Dates of first light and heavy frosts and snow—Continued.

State and station.	First frost. Light.	First frost. Heavy.	Snow.
Oregon—Cont'd.			
Hood River (near)		9	
Hubbard		17	
La Grande †		6	
Pendleton		7	
Portland	19		
Roseburg	6		
Salem †		11	
Sparta †		6	
The Dalles		7	
Pennsylvania.			
Aqueduct †		12	
Blooming Grove			14
Carlisle		12	
Cassandra			14
Chambersburg †		12	
Clarion			14
Coatesville		12	
Du Bois			15
Dyberry			14
Easton	7		
Edinboro		15	
Emporium			14
Grampian		7	14
Greenville		7	13
Hamburg †		16	
Harrisburg			14
Hollidaysburg			14
Huntingdon		12	
Johnstown		11	13
Kennett Square	7	15	
Kilmer		8	14
Lancaster †		16	
Lebanon		12	
Le Roy			14
Lewisburg †		16	
Lycippus †		15	
Oil City			14
Parker			14
Philadelphia	12		
Phœnixville		15	
Pittsburg		7	14
Pottstown	12	16	
Quakertown		12	
Ridgway			14
Saegerstown			14
Shinglehouse			14
Smethport			14
Somerset		6	
South Eaton		16	
State College			14
Towanda			14
Uniontown		12	
Westtown		12	
York		7	14
Rhode Island.			
Bristol	19		
Kingston		16	
Narragansett Pier	15		
Providence	12	16	
South Carolina.			
Aiken	15		
Blackville	15		
Blenheim	15		
Branchville	15		
Camden	15		
Central		15	
Cheraw	18		
Columbia	15		
Conway	15		
Cross Hill	15		
Effingham	14		
South Carolina—Cont'd.			
Georgetown	15		
Greenville	12		
Greenwood	15		
Hardeeville	15		
Hollands Store	15		
Little Mountain	12		
Longshore	12	15	
McCormick	15		
Pinopolis	16		
Shaws Fork	12	15	
Society Hill	15		
Statesburg	15		
Trenton	15		
Trial	15		
Watts	15		
Yorkville	14		
South Dakota.			
Alexandria			7
Ashcroft			6
Bowdle			7
Clark			7
Elandreau			3
Fort Meade			2
Fort Sully			7
Frankfort			7
Gary		5	
Highmore			3
Hotch City			7
Huron			3
Kimball			7
Millbank			7
Northville			7
Oelrichs			28
Piedmont			27
Pierre			7
Rapid City			2
Rosebud			7
Sioux Falls			29
Spearfish		7	7
Tennessee.			
Andersonville	6		
Ashwood		10	
Byrdstown	6	14	
Chattanooga	6	15	
Clarksville	5	10	
Covington	9		
Florence Station	5	9	
Franklin	5	10	
Greeneville	11	14	
Hohenwald	5	9	
Jacksboro	6	15	
Johnson City	5	15	
Knoxville		15	
Lynnville	6	10	
Memphis	9		
Milan	6	10	
Nashville	6	15	
Newport	11	15	
Nunnelly		9	
Riddleton	10	14	
Rogersville	11	14	
Rugby	5	6	
Springdale	5	11	
Tullahoma	4	10	
Waynesboro		9	
Texas.			
Arlington	30		
Arthur City	7		
Aurora	30		
Brady	30		
Brazoria	30		

Dates of first light and heavy frosts and snow—Continued.

State and station.	First frost. Light.	First frost. Heavy.	Snow.
Texas—Cont'd.			
College Station	30		
Columbia	30		
Corsicana	31		
Dallas	31		
Devine	30		
El Paso		30	
Estelle		30	
Fort Hancock †		21	
Fort Stockton	29		
Grape Vine	9		
Hale Center	8	29	
Hallettsville	30		
Happy		8	
Houston	30		
Jefferson	27	30	
Leakey		29	
Menardville		29	
Midland		29	
Mountain Spring	9		
New Braunfels	30		
Palestine	30		
Roby		30	
Round Rock	30		
Utah.			
Cisco †		2	
Loa			31
Manti †		13	
Moab †		8	
Mount Pleasant †		28	
Ogden †		28	
St. George †		1	
Salt Lake City			27
Soldier Summit			26
Vermont.			
Brattleboro †		19	
Burlington			14
Enosburg Falls			15
St. Johnsbury			15
Strafford			15
Vernon †		12	
Woodstock			16
Virginia.			
Ashland		12	
Bedford City	12		
Big Stone Gap	5	10	31
Birdsnest		16	
Blacksburg	6	12	
Buckingham †		15	
Dale Enterprise	7	15	
Hot Springs		6	31
Irwin †		15	
Lexington	12	15	
Lynchburg	12	16	
Norfolk		16	
Nottoway		15	
Petersburg		16	
Richmond	15		
Rocky Mount †		15	
Salem	15		
Smithville	15		
Spottsville		15	
Stanardsville		15	
Staunton	7	12	
Stephens City		15	
Warsaw	12		
Whittles Depot †		15	
Wytheville †		11	
Washington.			
Blaine †		6	
Bridgeport		10	
Chehalis		18	
Washington—Cont'd.			
East Clallam		17	
Everett †		2	
Fort Simcoe		18	
Kennewick †		9	
Lakeside †		18	
Lapush		12	
Madrone	19		
Olga	18		
Pine Hill	6		
Pullman			30
Pysht	7	18	
Tacoma		18	
Union City		21	
Walla Walla	7	20	
Waterville			23
West Ferndale		12	
West Virginia.			
Beverly		15	14
Bloomery		12	
Buckhannon			31
Creston †		10	
Davis			14
Elkhorn	6	15	
Ella		15	
Glenville		12	
Grafton		15	
Huntington †		8	
Madison	9	10	
Martinsburg	12	15	
Morgantown †		9	
New Cumberland †		15	
New Martinsville		9	
Nuttallburg †		5	
Parkersburg †		15	
Point Pleasant		9	
Powellton		14	
Sandyville		9	31
Tannery		12	
Wheeling †		15	
Wisconsin.			
Belleville			4
Beloit		14	
Black River Falls		9	
Chilton		9	
Depere		11	
Green Bay			13
Koepenick		8	11
La Crosse		9	
Lancaster		14	
Madison †		9	
Manitowoc		14	
Medford			7
New Holstein		6	
Oconomowoc			13
Osceola			30
Oshkosh †		9	
Pepin		13	
Port Washington †		8	
Sharon			13
Waukesha		14	
Wyoming.			
Big Horn Ranch			6
Camp Pilot Butte			20
Cheyenne			28
Fort McKinney			28
Laramie			29
Lusk			27
Saratoga			27
Sheridan			27
Sundance			2

HUMIDITY.

The quantity of moisture in the atmosphere at any time may be expressed by means of the weight contained in a cubic foot of air. This is usually known as the absolute measure and is equivalent to giving the tension of the vapor, the vapor pressure, or the temperature of the dew-point. The mean dew-points for each station of the Weather Bureau, as deduced from observations made at 8 a. m. and 8 p. m., daily, are given in Table I. These vapor tensions and the resulting dew-points, absolute humidities, and relative humidities are all deduced from observations of the wet-bulb thermometer by means of formulæ and tables that were first devised by August and subsequently modified by Regnault, 1845, and Ferrel in 1885, but which are still considered to be open to further improvement. In a general way the dew-points given in Table I are probably slightly lower than they should be, owing to the omission since 1887 of a correction for barometric pressure. There is also an uncertainty in the psychrometric formula which is only just now beginning to be understood, by virtue of which at temperatures below freezing the dew-points and the humidities are higher than they should be. For these reasons the monthly averages of the dew-points and relative humidities are subject to some uncertainty.

AVERAGE HUMIDITY.

The temperature of the wet bulb of the psychrometer is the temperature at which evaporation is going on from a special

surface of water on muslin at any moment, but a properly constructed evaporometer may be made to give us the *quantity of water evaporated* from a *similar surface* during any interval of time. Such an evaporometer, therefore, would sum up or integrate the effect of those influences that determine the temperature as given by the wet bulb, and from it, therefore, the average humidity of the air during any given interval of time may be deduced. Instead of attempting to make a self-registering wet-bulb thermometer we may use the evaporometer as an equivalent. The formula for determining the average vapor tension during an hour was given in 1887, at page 376 of the Treatise on Meteorological Apparatus and Methods (in the section on the use of the evaporometer as an integrating hygrometer), as based on the careful measurements made by Mr. Desmond Fitzgerald and published in the Transactions of the American Society of Civil Engineers, 1886. Let p be the average vapor tension in the free air, P the vapor tension corresponding to the temperature of the evaporating water (both of these tensions are to be expressed in inches of the mercurial barometer, and as the evaporometer was within the ordinary thermometer shelter, therefore, the temperature of the water corresponded closely with the temperature of the air and the vapor tension P was that for the average temperature of the air during the interval of observed evaporation); W the velocity of the wind in miles per hour as measured by the Robinson anemometer at the level of the surface of the evaporating water; E the observed depth of water evaporated in an hour and expressed in inches. With this notation the approximate formula that represents Mr. Fitzgerald's observations reads:

$$p = P - \frac{60E}{1+\frac{1}{2}W} = P - 60\frac{E}{W} \cdot \frac{1}{\frac{1}{W}+0.5}$$

An additional factor depending on the atmospheric pressure should probably be introduced, but would only become important at elevated stations.

It is much to be desired that one or more new series of accurate measurements of evaporation, wind velocity, temperature, and dew-point be made at high and low stations in instrument shelters similar to those used by the Weather Bureau, in order that a general empirical formula may be devised for use with the evaporometer considered as an integrating hygrometer.

WET-BULB OR SENSIBLE TEMPERATURES.

The sensation of heat experienced by the human body and attributed to the atmosphere depends not merely upon the temperature of the air, but especially upon its dryness and the force of the wind. Physiologists have explained this nervous sensation, erroneously called subjective temperature, as a condition due to the more or less rapid evaporation of the natural perspiration and the consequent drying of the outer layers of the skin.

Investigations were made into the relations between the moisture of the air and its physiological effects by Mr. J. W. Osborne, of Washington (see the Proceedings of the American Association for the Advancement of Science, 1876), and especially by the Chief of the Weather Bureau (see his memoir on "Sensible Temperatures," read before the American Climatological Association, June 1, 1894). It would seem that the rapid evaporation from the skin in dry, hot weather reduces the temperature of the layer of nerve cells at the surface of the skin. This reduction is not measurable by thermometers which give the temperature of large masses, but is appreciated by the minute nerves that end in these microscopic cells. This reduction of temperature, or sensible coolness, is apparently proportional to the reduction of temperature shown by the difference between the dry and wet bulb thermometers, and as shown by the chart accompanying Professor Harrington's memoir, it amounts on the average to 20° in the month of July in Arizona, Nevada, and Utah and 10° in Kentucky, Indiana, and Ohio.

The resulting sensible temperatures, as shown on his second chart, are simply the so-called average temperatures of the wet-bulb thermometer as obtained by the whirling apparatus used in the shaded shelter, and correspond to the surface or skin temperatures of persons standing in the shade of trees or houses exposed to a natural breeze of at least 6 miles per hour. The temperature of the wet-bulb thermometer and its depression below the dry bulb are the fundamental data for all investigations into the relation between human physiology and the atmosphere. In order to present a monthly summary of the atmospheric conditions from a hygienic and physiological point of view, Table I*a* has been prepared, showing the maximum, minimum, and mean readings of the wet-bulb thermometer at 8 a. m. and 8 p. m., seventy-fifth meridian time.

PRECIPITATION.

[*In inches and hundredths.*]

The distribution of precipitation for the month of October, 1894, as determined by reports from about 2,000 stations, is exhibited on Chart III. The numerical details are given in Tables I, II, and III; the first of these also gives the average departures from the normal for each district, whereas the average departure for each State is given in Table XII for each State Weather Service.

DIURNAL VARIATION.

Table IV*b* gives the total precipitation for each hour of seventy-fifth meridian time, as deduced from self-registering gauges kept at about 43 regular stations of the Weather Bureau; of these 27 are float gauges and 6 are weighing gauges.

NORMAL PRECIPITATION FOR OCTOBER.

The normal precipitation for October is shown on Chart IX of the Atlas of Bulletin C, entitled "Rainfall and Snow of the United States, Compiled to the End of 1891, with Annual, Seasonal, Monthly, and other Charts," by Mark W. Harrington, Chief of the Weather Bureau, Washington, 1894. From this chart it appears that the region of greatest rainfall in October is over 9 inches in the extreme northwest corner of Washington; the next largest rainfalls are over 6 inches in the southeastern end of Florida and the neighborhood of Cape Hatteras. The region of 3 inches, or over, covers the western quarter of Washington and Oregon and nearly all of the Atlantic and Gulf coasts, extending inland to a distance that varies from 100 miles in southern Texas to 300 miles in New England.

PRECIPITATION FOR CURRENT MONTH.

The precipitation for the current October was heaviest on the coasts of Washington and Oregon, where it ranged from 9 to 17 inches. Heavy precipitation, viz, above 8 inches, occurred at Narragansett Pier, Vineyard Haven, Woods Holl, and Nantucket. The precipitation averaged 1 inch, or less, in Mississippi, Tennessee, Illinois, and westward from the Mississippi River to the Rocky Mountains, and in southern California.

CURRENT DEPARTURES FROM NORMAL PRECIPITATION.

The precipitation for October was in excess on the coast of