	1.30	1.49	1.23	1.06	0.90	0.77		4.17
6.....	5.36		0.75	1.03								3.99
8.....	5.56	0.73	0.85	1.01	1.19	1.43	1.26	1.07	0.91	0.79		4.95
9.....	5.36		0.88	1.01	1.19		1.09	0.93	0.78	0.66		4.37
17.....	7.87		0.77	0.94	1.08	1.29	1.11	0.95	0.79	0.70		6.76
18.....	6.50	0.70	0.80	0.91	1.14		1.26	1.04	0.87	0.80		7.04
20.....	7.04						1.06	0.78	0.54			5.16
22.....	4.37		1.01	1.21	1.39							4.95
25.....	5.56			1.13								6.02
26.....	6.50						1.18	1.03	0.84	0.70		6.27
27.....	5.16						1.26	1.07	0.96			3.45
29.....	8.81				0.83							9.47
31.....	4.75						0.96	0.75	0.62	0.50		3.99
Means.....		0.80	0.82	0.92	1.08	1.48	1.13	0.94	0.78	0.67		
Departures.....		+0.04	+0.09	+0.00	-0.01		+0.02	+0.03	+0.01	-0.01		

TABLE 1.—Solar radiation intensities during October, 1923—Continued.

Madison, Wis.

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.	
	75th mer. time.	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.		
Oct. 2.....	mm. 8.18	cal. 1.12										8.48
14.....	4.57			1.08								5.79
15.....	5.16		0.88	1.06	1.27	1.51						5.56
19.....	3.99		1.09	1.19								5.36
22.....	3.63				1.14			1.27	0.97			3.99
23.....	5.79								0.76			4.57
24.....	6.27				1.26							5.16
30.....	2.36			1.26	1.39							3.30
31.....	3.15			1.17	1.36	1.57	1.37	1.17				3.00
Means.....		(0.98)	1.15	1.28	(1.54)	1.25	0.94					
Departures.....		+0.07	+0.09	+0.10			+0.07	+0.07	+0.11	+0.11		

Lincoln, Nebr.

Oct. 17.....	10.59		0.95		1.25		1.29					7.29
18.....	5.16					1.49	1.34	1.21	1.08	0.98		3.63
20.....	3.63		1.09	1.22	1.39	1.53	1.37	1.21	1.09	0.98		2.87
22.....	3.45		1.04	1.17	1.31	1.47	1.28	1.12	0.99	0.85		4.17
23.....	3.99	0.89	0.99	1.11	1.29	1.50	1.27	1.09	0.95	0.83		4.95
30.....	2.62			1.30	1.44	1.60	1.45	1.24	1.16	1.05		2.87
31.....	2.87	0.97	1.11	1.26	1.44	1.58	1.31	1.05				3.30
Means.....	(0.93)	1.04	1.21	1.35	1.53	1.33	1.15	1.05	0.94			
Departures.....		+0.03	+0.07	+0.10	+0.07		+0.07	+0.07	+0.11	+0.11		

* Extrapolated.

TABLE 2.—Solar and sky radiation received on a horizontal surface.

Week beginning.	Average daily radiation.				Average daily departure for the week.			Excess or deficiency since first of year.		
	Chi-cago.	Wash-ington.	Mad-ison.	Lin-cola.	Wash-ington.	Mad-ison.	Lin-cola.	Wash-ington.	Mad-ison.	Lin-cola.
	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Oct. 1...	254	396	323	297	+69	-49	-56	-3,823	-665	-3,050
8...	266	333	252	320	+25	-2	-4	-3,645	-677	-3,077
15...	147	247	176	320	-40	-49	+28	-3,922	-1,023	-2,881
22...	177	198	169	298	-67	-35	+5	-4,394	-1,270	-2,847
29...	156	249	217	241	+2	+31	-2	-4,382	-1,054	-2,860

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS.

NORTH ATLANTIC OCEAN.

By F. A. Young.

The average pressure for the month varied considerably, as compared with the normal, at a number of land stations on the coast and islands of the North Atlantic, as shown by the following figures:

The barometric readings are in inches, made at 8 a. m., 75th meridian time, and the departures are approximate, as the normals were taken from the Pilot Chart.

St. Johns, Newfoundland, mean 30.04, departure +0.11. Nantucket, 30.08, +0.05. Hatteras, 30.09, +0.05. Key West, 29.96, -0.01. New Orleans, 30.03, +0.02. Swan Island, 29.82, -0.09. Turks Island, 29.97, +0.02. Bermuda, 30.06, +0.01. Horta, Azores, 30.12, +0.01. Lerwick, Shetland Islands, 29.35, -0.43. Valentia, Ireland, 29.72, -0.19. London, 29.73, -0.18.

It can be seen from these figures that while the average pressure was practically normal in the Azores and Ber-

mudas, it was very much below in northern Europe. The Icelandic low was unusually deep, causing turbulent conditions along the European coast, north of the 50th parallel.

Taking the ocean as a whole, October was an unusually stormy month. There were a number of disturbances of tropical origin, that are described elsewhere in the REVIEW, and the eastern section was swept by one gale after another, while along the American coast the number of days with heavy winds was also above the normal.

Fog was unusually prevalent over the Grand Banks; where it was observed on from 14 to 15 days during the month. According to reports received the number of days on which it occurred over the remainder of the ocean did not differ materially from the normal as shown on the Pilot Chart.

Charts VIII and IX give the conditions on the 1st and 2d, respectively, with the location of the disturbance