Resultant velocities exceeded the normals during May, July, and November.

An outstanding feature of the year was the inauguration of free-rising captive-balloon observations. This method has proved valuable when winds are too light for kite flying and contributes to the continuity of daily free-air soundings.

A limiting-height device (Rossby deflation valve) was also used occasionally and the balloon allowed to rise unrestricted by wire. The valve was set so as to deflate the balloon between 2 and 3 kilometers. The balloon's ascent and descent were then followed by means of two theodolites and its recovery effected usually within a very short time.

During October, the International Month for 1927, a series of 44 sounding-balloon observations were made at Groesbeck, Tex. Thus far 34 of the meteorographs have been returned. Practically all of the ascensions were observed with two theodolites to high altitudes which in some cases exceeded 20 kilometers. On October 14 and 15, designated as the International Days, continuous kite flights were made at the aerological stations and 5 airplane soundings at the Naval Air Station, Anacostia, D. C.

A series of sounding-balloon observations were made on December 30 and 31 when 12 Weather Bureau stations released 2 balloons each. Continuous kite flights were also made on the same days at the aerological stations, a series of airplane observations at several naval air stations and special pilot-balloon observations at most of the pilot-balloon stations. This program was carried out in connection with a special study of free-air convection.

During the year there were 1535 kite flights made, averaging 2,685 meters in altitude, 32 captive-balloon observations, nearly 30,000 pilot-balloon observations and 225 airplane observations, the latter at the Naval Air Station, Anacostia, D. C.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during the year 1927*

TEMPERATURE (°C.)

Altitude, m. s. l. (Mean)	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C.* (7 meters)	
	Mean	Departure from 9-year mean	Mean	Departure from 7-year mean	Mean	Departure from 10-year mean	Mean	Departure from 9-year mean	Mean	Departure from 10-year mean	Mean	Departure from 3-year mean
Surface	15.5	−0.1	16.9	−0.1	4.0	−1.5	18.9	+0.7	10.8	−0.3	15.6	
250	15.4	−0.1	16.6	−0.1			18.4	+0.8	10.6	−0.3	13.9	
500	14.4	+0.2	15.0	+0.1	3.9	−1.5	17.4	+1.1	9.0	0.0	12.5	
750	13.6	+0.4	14.0	+0.4	3.7	−1.2	16.5	+1.1	8.0	+0.2	11.3	
1,000	13.0	+0.6	13.0	+0.5	3.6	−1.0	15.9	+1.2	7.3	+0.5	10.2	
1,250	12.4	+0.8	11.8	+0.5	3.2	−0.9	15.2	+1.3	6.4	+0.6	9.1	
1,500	11.6	+1.0	10.6	+0.5	2.5	−0.8	14.3	+1.3	5.4	+0.6	8.1	+1.9
2,000	9.3	+0.9	8.1	+0.4	0.3	−0.9	12.2	+1.3	3.1	+0.4	6.0	+2.0
2,500	6.7	+0.9	5.7	+0.5	−2.3	−0.9	9.8	+1.3	0.8	+0.5	3.7	+2.0
3,000	3.8	+0.8	3.5	+0.8	−5.2	−1.0	7.1	+1.1	−1.6	+0.6	1.1	+2.1
3,500	1.1	+0.9	1.2	+1.2	−7.9	−0.9	4.6	+1.3	−4.2	+0.6	−1.1	+2.9
4,000	−2.0	+0.7	−1.2	+1.6	−10.8	−1.0	1.6	+1.1	−6.8	+0.6	−3.6	+3.4
4,500	−5.3	+0.2	−3.0	+2.6	−13.8	−1.1	−1.6	+0.6	−9.7	+0.4	−4.6	+5.6
5,000	−8.1	+0.2	−4.4	+4.0	−16.5	−1.0			−12.9	+0.4	−8.4	+4.9

RELATIVE HUMIDITY (%)

Surface	70	+2	68	+2	75	+3	75	+1	72	+2	63	
250	70	+2	68	+2			75	+2	72	+2	64	
500	65	0	67	+1	74	+3	74	+3	71	+2	63	
750	61	−2	65	−1	69	+2	72	+4	69	+1	61	
1,000	59	−2	65	−1	65	+1	67	+3	65	−1	60	
1,250	56	−2	66	0	63	+2	62	+2	62	−2	59	
1,500	53	−3	66	+1	61	+2	57	0	60	−2	58	
2,000	48	−4	63	+1	61	+4	50	−1	56	−2	54	
2,500	46	−4	57	−1	62	+6	46	−2	51	−3	49	
3,000	46	−3	54	−1	62	+7	44	−1	51	−1	47	
3,500	45	−3	52	−1	60	+6	43	0	48	−2	44	
4,000	45	−2	47	−5	57	+4	47	+5	44	−4	39	
4,500	51	+6	52	0	56	+3	50	+10	43	−4	29	
5,000	40	−5	15	−35	52	+1			42	−3	21	

VAPOR PRESSURE (mb.)

Surface	14.35	+0.57	14.39	+0.40	7.93	−0.17	17.98	+1.13	10.01	−3.18	12.96	
250	14.21	+0.54	14.20	+0.42			17.43	+1.21	10.55	−0.06	11.91	
500	12.56	+0.38	12.83	+0.47	7.72	−0.17	16.08	+1.35	9.43	5+.03	10.76	
750	11.20	+0.23	11.78	+0.44	6.92	−0.13	14.56	+1.31	8.68	+0.13	9.66	
1,000	10.30	+0.30	11.05	+0.57	6.28	−0.14	12.82	+1.11	7.84	+0.04	8.83	
1,250	9.33	+0.30	10.34	+0.73	5.80	−0.05	11.14	+0.80	7.02	−0.04	8.02	
1,500	8.31	+0.24	9.43	+0.74	5.28	−0.02	9.58	+0.48	6.29	−0.04	7.34	
2,000	6.41	+0.06	7.44	+0.51	4.44	+0.10	7.06	+0.03	5.02	+0.02	5.92	
2,500	5.03	+0.06	5.63	+0.18	3.71	+0.15	5.41	−0.17	3.83	+0.01	4.44	
3,000	4.12	+0.18	4.49	+0.16	3.01	+0.15	4.33	−0.14	3.10	+0.12	3.38	
3,500	3.36	+0.19	3.77	+0.27	2.32	+0.02	3.58	−0.03	2.41	+0.10	2.50	
4,000	2.51	+0.05	2.83	−0.01	1.75	−0.11	3.07	+0.12	1.83	+0.08	1.89	
4,500	2.01	+0.07	2.84	+0.42	1.23	−0.27	2.78	+0.39	1.51	+0.09	1.25	
5,000	0.99	−0.58			0.60	−0.60			1.27	+0.10	0.67	

* Naval air station, Anacostia, D. C.

THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS[1]

A cold month, particularly in the upper Missouri Valley and adjacent regions as shown by Chart III. Precipitation was on the whole more abundant than for the average December. See the inset on Chart IV. The usual details follow.

THE WEATHER ELEMENTS

By P. C. DAY

PRESSURE AND WINDS

The notable feature of the closing month of 1927 was the persistent and severe cold that prevailed over the northern districts from the Great Lakes westward during the greater part of the first two decades, and to a less extent even during the last. Anticyclones largely dominated the weather over the northwestern districts and few important cyclones entered the country from that section during the latter half of the month until near the end.

Moderately low pressure over the Atlantic Coast States during the first few days caused heavy precipitation from the East Gulf States northeastward to New England, with some sleet and the only snow of the month in the Middle Atlantic States. At the same time light, scattered snows occurred over most northern districts from the Great Lakes westward.

By the morning of the 6th a moderate barometric depression was central over Colorado, and light precipitation, mostly snow, had occurred from the upper Missouri Valley westward to Oregon and Washington. During the following 24 hours this depression moved to southeastern Iowa and precipitation extended into the central valleys, with some heavy rain in eastern Texas and considerable snow from the upper Lakes westward to Montana. During the following day this storm advanced to the southeastward, increasing greatly in severity as it crossed the upper Lakes where it was one of the most severe experienced in many years. Precipitation, mostly rain, extended into all districts from the Mississippi River eastward, heavy amounts occurring in a few localities, and some snow falling in the upper Lake region.

With the passage of this cyclone no important storm occurred until about the 12th, when general rains set in over a wide area from the west Gulf region northeastward to the Great Lakes and North Atlantic States, ex-

[1]This paragraph will be discontinued with the issue for the current month.—*Editor.*

tending during the following day into the Middle Atlantic States, where, on the morning of the 14th, a well-developed barometric depression was present and heavy rains had occurred in portions of the Lake region and Ohio Valley.

At the same time a cyclone of considerable strength had moved from the north Pacific coast and was central over Colorado on the morning of the 14th, whence it moved to southern Wisconsin by the following morning and to Lake Superior by the morning of the 16th, but without important precipitation. As this was moving northeastward low-pressure was developing along the Atlantic coast and rain, heavy in may localities, had occurred over a wide belt from the West Gulf States northeastward to New England. During the following day the barometric depression became well-defined and moved northeastward off the coast of Maine and heavy rains extended into New England and the Canadian Maritime Provinces.

From the 17th onward no important cyclone entered the country until after the middle of the last decade, when low pressure moved from the far Southwest to the upper Lakes from about the 26th to 29th and widely extended precipitation occurred both to the westward and eastward of the low-pressure area as it advanced northeastward, the falls being light, however, except in portions of the Middle Gulf States. This was quickly followed by a rather important cyclone that developed over the eastern slope of the central Rocky Mountain region about the 28th and moved southward to Kansas during the following 24 hours and thence to the lower Lakes by the morning of the 30th. This caused a wide distribution of precipitation, particularly on the last day of the month from the Mississippi Valley eastward, with considerable snow over a narrow area from eastern Kansas to lower Michigan, and smaller amount over the upper Lakes.

Anticyclonic conditions prevailed during the first week over the Plateau region and again from about the 15th to about the 25th. Near the close the most important anticyclone and cold wave of the months had entered the northwestern districts and by the morning of the 31st had advanced into the upper Missouri Valley with atmospheric pressure above 31 inches, and decided cold had extended nearly to the coast of Texas, while the lowest temperatures of the month, 50° or slightly more below zero, were being experienced locally in the northern Rocky Mountain region.

The pressure for the month was mainly above normal and distinctly so along the northern border from Lake Superior to Montana and over the near-by Canadian Provinces. It was also distinctly higher than during the preceding month, except over a narrow area along the Atlantic coast and in central California.

Damaging windstorms were rather infrequent for the first winter month, and were confined largely to the area covered by the cyclone of the 7th and 8th in the middle Mississippi Valley and northeastward over the Great Lakes.

The prevailing wind directions were mainly from northerly points in the Missouri and upper Mississippi Valleys, in the Lake Superior district and New England; also in the Southern States from central Texas eastward. In the middle plains and thence eastward they were mainly from southerly points. Elsewhere they were variable.

TEMPERATURE

As stated previously December was a remarkably cold month over the northern districts from the Great Lakes westward. No less than three distinct cold waves entered the upper Missouri Valley from the adjacent Canadian Provinces and overspread the districts to the southward and eastward with varying degrees of intensity.

The month opened with moderate cold existing over much of the country, ranging from about 10° below zero along the Canadian boundary from Lake Superior to northeastern Montana, to freezing in central Texas, with sharp falls of 20° to 40° within 24 hours over a wide area from southern Texas to the Great Lakes. The cold area reached the Atlantic coast during the day, and it continued cold in most districts from the Rocky Mountains eastward for several days.

The first cold wave in the Northwest entered that district on the 5th and by the morning of the 7th had advanced into the Great Plains with temperatures of zero or lower as far south as northwestern Kansas. This cold area advanced into the central valleys during he following 24 hours, with freezing weather to the Gulf coast and the line of zero temperatures extending to the southern limits of Kansas and Missouri. The cold wave had extended to the Atlantic coast by the morning of the 9th, bringing the lowest temperatures of the month in a number of States from the Great Plains eastward. This cold period was particularly severe in the South where minimum temperatures of 8° to 15° occurred at exposed points in the Gulf States and a temperature as low as 22° occurred in northern Florida.

A second important cold period over much of the country appeared over the upper Missouri Valley on the morning of the 13th, and, with some interruptions, finally overspread most districts to the southward and eastward during the following few days, passing off the Atlantic coast by the 17th. This cold wave also carried freezing temperatures nearly to the Gulf coast, and the coldest weather of the month was experienced in portions of the plateau and middle Pacific sections. A few States of the Southwest had the coldest weather of the month on the 18th and 19th when an extensive anticyclone covered the middle plateau.

The closing decade of the month had rather steady cold nearly throughout over much of the country, and by the morning of the 28th the third cold wave of the month appeared over the Canadian Northwest and by the following morning it had entered the Dakotas and near-by territory. By the end of the month the anticyclone had developed greatly, the barometric pressure had risen above 31 inches, and temperatures as low as zero had penetrated to the Panhandle region of Texas and into central Oklahoma, while readings from 30° to 50° below zero had occurred in the northern Rocky Mountains and thence eastward to Lake Superior and freezing weather had already reached south-central Texas. By the morning of January 1, 1928, the cold wave had reached the Gulf coast and north-central Florida with prospects of a further lowering. The lowest temperatures of the month occurred on the 31st in the far northwestern districts, and the lowest so far during the winter occurred during the early days of January over most districts to the southward and eastward, with severe damage to winter vegetation.

The highest temperatures of the month occurred on the 1st and 2d along the Atlantic coast and about the same time over most districts from the Rocky Mountains westward. Another warm spell occurred about the 12th and 13th over the central valleys and many eastern districts. Maximum temperatures went above 90° only in Texas, but they did not rise to 50° in portions of North Dakota and thence eastward to the Lake Superior district.

The month as a whole was the coldest of record for December over much of Montana, the Dakotas, and some near-by areas, the averages ranging from 15° to nearly 20° below normal, and the month was much colder than normal over nearly all other portions of the country from the Mississippi Valley westward save in certain of the coast districts of California, where, in a few instances, the month was slightly warmer than average.

Over the more eastern districts the average monthly temperatures were above normal, the excess increasing toward the Atlantic coast and New England, though even there the positive departures were mainly not large. In Canada the month was decidedly cold over western districts but moderately warm over the Maritime Provinces.

PRECIPITATION

The month was distinctly wet over most eastern districts and moderately dry in the West.

In the Southeastern States the monthly amounts were mainly well above normal, a few points having unusually heavy falls for December, though the distribution was satisfactory. Over Florida, however, the precipitation was generally less than normal, but sufficient as a rule to greatly benefit the trucking interests. Much replanting, however, was necessary, due to the dry weather preceding. Over the Plains States from Oklahoma to Nebraska and thence westward and northwestward to the Pacific there was mainly deficient precipitation, a few points in the north Pacific coast sections having the least precipitation of record for December. In portions of the far Northwest heavy rains during the first few days, in connection with rapid melting of the snow cover, due to warm weather, produced important floods in some of the mountain streams.

SNOWFALL

The amount of snow was generally less than is expected in December, save along the northern border from the Great Lakes westward; there locally the fall was well above normal and some section had the heaviest individual snowstorms of record. Over the more eastern districts, however, there was mainly little snow and some stations in southern New England had the least of record for December, while others reported no snowfall during the entire month, a condition not heretofore observed.

Despite the absence of important snowfall over the country as a whole it was widely distributed and occurred in small quantities at least over most districts where is it usually expected.

Some heavy falls occurred in the upper Mississippi Valley on the 6th–7th in connection with the severe storm on those dates over the Great Lakes, and some heavy local falls occurred in the Dakotas and Minnesota on the 14th and 15th. In Buffalo, N. Y., rather unusual conditions as to snowfall existed on the 17th and 18th. On the 17th the heaviest snow of the year was recorded at the Weather Bureau office, nearly 13 inches, while on the following day only a trace was recorded at that office, while in some outlying suburbs the snow fell to depths of 2 to 4 feet, the greatest of record, causing almost complete tie-ups in local traffic.

Snow was generally deficient in the central and southern mountain districts and the accumulated pack at the end of the month was usually less than normal.

RELATIVE HUMIDITY

Despite a marked excess of precipitation over most portions of the South Atlantic and Gulf Coast States there was a general, and, in some cases, extensive deficiency in the average relative humidity. There were likewise important deficiencies in the middle and southern Plains and over the far Northwest, which may be attributed to the general lack of precipitation. Over most other districts there were general excesses, these being large in the far Southwest and over northern districts from the Rocky Mountains to the Great Lakes.

SEVERE LOCAL STORMS, DECEMBER, 1927

The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau.

Place	Date	Time	Width of path	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
			Yards					
Virginia (southeastern)	4					High winds	Considerable damage by high water; some sections near Norfolk inundated.	Official, U. S. Weather Bureau.
Havre, Mont	4-5					Wind and snow	A number of people and livestock frozen to death; minor property damage.	Do.
Hearne, Tex., and vicinity	6	P. m.		1		Wind and rain	Two homes wrecked, others blown from foundations; roofs torn off and cotton sheds demolished.	Dallas Morning News (Tex.)
Illinois, Indiana, Iowa, Minnesota, Missouri, Ohio, and Wisconsin.	6-8					Wind and snow	Heavy damage to wires, trees, and poles; transportation delayed; many minor accidents and several deaths reported; much suffering from cold.	Official, U. S. Weather Bureau.
Tunnell Springs, Ala. (near).	7			1		Tornadic wind	School building and several homes demolished; trees uprooted.	Courier (Evansville, Ind.).
Cheesman Lake, Colo	8					Wind	Many trees broken; roofs blown off	Official, U. S. Weather Bureau.
Buffalo, N.Y., and vicinity	8			5	700,000	Severe wind	Lake steamers, small craft, amusement beaches, and lake shore property damaged.	Do.
Parkersburg, W. Va	8	A. m.				do	Overhead wires considerably damaged	Do.
Mount Vernon (near) to Oakland City, Ind.	13				50,000	Tornadic wind	Trees, wires, crops, and buildings damaged	Do.
New York (northern)	16					Glaze and wind	Great amount of damage to telephone, telegraph, and power lines; trees broken; transportation delayed.	Do.
South Dakota (western)	29-30					Wind and snow	Highways impassable; stock suffers greatly; trains delayed.	Do.
Illinois and Missouri	30-31					do	Trains delayed; highways obstructed; car service hampered; 2 railway accidents in Illinois.	Do.