AEROLOGICAL OBSERVATIONS

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

By L. T. SAMUELS

In view of the fact that airplane observations were begun at a number of stations on July 1, 1934, so that a 3-year period has been completed, the departures from the "normals" thus determined have been included in table 1. The total number of observations represented by the normals for each station is indicated at the bottom of the table.

The free-air temperatures for July averaged above normal in most cases, except along the Atlantic coast and the Great Lakes region where the departures were negative. Temperature departures were of small to moderate magnitude at all stations. The lowest mean temperature for the month occurred at Selfridge Field at the 5-km level.

Free-air relative humidity departures for the month were of small to moderate magnitude in all cases, and mostly negative except at San Diego and Boston where they were positive at all levels. The free-air relative humidities in general averaged lower at the northern than at the southern stations with certain exceptions, viz., at Billings the average relative humidity increased in the higher levels to a mean of 60 percent at 5 km. The relative humidity also averaged comparatively high in the upper levels at Pensacola, El Paso, and Mitchel Field. The free-air relative humidity averaged lowest for the month at Selfridge Field.

A comparison of the free-air resultant winds for the month with the corresponding normals reveals a greater northerly component than normal over the Great Lakes region, Ohio Valley, and middle Atlantic coast. In most of these cases the resultant velocities were above normal in the lower levels, and below normal in the upper levels.

The resultant wind movement for the month showed in general a southerly drift west of the Mississippi River, and a northerly drift elsewhere. Resultant directions, except as noted above, were in general close to normal.

Resultant velocities in the lower levels averaged above normal over most stations, except over the Great Plains States where the departures were mostly negative. At the higher levels negative departures occurred over most of the country, except the Pacific coast and New England where they were positive. No large departures in resultant velocities occurred at any of the stations.

TABLE 1.—*Mean free-air temperatures and relative humidities obtained by airplanes during July 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)	24.2	------	25.1	------	22.8	------	19.9	------	17.3	------	14.3	------	11.2	------	4.7	------	−1.3	------	31
Billings, Mont.[2] (1,088 m)	22.2	+2.6	------	------	------	------	24.5	+2.5	21.8	+1.9	18.2	+1.6	14.4	+1.2	6.6	+1.0	−1.3	+1.1	31
Boston, Mass.[1] (5 m)	16.3	------	17.3	------	14.4	------	11.4	------	9.0	------	7.0	------	4.8	------	−0.1	------	−5.1	------	7
Cheyenne, Wyo.[2] (1,873 m)	16.3	+0.4	------	------	------	------	------	------	18.8	+0.6	19.5	+0.3	16.0	+0.3	7.8	+0.6	−0.6	+0.9	31
El Paso, Tex.[2] (1,194 m)	23.6	------	------	------	------	------	23.3	------	20.3	------	16.6	------	12.8	------	5.0	------	−1.8	------	31
Fargo, N. Dak.[2] (274 m)	21.0	+2.4	25.5	+3.6	23.9	+2.1	21.2	+1.7	17.9	+1.2	14.2	+0.7	10.6	+0.5	3.6	+0.5	−3.6	+0.4	31
Kelly Field (San Antonio), Tex.[1] (206 m)	23.3	−0.2	23.4	−0.4	21.8	−0.4	19.3	−0.5	17.1	+0.1	14.4	+0.4	11.5	+0.5	5.0	+0.3	−1.8	−0.2	28
Lakehurst, N. J.[3] (39 m)	19.2	------	20.7	------	18.6	------	16.1	------	13.2	------	10.5	------	8.3	------	2.9	------	−1.3	------	26
Maxwell Field (Montgomery), Ala.[1] (52 m)	24.5	+0.2	24.7	0.0	22.6	+0.3	19.5	+0.5	16.6	+0.6	13.7	+0.5	11.0	+0.7	4.5	+0.3	−1.8	0.0	30
Mitchel Field (Hempstead, L. I.), N. Y.[1] (29 m)	18.6	−1.3	20.1	−1.0	19.2	0.0	16.4	+0.2	13.3	+0.1	10.4	−0.1	7.7	−0.1	2.0	0.0	−4.7	−0.7	29
Murfreesboro, Tenn.[2] (174 m)	22.9	+0.4	24.2	0.0	23.1	+0.7	20.5	+1.0	18.0	+1.3	14.9	+1.1	11.7	+1.1	5.3	+0.9	−0.6	+1.1	30
Norfolk, Va.[3] (10 m)	23.4	−1.1	23.9	+0.2	21.4	−0.2	18.3	−0.6	14.7	−1.0	11.6	−1.3	8.6	−1.5	1.7	−2.3	−4.3	−2.5	24
Oklahoma City, Okla.[2] (391 m)	24.7	+0.5	26.4	+0.6	25.5	−0.3	22.7	0.0	19.0	−0.1	15.4	−0.3	11.8	−0.3	5.1	−0.1	−1.3	−0.2	31
Omaha, Nebr.[2] (300 m)	25.0	+1.9	27.9	+2.8	27.9	+2.0	24.6	+1.6	21.1	+1.3	17.2	+1.1	13.4	+1.0	6.1	+1.1	−1.3	+0.8	31
Pensacola, Fla.[3] (13 m)	24.2	−1.4	24.2	0.0	21.5	0.0	18.4	0.0	15.5	+0.2	12.4	+0.1	9.9	+0.5	3.3	0.0	−2.6	−0.1	30
San Diego, Calif.[3] (10 m)	20.3	−0.2	19.8	+1.3	23.5	+1.2	23.4	+1.0	20.7	−0.4	17.4	−1.4	13.0	−3.1	6.3	−2.8	−1.3	−3.2	30
Scott Field (Belleville), Ill.[1] (135 m)	23.2	+0.8	26.5	+0.3	25.7	+1.0	22.8	+1.2	19.1	+0.9	15.7	+0.8	12.2	+0.8	5.3	+1.1	−1.3	+0.8	28
Seattle, Wash.[3] (10 m)	14.0	−1.9	12.2	−1.3	10.9	−1.5	8.9	−1.7	8.2	−0.7	6.5	−0.3	4.9	+0.3	−1.2	−0.1	------	------	11
Selfridge Field (Mount Clemens), Mich.[1] (177 m)	17.2	−1.7	21.1	−0.7	19.5	−0.6	16.1	−0.8	12.6	−1.2	9.2	−1.6	6.4	−1.6	0.0	−1.8	−6.5	−2.1	31
Spokane, Wash.[2] (596 m)	15.6	+0.4	------	------	21.7	+2.0	21.2	+2.8	18.0	+3.1	14.5	+3.4	11.3	+3.6	4.5	+3.5	−2.6	+3.5	31
Washington, D. C.[3] (13 m)	20.9	−2.8	22.5	+0.1	20.2	−0.2	17.1	−0.5	13.9	−0.8	10.8	−1.0	8.0	−1.0	1.9	−1.4	−3.3	−0.9	29
Wright Field (Dayton), Ohio[1] (244 m)	20.9	+0.3	23.0	+0.2	23.1	+0.6	20.3	+0.8	17.2	+0.8	13.9	+0.6	10.6	+0.3	4.6	+0.3	−1.1	+0.6	31

Observations taken about 4:00 a. m., 75th meridian time, except along the Pacific coast and Hawaii where they are taken at dawn.
[1] Army.
[2] Weather Bureau.
[3] Navy.

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

RELATIVE HUMIDITY (PERCENT)

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.	86	------	71	------	66	------	63	------	59	------	57	------	57	------	62	------	56	------	------
Billings, Mont.	44	−8	------	------	------	------	33	−9	33	−7	36	−6	40	−3	43	+2	60	+8	------
Boston, Mass.	76	------	54	------	53	------	53	------	49	------	42	------	45	------	40	------	40	------	------
Cheyenne, Wyo.	61	0	------	------	------	------	------	------	54	−1	42	−1	43	+1	48	+1	56	+1	------
El Paso, Tex.	54	------	------	------	------	------	58	------	59	------	61	------	65	------	70	------	63	------	------
Fargo, N. Dak.	62	−15	46	−15	41	−10	39	−8	40	−4	43	0	45	+1	49	+4	53	+6	------
Kelly Field (San Antonio), Tex.	95	+3	92	+5	79	+5	73	+5	63	−1	57	−2	53	−2	53	+2	53	+2	------
Lakehurst, N. J.	87	------	61	------	53	------	58	------	61	------	58	------	46	------	46	------	38	------	------
Maxwell Field (Montgomery), Ala.	86	−2	74	+1	70	−1	69	−4	65	−5	59	−5	56	−6	56	−5	54	−2	------
Mitchel Field (Hempstead, L. I.), N. Y.	92	+1	80	+5	70	0	69	−1	73	+3	73	+7	69	+7	61	+3	62	+6	------
Murfreesboro, Tenn.	87	−3	69	−2	64	−5	63	−6	58	−7	55	−5	54	−4	52	0	49	0	------
Norfolk, Va.	88	+7	66	−6	64	−3	61	−5	62	−1	60	0	57	+1	58	+3	52	+4	------
Oklahoma City, Okla.	65	−6	62	−2	56	+2	53	0	53	0	53	+1	55	+4	53	+2	49	+1	------
Omaha, Nebr.	55	−16	47	−14	39	−9	39	−7	39	−6	41	−5	43	−4	43	−4	42	−3	------
Pensacola, Fla.	92	+5	80	0	76	0	75	+1	71	0	67	−1	60	−5	62	−2	62	+3	------
San Diego, Calif.	86	+6	82	+1	55	+4	43	+3	41	+8	42	+7	45	+7	52	+9	55	+10	------
Scott Field (Belleville), Ill.	75	−8	57	−4	48	−10	48	−10	51	−7	50	−5	50	−4	47	−6	46	−4	------
Seattle, Wash.	84	+7	78	+1	72	0	70	+3	57	−4	44	−10	35	−13	27	−18	------	------	------
Selfridge Field (Mount Clemens), Mich.	79	−1	54	−5	48	−8	48	−9	49	−9	46	−7	41	−7	34	−9	32	−6	------
Spokane, Wash.	61	0	------	------	52	+4	48	+3	48	+1	49	−1	52	+1	54	+3	50	0	------
Washington, D. C.	87	+11	49	−17	48	−14	52	−11	56	−7	56	−5	52	−6	49	−3	44	−3	------
Wright Field (Dayton), Ohio	75	−8	66	−3	61	0	64	+1	64	+4	63	+6	63	+8	54	+5	51	+6	------

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: Billings, 93; Cheyenne, 92; Fargo, 93; Kelly Field, 90; Maxwell Field, 85; Mitchel Field, 71; Murfreesboro, 92; Norfolk, 173; Oklahoma City, 92; Omaha, 121; Pensacola, 210; San Diego, 196; Scott Field, 89; Seattle, 67; Selfridge Field, 89; Spokane, 92; Washington, 251; Wright Field, 92.

TABLE 2.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during July 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
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	354	2.3	255	2.1	282	2.1	298	1.4	288	2.6	344	0.1	115	0.3	318	1.2	148	2.2	141	0.5	127	2.6	294	0.9	203	1.2
500	------	------	273	5.0	------	------	309	5.2	------	------	137	0.5	255	2.1	341	2.0	165	5.0	187	6.6	124	5.6	287	1.6	258	3.1
1,000	------	------	285	6.5	------	------	295	5.6	------	------	269	2.0	299	4.3	324	3.1	198	3.9	188	6.4	122	5.1	288	1.9	272	3.5
1,500	------	------	282	4.5	247	1.1	291	6.3	------	------	287	4.7	308	6.2	305	4.4	252	2.6	182	5.4	115	4.3	329	0.3	288	3.0
2,000	138	1.9	271	3.7	237	2.0	291	9.2	283	3.5	299	6.1	317	7.2	308	6.4	265	3.8	163	3.4	112	3.5	221	0.6	293	2.5
2,500	169	2.9	270	2.6	243	2.6	288	10.5	250	2.9	308	6.6	326	8.0	311	8.8	293	6.3	146	2.7	119	3.3	202	5.6	311	2.4
3,000	175	2.6	247	2.6	235	4.5	283	12.4	235	2.6	310	7.3	327	7.6	311	9.9	306	7.0	140	1.9	133	2.2	204	8.6	358	2.3
4,000	123	1.0	225	1.2	249	6.0	284	12.4	234	2.0	302	6.7	360	4.4	311	11.5	296	7.9	79	1.6	295	2.3	213	10.9	------	------
5,000	81	4.3	18	0.1	262	8.5	------	------	248	1.1	299	6.0	54	4.9	314	12.6	------	------	159	2.2	------	------	216	14.0	------	------

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
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	328	1.3	338	0.5	187	3.2	176	1.5	------	------	253	1.8	248	1.0	143	4.4	355	1.0	6	0.3	111	0.7	106	1.7	315	1.0
500	318	5.0	243	2.5	196	5.8	198	6.2	------	------	255	4.0	268	3.9	------	------	359	1.0	334	1.4	67	1.3	------	------	310	4.6
1,000	321	5.1	284	3.6	215	9.1	224	9.3	------	------	257	4.3	296	4.0	------	------	347	3.4	306	4.2	228	1.2	213	2.9	312	5.1
1,500	299	5.9	244	2.2	193	3.5	239	7.6	------	------	247	3.2	287	3.2	157	6.1	326	3.5	308	5.4	246	2.1	226	4.6	311	5.8
2,000	287	8.2	217	3.4	150	1.8	246	6.1	------	------	240	2.8	293	2.5	171	5.2	305	0.7	312	7.0	240	3.7	217	6.0	301	6.3
2,500	281	9.2	222	4.0	108	2.3	265	3.8	------	------	222	2.8	309	2.6	191	3.8	147	1.8	315	7.4	232	4.6	224	7.3	304	7.0
3,000	280	10.2	215	3.7	103	2.9	277	3.3	------	------	214	2.2	315	2.7	217	3.5	142	3.6	310	8.1	234	5.4	231	8.9	297	7.5
4,000	296	10.7	------	------	113	4.7	320	4.3	------	------	201	2.3	288	2.5	226	3.8	132	6.8	329	9.2	231	10.4	226	12.3	304	5.5
5,000	------	------	------	------	------	------	280	2.9	------	------	------	------	------	------	214	5.1	------	------	334	11.6	228	11.5	240	13.0	315	8.0

[1] Navy stations.