

TABLE 2.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 6 a. m. (E. S. T.) during June 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)		Murfrees- boro, Tenn. (190 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
Surface	321	1.2	214	0.6	346	1.7	283	1.3	270	2.4	21	1.0	11	0.6	299	1.6	144	1.3	95	0.3	149	2.6	201	0.8	273	0.8	
500	226	2.1	226	2.1	250	4.9	250	4.9	100	2.2	131	.5	299	2.7	185	1.6	150	4.6	155	4.0	279	1.5	224	1.3	224	1.3	
1,000	264	3.1	264	3.1	276	5.1	276	5.1	278	4.8	281	2.3	301	4.1	278	3.0	149	4.7	162	2.3	293	1.8	271	2.3	271	2.3	
1,500	296	2.3	296	2.3	33	1.4	281	6.3	277	4.8	287	4.6	290	5.5	287	4.8	133	4.0	150	2.0	196	.6	287	2.5	287	2.5	
2,000	217	2.2	295	2.7	301	.4	277	8.7	261	3.8	276	6.8	280	5.6	294	6.4	286	7.4	108	3.2	144	.6	187	2.1	306	4.0	
2,500	238	3.7	325	1.8	259	3.5	269	10.5	253	6.0	285	7.5	287	6.1	304	6.2	304	9.7	82	4.1	207	1.8	205	7.2	300	4.9	
3,000	245	3.8	332	2.5	284	5.6	278	11.2	255	6.3	294	8.3	292	6.4	299	5.3	301	10.0	75	4.1	218	3.1	204	9.8	316	4.6	
4,000	243	4.4	345	4.1	249	9.1	---	---	260	6.4	302	9.2	314	6.6	313	7.0	298	10.0	58	4.5	222	4.8	216	11.3	345	4.8	
5,000	249	1.7	330	6.2	284	9.5	---	---	273	5.2	317	10.8	344	7.9	308	7.8	---	---	48	3.5	---	---	230	13.8	---	---	

Altitude (m) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (102 m)		Omaha, Nebr. (306 m)		Pearl Har- bor, Terri- tory 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)		Washing- ton, 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
Surface	360	0.6	225	0.6	158	2.1	128	0.7	---	---	2	0.8	180	0.4	149	2.8	325	1.2	117	0.2	146	0.8	180	1.1	282	0.1	
500	280	4.0	272	3.1	180	4.3	151	3.1	---	---	275	1.3	174	1.8	---	---	302	2.5	281	1.7	210	1.4	---	---	287	2.5	
1,000	293	5.9	286	4.1	204	9.1	197	3.8	---	---	244	1.4	271	2.7	---	---	311	3.6	278	5.6	191	3.0	208	2.6	286	4.8	
1,500	293	6.8	238	2.2	216	6.4	245	4.3	---	---	60	1.5	281	4.9	160	3.5	289	3.4	288	7.5	205	3.6	230	3.3	290	4.9	
2,000	286	7.1	213	3.4	216	4.3	272	5.8	---	---	84	1.7	283	6.9	183	3.7	---	---	288	7.3	199	4.7	231	4.6	292	6.6	
2,500	280	7.5	219	4.3	225	3.1	281	6.7	---	---	49	2.1	292	5.8	205	3.9	---	---	286	8.0	107	5.8	225	5.1	276	6.7	
3,000	286	8.8	212	5.1	285	1.8	284	6.6	---	---	45	2.1	309	5.0	217	5.6	---	---	289	9.5	206	7.4	237	6.6	275	7.4	
4,000	279	9.2	---	---	34	1.4	290	9.2	---	---	24	3.5	311	7.9	234	7.1	---	---	296	12.2	224	8.8	236	10.1	290	5.0	
5,000	---	---	---	---	41	1.3	300	11.3	---	---	---	---	312	10.8	226	7.8	---	---	302	10.0	---	---	243	12.7	---	---	

¹ Navy stations.

RIVERS AND FLOODS

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

By W. J. MOXOM

The severe flood in the Arkansas River in Colorado, during the last few days of May, passed into Kansas on June 1 and gave bankfull and near bankfull stages from the Colorado line almost to Wichita, Kans. Flood stage was slightly exceeded at Great Bend, Kans. It is estimated that losses to tangible property in Kansas amounted to about \$8,000. Approximately 1,800 acres of prospective crops were damaged to the extent of about \$4,500 in the reach of the river embracing Dodge City, Great Bend, and Bentley, Kans.

Moderate floods occurred in the North Canadian River from Woodward to Oklahoma City, Okla.; the South Canadian River in the vicinity of Union, Okla.; and the Cimarron River near Perkins, Okla. Losses were estimated to be in excess of \$100,000. Owing to the efficient work of the river observer at Perkins, Okla., the losses in that section were much smaller than otherwise would have occurred; they amounted to approximately \$3,500. All families along the river in that section were called by telephone, and all movable property, such as shocked wheat, cattle, etc., was removed to higher ground.

Moderate to heavy flooding occurred during the latter part of May and the first few days of June in the Colorado and Guadalupe Rivers in Texas with estimated losses in excess of \$500,000.

Minor floods occurred in some of the tributaries of the Colorado River in Colorado during the first few days of June, with little or no damage.

Unusually low river stages prevailed in the Mississippi River and some of its tributaries.

The district center at Portland, Oreg., furnishes the following remarks on the annual rise of the Columbia River:

Precipitation from September 1, 1935, to February 29, 1936, was about normal or slightly above in the Okanagan drainage, slightly below normal in the Kettle River, West Kootenai, and Arrow Lakes drainage and at Revelstoke, and as much as 30 percent below in the Columbia Basin above Golden, British Columbia, and the East Kootenai Basin. According to the Canadian Water Resources Branch at Vancouver, precipitation ranged from 60 percent to 70 percent of the normal for the Columbia drainage in Canada, although at Trail, British Columbia, the amount exceeded the 20-year average.

In southern Idaho the amount of precipitation ranged from 100 percent to 150 percent of normal, in some areas exceeding this average. The amount of water contributed by this section was proportionate. Except for comparatively small areas in Washington, northern Oregon, southwestern Montana, northern, southwestern, and east-central Idaho, where as low as 38 percent of normal was reported, precipitation over the Columbia drainage in the United States was between 75 percent and 100 percent. During the last week in May and the first week in June the rainfall was quite heavy in the mid-Columbia and Snake River drainage.

Snowfall in Canada was about two-thirds of the average, but was solidly packed, the departure being less at the higher elevations. This conclusion is the result of reports from several sources. Two points where snow survey measurements were made substantiate this view. One point, 30 miles northwest of the north end of Kootenay Lake, at an elevation of 6,000 feet, reported 86 percent of the 1935 water content. The other point, which was Sinclair, on the Banff-Windemere highway, at an elevation of

4,500 feet, reported 78 percent of the water content for the same period. The amount of snow in that portion of the Cascades drained by the Columbia River exceeded by several inches the amount recorded last year. Snow depths in the elevated districts south of the international line ranged from normal to considerably above, according to reports, and was generally above normal in water content, except in the upper Snake, where snow depths and water content were sufficient to sustain the highest average summer flow at Weiser, Idaho, since 1928.

Due to low average temperatures over the entire upper Columbia drainage during the winter and early spring, the average stage of the Columbia and its tributaries was considerably lower than normal. In January to April, inclusive, it was the lowest since 1931, when, on account of a considerable deficiency in precipitation during 1930, the river stages were abnormally low. The Dalles, Oreg., reported a stage of -3.5 feet on February 10, 1936. This exceeds by 1 foot the previous low record.

Temperatures continued low the first part of April, with freezing nights over the entire snowfield. About the 10th mean temperatures rose sharply, except over the northern portion of the Canadian drainage, and by the middle of April a considerable amount of the lowest snow had melted and all streams were rising rapidly. A stage of 15.2 feet was reached at Lewiston, Idaho, on the Snake River, on April 25; the highest stage (on May 16) exceeded this by only 1.2 feet. Mean temperatures fell considerably the middle of May, and night temperatures were near freezing on May 15 and 16. Except for a very slight rise in the Snake River the first part of June, caused by heavy precipitation and a decreased demand for irrigation water in southern Idaho, the stage fell steadily after May 16. The effective snow cover for increased run-off had been exhausted by the warm weather the last half of April and the first half of May.

Abnormally high temperatures in the interior of western Canada caused the Columbia to continue to rise. Crest stages were reached in the upper Columbia the first week in June and, accompanied by a near stationary stage in the Snake River, they advanced as far downstream as Vancouver, Wash., and Portland, Oreg., by the 11th. However, most apprehension was over when the Snake River failed to rally with the high temperatures the last week of May. Experience has shown that it is necessary to have both the upper Columbia and Snake Rivers at high stages, with a tendency to rise or rising, to produce a serious flood in the lower river. When one is rising and the other falling the effect is compensating. The hydrograph below the confluence of the two rivers is considerably flattened, and very much reduced crest stages result.

The damage resulting from the high water this season is thought to have been almost negligible. Ample warnings were issued.

Tentative forecasts of 20 feet for Portland and 35 feet for The Dalles were made at the end of March. Shipping interests were advised promptly, so that the lower docks could be evacuated without damage to cargo. It was necessary for some farmers on the lowlands to delay planting and for others to purchase a small additional amount of feed; however, this is expected almost annually.

Table of flood stages during June 1936

[All dates in June, unless otherwise specified]

River and station	Flood stage	Above flood stages— dates		Crest	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE					
Cape Fear: Lock No. 2, Elizabeth- town, N. C.	20	26	26	20.0	26.
MISSISSIPPI SYSTEM					
<i>Arkansas Basin</i>					
Cimarron: Perkins, Okla.	11	6	7	12.8	6.
North Canadian:					
Woodward, Okla.	5	2	2	6.0	2.
Canton, Okla.	6	5	8	8.0	6.
Yukon, Okla.	8	May 27	9	8.5	7.
East Oklahoma City, Okla.	14	10	12	11.4	11.
Canadian: Union, Okla.	6		12	15.3	12.
Arkansas: Great Bend, Kans.	5	3	4	9.0	5.
				5.8	3.
WEST GULF OF MEXICO DRAINAGE					
Guadalupe: Victoria, Tex.	21	May 23	2	29.6	May 25.
Rio Grande: Eagle Pass, Tex.	16	29	29	20.2	29.
GULF OF CALIFORNIA DRAINAGE					
<i>Colorado Basin</i>					
Eagle: Eagle, Colo.	5	May 30	1	5.3	May 31.
Roaring Fork: Carbondale, Colo.	5	May 15	2	6.2	May 30, Junet
		9	14	5.4	12.
PACIFIC SLOPE DRAINAGE					
<i>Columbia Basin</i>					
Willamette: Portland, Oreg.	18	5	14	19.7	10, 11.
Columbia: Vancouver, Wash.	15	May 6	21	20.4	10, 11.

WEATHER ON THE ATLANTIC AND PACIFIC OCEANS

[The Marine Division, I. R. TANNEHILL in Charge]

NORTH ATLANTIC OCEAN, JUNE 1936

By H. C. HUNTER

Atmospheric pressure.—Near the British Isles and the western coasts of Europe and northern Africa the pressure averaged greater than normal. However, most of the

TABLE 1.—Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, June 1936

Stations	Average pressure	Departure	Highest	Date	Lowest	Date
	<i>Inches</i>	<i>Inch</i>	<i>Inches</i>		<i>Inches</i>	
Julianehaab, Greenland	29.79	-0.07	30.18	25	29.44	14
Reykjavik, Iceland	29.86	-.02	30.32	1	29.20	11
Lerwick, Shetland Islands	30.00	+.20	30.35	19	29.55	6
Valencia, Ireland	30.01	+.01	30.25	5	29.61	30
Lisbon, Portugal	30.12	+.09	30.50	5	29.75	20
Madeira	30.12	+.05	30.27	4	29.96	1
Horta, Azores	30.24	.00	30.51	{ 6, 7, 8, 9	29.82	26
Belle Isle, Newfoundland	29.87	+.01	30.36	19	29.08	17
Halifax, Nova Scotia	29.92	-.05	30.34	24	29.28	2
Nantucket	29.91	-.07	30.29	23	29.44	28
Hatteras	29.94	-.07	30.26	26	29.66	28
Bermuda	30.02	-.11	30.22	27	29.66	16
Turks Island	29.94	-.09	30.08	26	29.79	16
Key West	29.90	-.09	30.09	30	29.58	15
New Orleans	29.92	-.06	30.12	26	29.72	1

NOTE.—All data based on a. m. observations only, with departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

Atlantic area had pressure less than normal, particularly the vicinity of Bermuda and the regions to southwestward toward the Greater Antilles, where readings were seldom as high as normal until after the 21st.

The extremes of pressure so far reported from vessels are 30.70 and 29.13 inches, the former mark being recorded on the British steamship *Goolistan*, during the forenoon of the 8th, near latitude 43° N., longitude 24° W., and the latter on the American steamship *Scanmail*, at 11 p.m., the 10th, at about 57° N., 22° W.

Cyclones and gales.—There were about as many reports of gales as usual in June. Whole gales (force 10) occurred several times, in various parts of the ocean, but in no case near or over tropical waters.

The storm most notable for its effects along the chief steamship lane to northern Europe was located between Bermuda and Newfoundland on the 1st, and moved eastward then toward the east-southeast to about the fortieth meridian on the 2d; thereafter it was practically stationary, and by the 5th had almost filled up.

During about a fortnight thereafter the few strong winds over Atlantic waters east of the fiftieth meridian were mostly related to the unusually high pressure prevailing in the region north of the Azores. The Belgian steamship *Kambove*, from Argentina to the English Channel, reported intensified northeast trade winds from the