

POSITIONS AND AREAS OF SUN SPOTS—Continued
MEAN DAILY AREA FOR 30 DAYS, 812—Continued

Date	East-ern stand-ard time		Heliographic			Area		Total area for each day	Observatory	
			Diff. in longi-tude	Longi-tude	Lat-i-tude	Spot	Group			
1936	h	m	°	°	°					
Apr. 26	14	40	-26.0	257.3	+37.0	-----	12	-----	Mt. Wilson.	
			+5.0	288.3	+36.0	-----	14	-----		
			+5.0	288.3	+12.0	-----	19	-----		
			+23.0	308.3	-16.0	-----	15	-----		
			+51.0	334.3	-26.0	-----	197	-----		
			+57.5	340.8	-13.0	-----	17	-----		
			+58.0	341.3	-12.0	-----	-----	125		
			+68.0	351.3	-18.0	-----	185	-----	584	
Apr. 27	13	50	-16.0	254.6	+36.0	-----	16	-----	Do.	
			+19.0	289.6	+13.0	-----	35	-----		
			+35.0	305.6	-16.0	-----	9	-----		
			+64.0	334.6	-26.0	-----	226	-----		
			+68.0	338.6	-13.0	-----	23	-----		
			+68.0	338.6	-10.0	-----	25	-----		
			+79.0	349.6	-18.0	-----	227	-----	561	
Apr. 28	11	44	+33.0	291.5	+12.0	-----	46	-----	U. S. Naval.	
			+74.0	332.5	-26.0	-----	46	-----		
			+87.0	345.5	-27.0	-----	62	-----	154	
Apr. 29	11	6	-68.0	177.6	-18.0	-----	-----	77	-----	Do.
			+50.0	295.6	+12.0	-----	15	-----	92	Do.
Apr. 30	11	13	-54.0	178.3	-18.0	-----	-----	46	-----	Do.

PROVISIONAL SUN-SPOT RELATIVE NUMBERS, APRIL 1936

[Dependent alone on observations at Zurich and its station at Arosa]

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

April 1936	Relative numbers	April 1936	Relative numbers	April 1936	Relative numbers
1	Wac93	11	a91	21	a67
2	100	12	Ec92	22	a49
3	a91	13	a83	23	56
4	Ec74	14	86	24	Ec53
5	85	15	a73	25	Wc72
6	d91	16	ad88	26	77
7	b	17	—	27	56?
8	b76	18	73	28	—
9	d89	19	83	29	32
10	99	20	75	30	—

Mean, 26 days = 77.1.

a = Passage of an average-sized group through the central meridian.
 b = Passage of a large group or spot through the central meridian.
 c = New formation of a center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central circle.
 d = Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE in charge]

By L. T. SAMUELS

At those stations with a sufficient period of record for the determination of approximate normals, upper-air temperatures during April averaged below normal except over San Diego where the departures were positive. (See table 1.) In practically all cases the departures were of moderate to small magnitude.

Upper-air relative humidity departures were mostly of opposite sign to those for temperature, and of small to moderate magnitude. The comparatively pronounced

increase in the mean relative humidity with elevation found at El Paso is characteristic of the approach of the warm season.

The directions of the upper-air wind resultants were close to normal at the 3-kilometer level. (See table 2.) Resultant velocities at that level exceeded the normals over the northern half and southeastern section of the country, and were below normal elsewhere. Departures were of small to moderate magnitude.

TABLE 1.—Mean free-air temperatures and relative humidities obtained by airplanes during April 1936

TEMPERATURE (° C.)

Stations	Altitude (meters) m. s. l.																Number of observations		
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000			5,000	
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal		Mean	Departure from normal
Barksdale Field (Shreveport), La. ¹ (52 m).....	13.4	-----	15.1	-----	13.2	-----	11.0	-----	8.9	-----	6.4	-----	3.5	-----	-2.7	-----	-9.9	-----	30
Billings, Mont. ² (1,088 m).....	2.9	-----	-----	-----	-----	-----	4.2	-----	1.8	-----	-1.2	-----	-4.5	-----	-11.1	-----	-17.7	-----	30
Boston, Mass. ¹ (5 m).....	4.2	-2.4	3.1	-1.1	1.1	-1.2	-1.2	-1.8	-3.6	-2.0	-5.6	-1.8	-7.8	-1.7	-12.2	-1.3	-18.3	-1.2	13
Cheyenne, Wyo. ² (1,873 m).....	1.6	-----	-----	-----	-----	-----	-----	-----	2.4	-----	4	-----	-2.7	-----	-9.7	-----	-17.6	-----	30
El Paso, Tex. ¹ (1,194 m).....	14.0	-----	-----	-----	-----	-----	15.9	-----	13.1	-----	9.4	-----	5.4	-----	-2.5	-----	-10.1	-----	30
Fargo, N. Dak. ² (274 m).....	-1.9	-----	-8	-----	-2.6	-----	-4.0	-----	-5.8	-----	-8.2	-----	-10.6	-----	-16.0	-----	-21.8	-----	30
Kelly Field (San Antonio), Tex. ¹ (206 m).....	14.3	-----	15.2	-----	14.4	-----	13.1	-----	11.5	-----	9.1	-----	5.9	-----	-8	-----	-7.4	-----	30
Lakehurst, N. J. ² (39 m).....	5.8	-----	4.7	-----	2.5	-----	.7	-----	-1.0	-----	-3.1	-----	-5.4	-----	-10.8	-----	-----	-----	25
Maxwell Field (Montgomery), Ala. ¹ (52 m).....	15.0	-----	15.6	-----	13.2	-----	10.7	-----	8.1	-----	5.8	-----	2.7	-----	-2.8	-----	-8.7	-----	22
Mitchel Field (Hempstead, Long Island), N. Y. ¹ (29 m).....	5.3	-----	5.2	-----	3.2	-----	.7	-----	-1.2	-----	-3.6	-----	-6.0	-----	-10.3	-----	-16.7	-----	22
Murfreesboro, Tenn. ² (174 m).....	8.9	-----	10.7	-----	8.9	-----	7.3	-----	5.1	-----	2.9	-----	.6	-----	-4.8	-----	-11.0	-----	30
Norfolk, Va. ² (10 m).....	9.5	-2.0	9.6	-1.6	7.0	-2.1	4.9	-1.9	2.7	-1.7	.4	-1.5	-2.6	-1.8	-8.3	-2.1	-13.7	-2.0	20
Oklahoma City, Okla. ² (391 m).....	12.1	-----	13.9	-----	13.1	-----	11.2	-----	9.1	-----	5.9	-----	2.4	-----	-4.8	-----	-----	-----	30
Omaha, Nebr. ² (300 m).....	5.6	-1.0	6.0	-1.3	5.2	-1.7	3.1	-2.0	1.2	-1.7	-1.1	-1.5	-3.8	-1.4	-10.1	-1.4	-16.9	-1.1	30
Pearl Harbor, Territory of Hawaii ¹ (6 m).....	20.3	-2.3	18.4	-1.3	15.0	-1.1	12.6	-8	11.5	+1	10.0	-1	7.4	-9	1.5	-2.6	-----	-----	30
Pensacola, Fla. ² (2 m).....	17.2	-6	16.4	-1	14.6	0	12.5	0	9.9	-4	7.1	-5	4.1	-7	-1.5	-1	-7.9	0	27
San Diego, Calif. ² (10 m).....	13.0	-2.5	12.2	-1.0	13.6	+9	13.2	+2.0	11.2	+1.9	8.4	+1.8	5.6	+1.6	-1	+1.4	-6.5	+1.8	29
Scott Field (Bellefonte), Ill. ¹ (135 m).....	5.6	-----	9.2	-----	8.0	-----	5.4	-----	2.8	-----	.1	-----	-2.1	-----	-7.5	-----	-13.6	-----	24
Seattle, Wash. ² (10 m).....	10.5	+7	6.6	-1.2	4.8	-6	2.2	-4	-2	0	-3.0	-1	-5.8	-3	-12.6	-1.3	-20.2	-2.0	15
Spokane, Wash. ² (596 m).....	5.9	-----	-----	-----	8.8	-----	8.2	-----	5.3	-----	1.8	-----	-1.4	-----	-7.9	-----	-15.3	-----	30
Washington, D. C. ² (13 m).....	7.1	-3.2	7.1	-1.5	4.5	-1.8	2.4	-2.2	.5	-2.4	-1.9	-3.2	-4.2	-3.9	-8.7	-3.6	-13.4	-3.0	26
Wright Field (Dayton), Ohio ¹ (244 m).....	5.3	-----	6.5	-----	4.6	-----	2.7	-----	.8	-----	-1.5	-----	-3.9	-----	-9.1	-----	-14.9	-----	26

RELATIVE HUMIDITY (PERCENT)

Barksdale Field (Shreveport), La.	71	-----	58	-----	54	-----	51	-----	40	-----	37	-----	34	-----	33	-----	31	-----	-----
Billings, Mont.	67	-----	-----	-----	-----	-----	60	-----	60	-----	63	-----	66	-----	68	-----	64	-----	-----
Boston, Mass.	73	+3	65	-1	64	+1	64	+3	63	+1	63	+1	64	+4	60	+6	55	+4	-----
Cheyenne, Wyo.	69	-----	-----	-----	-----	-----	-----	-----	64	-----	59	-----	59	-----	59	-----	61	-----	-----
El Paso, Tex.	31	-----	-----	-----	-----	-----	33	-----	33	-----	35	-----	38	-----	43	-----	47	-----	-----
Fargo, N. Dak.	82	-----	65	-----	60	-----	57	-----	56	-----	53	-----	53	-----	55	-----	55	-----	-----
Kelly Field (San Antonio), Tex.	79	-----	75	-----	63	-----	55	-----	43	-----	39	-----	37	-----	35	-----	33	-----	-----
Lakehurst, N. J.	71	-----	65	-----	59	-----	59	-----	62	-----	58	-----	53	-----	42	-----	-----	-----	-----
Maxwell Field (Montgomery), Ala.	72	-----	58	-----	53	-----	51	-----	53	-----	53	-----	46	-----	36	-----	34	-----	-----
Mitchel Field (Hempstead, Long Island), N. Y.	77	-----	67	-----	62	-----	62	-----	65	-----	62	-----	59	-----	57	-----	54	-----	-----
Murfreesboro, Tenn.	79	-----	69	-----	69	-----	66	-----	66	-----	59	-----	55	-----	47	-----	45	-----	-----
Norfolk, Va.	76	+7	62	+3	60	+4	60	+5	58	+5	53	+2	54	+5	51	+9	48	+11	-----
Oklahoma City, Okla.	54	-----	56	-----	54	-----	49	-----	46	-----	45	-----	46	-----	49	-----	-----	-----	-----
Omaha, Nebr.	62	-8	61	-6	56	-5	54	-3	62	-2	51	-2	51	-1	57	+5	57	+6	-----
Pearl Harbor, Territory of Hawaii.	83	+13	82	+8	85	+7	81	+6	67	-1	52	-2	46	+3	39	+10	-----	-----	-----
Pensacola, Fla.	78	-1	65	-5	62	-1	56	-1	56	+5	53	+5	51	+7	38	+2	28	-3	-----
San Diego, Calif.	87	+13	81	+5	49	-5	38	-11	29	-10	24	-10	21	-8	18	-----	18	-4	-----
Scott Field (Bellefonte), Ill.	76	-----	55	-----	49	-----	51	-----	54	-----	67	-----	58	-----	53	-----	51	-----	-----
Seattle, Wash.	74	+2	77	+7	74	+7	73	+9	69	+9	65	+8	60	+6	50	+3	46	+1	-----
Spokane, Wash.	74	-----	-----	-----	61	-----	57	-----	59	-----	61	-----	61	-----	60	-----	60	-----	-----
Washington, D. C.	71	+6	56	-3	55	-2	54	-3	55	-1	56	+3	50	+1	45	0	48	+3	-----
Wright Field (Dayton), Ohio	77	-----	71	-----	69	-----	67	-----	65	-----	66	-----	67	-----	68	-----	62	-----	-----

¹ Army.

² Weather Bureau.

³ Navy.

Observations taken about 4 a. m., 75th meridian time, except along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—The departures are based on "normals" covering the following total number of observations made during the same month in previous years, including the current month: Boston, 84; Norfolk, 141; Omaha, 149; Pearl Harbor, 112; Pensacola, 190; San Diego, 175; Seattle, 84; Washington, 226.

TABLE 2.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during April 1936

[Wind from N=360°, E=90°, etc.]

Altitude (m) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (309 m)		Billings, Mont. (1,088 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (153 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (274 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (410 m)		Murfreesboro, Tenn. (180 m)				
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	
Surface.....	335	0.9	290	0.9	269	1.4	266	1.9	284	3.4	294	0.3	259	0.6	269	1.4	329	1.0	15	1.7	74	2.2	108	0.2	202	0.9			
500.....	263	2.0	263	2.0	266	1.9	286	9.9	259	3.6	255	2.7	284	3.1	343	2.8	123	2.0	95	3.6	308	4.4	217	2.9	303	4.4	217	2.9	
1,000.....	283	4.1	294	9.8	294	9.8	294	9.8	289	5.2	281	6.4	292	6.1	323	4.4	125	2.2	130	2.6	308	4.9	250	5.1	303	4.9	250	5.1	
1,500.....	273	5.9	284	4.7	288	10.8	288	10.8	300	6.5	281	8.6	274	7.8	305	5.7	204	1.2	180	1.4	180	1.4	180	1.4	280	6.0	280	6.0	
2,000.....	279	3.3	288	8.2	289	5.2	290	11.0	277	5.9	303	8.7	236	10.5	307	8.4	234	2.2	219	1.9	196	2.4	298	7.3	196	2.4	298	7.3	
2,500.....	271	5.8	282	9.2	284	7.4	283	10.7	287	8.8	298	10.4	298	9.8	289	11.3	304	9.8	261	2.7	252	2.5	225	2.7	287	7.8	287	7.8	
3,000.....	284	6.8	285	8.8	291	8.2	280	12.7	298	9.4	301	13.3	301	11.0	276	11.9	307	8.5	275	8.0	255	3.3	225	5.5	264	5.9	264	5.9	
4,000.....	291	5.4	---	---	304	7.8	---	---	297	7.4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
5,000.....	302	5.1	---	---	313	7.6	---	---	284	6.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Altitude (m) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Harbor, Territory of Hawaii ¹ (68 m)		Pensacola, Fla. ¹ (24 m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,294 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washington, D. C. (10 m)			
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface.....	265	2.1	199	0.7	182	1.9	36	0.7	---	---	70	1.5	253	0.9	138	2.2	360	0.1	331	1.8	150	1.5	139	0.9	291	1.8	291	1.8
500.....	277	6.9	288	2.5	177	5.2	110	0.8	---	---	189	1.2	241	3.2	---	---	333	1.9	342	3.5	201	2.6	---	---	278	4.8	278	4.8
1,000.....	279	9.0	315	4.4	211	8.6	234	3.6	---	---	240	4.4	282	5.2	---	---	346	2.8	340	4.6	193	2.4	223	2.5	276	6.7	276	6.7
1,500.....	276	9.1	321	3.0	245	6.6	269	6.3	---	---	263	5.1	293	7.9	148	2.6	254	3.7	322	5.2	210	2.7	242	3.6	289	9.7	289	9.7
2,000.....	284	10.1	315	3.0	259	4.8	304	9.9	---	---	278	7.8	290	9.0	210	2.2	320	3.0	255	3.4	223	4.2	250	4.7	286	10.4	286	10.4
2,500.....	287	12.9	321	3.8	378	4.5	310	11.0	---	---	287	7.5	296	9.4	262	2.3	297	4.8	---	---	224	6.3	258	5.5	271	9.9	271	9.9
3,000.....	287	12.4	284	4.2	301	5.7	310	12.4	---	---	299	6.6	300	9.4	276	3.6	378	4.8	---	---	221	5.7	257	5.9	270	10.4	270	10.4
4,000.....	---	---	---	---	299	5.8	312	12.0	---	---	---	---	---	---	283	6.5	338	8.3	---	---	233	7.0	266	8.2	---	---	---	---
5,000.....	---	---	---	---	---	---	---	---	---	---	---	---	---	---	295	7.5	---	---	---	---	---	---	250	10.8	---	---	---	---

¹ Navy stations.

RIVERS AND FLOODS

[River and Flood Division, MONTROSE W. HAYES in charge]

By W. J. MOXOM

The winter of 1935-36 was unusually cold over the region east of the Rocky Mountains, and the snowfall was the heaviest in many years in the country north of the Potomac, Ohio, and Missouri Rivers. These conditions usually bring about floods when there is a sudden melting of snow and breaking up of ice by rain and warm weather; and in March floods occurred in Iowa, Minnesota, and in all the States east of the Mississippi River, except Michigan. They were light to moderate, except along the Atlantic seaboard from Virginia northward and in the upper Ohio Valley, where they were extremely high and exceeded all previous records.

Late in February and early in March, mild, rainy weather caused rises and ice gorges in the rivers of Virginia and Maryland, and some damage resulted from ice movement, but the combined run-off from the rain and melted snow was insufficient to give injurious floods. New England, New York, and Pennsylvania were not so fortunate, and there was considerable damage from both the crushing effects of ice and from floodwaters.

By March 16 the streams in Virginia and Maryland had fallen considerably and a fall had begun north of Maryland. Conditions were approaching normal, but on March 17 a storm that originated on March 15 in Texas had moved to south-central North Carolina and was causing general rains over the Middle Atlantic seaboard and the upper Ohio Basin. These rains were phenomenally heavy in the country to the west of the Coastal Plains and along the divide between the eastern rivers

and the upper Ohio Basin. Amounts of nearly 5 inches occurred in 12 hours or less over a large area in the mountainous regions of Virginia, Maryland, and western Pennsylvania, and more than 6 inches fell at some stations in a period of 48 hours or less. The storm moved slowly in a northeasterly direction and the rains were heavy over all of the North Atlantic seaboard. To the north-eastward the amounts were not so heavy, but from a flood-producing viewpoint the results were about the same, because the rivers in the southern part of the area under consideration were much lower at the beginning of the rain than they were in Pennsylvania, New York, and New England.

The rains fell on well-saturated and semifrozen soil, and the percentage of run-off was unusually high. This, coupled with the fact that the northern rivers were at or above flood stage, and those in Maryland and Virginia, while not in flood were higher than normal, gave the most disastrous floods of record in the James, Potomac, Susquehanna, Connecticut, and Merrimack Rivers, in some of the tributaries of the Ohio River in Pennsylvania and in the Ohio River from Pittsburgh, Pa., to below Wheeling, W. Va.

The Ohio River flood, which gave a record crest stage of 46.0 feet at Pittsburgh, Pa., on March 18, crested at Evansville, Ind., on March 31. The rise in the Ohio below Evansville was prolonged, due to early April floods in the Cumberland and Tennessee Rivers, and a crest stage of 52.8 feet occurred at Cairo, Ill., on April 16.