U. S. DEPARTMENT OF AGRICULTURE, WEATHER BUREAU.

CO-OPERATING WITH THE

MARYLAND STATE WEATHER SERVICE

Established by an Act of the General Assembly of the State of Maryland, 1892, and Maintained in Connection with

The Johns Hopkins University and the Maryland Agricultural College.

CENTRAL OFFICE, JOHNS HOPKINS UNIVERSITY, BALTIMORE, MD.

PROF. WM. B. CLARK, Johns Hopkins University, Director.

PROF. MILTON WHITNEY, Maryland Agricultural College, Secretary and Treasurer.

DR. C. P. CRONK, U. S. Weather Bureau, Meteorologist in Charge.

VOL. V, NO. 7. MONTHLY REPORT. NOVEMBER 8, 1895.

Contains Review for the Month of October.

Relations of the Weather Bureau to the Science and Industry of the Country.*

WILLIS L. MOORE,

CHIEF OF THE WEATHER BUREAU.

Mr. President and Members of the American Association for the Advancement of Science:

It is a matter of much pleasure to me that I am allowed the privilege of speaking at a joint session of this Association—representing as it does within the confines of its admirable organization the scientific thought of our country. This is the Mecca towards which annually journey all those who wish each to contribute his mite to the sum of human knowledge; each inspired with an ambition to add even one flickering ray to the great luminous orb which to-day is shedding the benign light of wisdom even unto the uttermost recesses of the earth, subduing the barbarous instincts of man and warming and invigorating into life the better impulses of his nature. Thus is civilization advanced, and thus is humanity elevated to higher and higher planes of existence.

I hope to be a worker in the ranks of this great army, and as the science of meteorology can hardly be said to have passed beyond the embryonic state, I feel that the realms of investigation are boundless, and that the opportunities are correspondingly great.

As the Chief of the greatest meteorological system in the world, and with the power to control, under the direction of the Honorable Secretary of Agriculture, not only its executive functions, but the lines of future scientific investigation, I fully realize the great responsibility that rests upon me, and that, at the bar of public and scientific opinion, I shall, in the years to come, justly be held to a strict accountability for my stewardship.

Before considering the line of investigation which consistently can be prosecuted by the Weather Bureau, it will be well to note the law which prescribes the duties of the chief.

By an Act of Congress approved Oct. 1, 1890, Sect. 3, it is provided,

"That the Chief of the Weather Bureau, under the direction of the Secretary of Agriculture, on and after July 1, 1891, shall have charge of the forecasting of weather, the issue of storm warnings, the display of weather and flood signals for the benefit of agriculture, commerce, and navigation, the gauging and reporting of rivers, the maintenance and operation of sea coast telegraph lines and the collection and transmission of marine intelligence for the benefit of commerce and navigation, the reporting of temperature and rainfall conditions for the cotton interests, the display of frost and cold wave signals, the distribution of meteorological information in the interests of agriculture and commerce, and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, or as are essential for the proper execution of the foregoing duties."*

It will be seen that the main object for the existence and continuation of this Bureau is to give warning of the approach of storms, and therefore that the proper line of investigation should be for the purpose of determining the true philosophy of storms. The goal to be striven for is the improvement of weather forecasts, and surely one of the prerequisites to determine coming events is a thorough knowledge of existing conditions.

To those who have read every important treatise on meteorology, and who have studied

* Read before the American Association for the Advancement of Science, at Springfield, Mass., Aug. 30, 1895, and published by Science and by the American Meteorological Journal for November.

* Statutes at Large. Fifty-First Congress. Page 653.

every text-book on the subject, it is painfully patent that we are extremely ignorant of the mechanism of storms; of the operations of those vast and subtle forces in free air which give inception to the storm, and which supply the energy necessary to accelerate cyclonic action when formed, or to disperse the same when once fully in operation. We know that great atmospheric swirls in the shape of high and low pressure areas alternately drift across the country at intervals of two or three days; that the atmosphere flows spirally into the cyclonic, or low pressure, system, and outward from the anticyclonic or high pressure, system, that the in-drawn east and south winds on the front of the storm are warm, and that the inwardly-flowing north and west winds are cold.

The theories of Redfield, Espy, Loomis, Ferrel and others teach that our great storms are composed of immense masses of air gyrating about a vertical or nearly vertical axis, drifting eastward and at the same time drawing warm easterly currents in at the front and cold westerly currents into the rear; that the commingling of these two as they rise to greater and greater elevations, near the region of the cyclonic centre, throws down volumes of rain or snow; that as precipitation occurs with the ascending currents the heat of condensation energizes the cyclonic circulation; that the air at the centre of the storm is relatively warm, is rarefied by centrifugal force, and by reason of less density, rises to a great elevation, and in the upper regions of the atmosphere flows away laterally to assist in building up the high pressure areas on either side.

The high and low pressure areas are supposed to be carried eastward by the general easterly drift of the atmosphere in the middle latitudes, somewhat as eddies are carried along by water in a running stream.

But unfortunately for the complete accuracy of these theories, the forecaster often finds heavy downpours of rain without any cyclonic circulation and no convectional system in operation; again, over immense areas of our country, especially in the Rocky Mountain region, for many months in the year, condensation occurs not at all in the warmer easterly currents flowing into the storm centre, but almost exclusively in the south and west quarters of the storm area, where the cold north and west winds are flowing in.

Again, many investigators to-day have good reason to doubt that the centre of the storm is warm to any great elevation, or that cyclonic circulation obtains to the top of the air.

In outlining, in a rough and general way, the line of investigation which, in my judgment, promises to give the most prolific results, not only to the cause of meteorological science, but to the making of more accurate forecasts for the benefit of agriculture and commerce, I will say that we have been for years taking our measurements at the bottom of this great ocean of air, while the forces which cause the formation of storms, and which influence their intensity and direction of motion operate at great elevations, or are extraneous to our earth. It therefore seems imperative that systematic exploration should be made of the upper air. Balloon ascensions should be made in the several quadrants of a cyclonic storm, and also at the centre thereof, especially when rain is falling and the barometric gradient is steep. It is especially important to know the level at which condensation ceases, the depth of the cloud stratum, the temperature gradient, the air pressure and humidity, to a height of four or five miles. Skilled aeronauts with complete and accurate instruments should be placed in the region of severest action at the season of the year when storms are most frequent. They should be held in readiness until the approach of storms typical of cyclonic action, and then from the central office, where the movement of the storm is being carefully watched on the daily synoptic chart, they should be given telegraphic orders to ascend, and their ascensions should be so timed as to secure accurate readings at great elevations throughout the several quarters of the storm. It is believed that information thus secured will establish something like an approach to the true philosophy of storms in contradistinction to the very imperfect theories which too often are hastily approved as demonstrated principles.

Practically all of the theory of storms has been written by men not daily engaged in watching their inception and progression with the help of the weather map. Instead of erecting a cumbersome superstructure upon the sand, let us endeavor to lay a corner-stone upon which to erect something exact enough to be called a science.

In winter the great high pressure areas which constitute our cold waves should receive the same thorough exploration. Readings at Pike's Peak or Mt. Rainier might be useful in this investigation, but they are too far removed from the general track of storms and cold waves to furnish the full information desired.

Upper air exploration may be accomplished by a train of kites carrying automatic instruments, by captive kite-balloons, which may be forced nearer and nearer the zenith with increasing wind velocity, or by the ascension of trained observers in free balloons. We must strive for the perfection of appliances and instruments which will, at no distant day, enable us to present to the forecaster the charted synchronous meterorological conditions prevailing at high levels, and covering a great area. Mr. McAdie, at Washington, has secured recently

some good records with kites at 1,000 to 2,000 feet elevation.

Systematic exploration of the upper air, with a continuation of the studies begun by Professor Bigelow of terrestrial magnetic forces as induced by the solar magnetic field, will be the line of investigation prosecuted during the next two years, and from which it is hoped that results satisfactory to the practical as well as the theoretical man may be obtained. The Honorable Secretary of Agriculture is in thorough sympathy with all lines of research which can be legally carried on under the Act of Congress constituting the Weather Bureau, and which promise to give results useful to the people.

Harmonious co-operation between the practical worker and the scientific investigator is essential to success. Too often they have found themselves picking out diverging paths. In the future they will work on parallel and converging lines, and not far removed from each other, and the result, I am confident, will be beneficial to all. In a great system like ours each worker must be justly recognized for the merit that is in him, whether he be a skilled scientist or an able executive officer, and he should be given his proper place as an integral part of the great whole which constitutes the efficient Bureau.

A brief retrospect of the forecast may not be without compensating results in our efforts at future improvements. Forecasts were begun in the United States about twenty-five years ago, and have, during the past decade, become of such benefit to the many and diversified interests of the country that, with one accord, the people now acknowledge their value and applaud all efforts to improve and extend their usefulness. Fifty million dollars is a low estimate of the value of property placed in jeopardy by one West Indian hurricane sweeping up our Atlantic Coast.

Predictions were first called "probabilities," and were made for districts, each comprising several States, and included a prediction as to the probable change in barometer. Later the prediction as to barometer was omitted. Forecasting by districts was soon shown not to be specific enough as to boundary, and the designations applied were not well understood by the people; hence forecasting by States was adopted. Forecasts were made only at the Central Office at Washington, and the local observers were allowed to disseminate no other, nor to give public expression to any opinion of their own which might be construed into a forecast. Considering the very limited training of the observers and the lack of all charted meteorological conditions for their study and enlightenment, the wisdom of that regulation could hardly be questioned.

With the transfer of the Weather Bureau to the Department of Agriculture came the inauguration of far more liberal and progressive ideas. The office of Local Forecast Official was created for such observers as had shown special fitness for forecast work, and they were assigned to duty at the more important agricultural, commercial, and maritime centres, with instructions to carefully study the local climatology of their sections, so that products which were indigenous to limited areas, or interests which were of special importance to particular sections, might have such application of the weather forecasts as the intimate personal attentions of a competent local official could give.

The changes enumerated have been carefully tested and found to be beneficent in purpose and worthy of continued and permanent application. Thus has the forecasting system of to-day slowly developed during the past twenty-five years. Is it not the essential feature of the Weather Bureau? Is it not the nucleus around which all departments of thought and study must rotate and become auxiliary, if the original intent of Congress, made manifest by the establishment of a national storm-warning system, is to be carried forward to as successful operation as the present knowledge of the physics of the air will permit? It is to be hoped that discoveries may be made relative to the controlling and modifying forces of storms which shall raise the standard of forecasting accuracy attained by our most expert officials, who have had all the benefits to be derived from many years of patient and intelligent observation of storms from the time of their inception in, or entrance within, our daily observed and charted territory, until they have been dissipated or have passed eastward beyond our range of vision.

It may be well to consider what class of forecasts can be most successfully made by our more or less empirical methods, the object being to extend the work along such lines of activity as promise the most beneficent results. As to this proposition, it is doubtless conceded by all that when pronounced high and low pressure areas dominate the weather conditions, and the changes in wind, temperature, and weather are characterized by such force and degree as to render them destructive to lives and property, a forecaster of average ability and well-balanced judgment is able to make nearly or quite as accurate a forecast as when the air pressure is quite uniformly distributed and all changes of weather are so slight as to be of no importance.

If, then, a destructive frost or cold wave can be predicted as easily as a change of a few degrees in temperature, and if the coming of high winds and gales are as easily foretold as that of a gentle zephyr, it is evident which class

of forecasts should receive the greater attention. The public care comparatively little for predictions of moderate changes, and but little credit attaches to the Bureau when such forecasts are verified, but when great heat, cold waves, or violent winds are on the program, a vital interest in the subject is felt, and the accurate forecasting of such conditions is the gauge by which the public measures the usefulness of the Bureau.

Horticulturists and the growers of tobacco and cranberries realize the vast benefit to be derived from accurate frost predictions, and I will give a brief statement of what I believe to be original ideas introduced into the making of frost forecasts while in charge of the Wisconsin State Weather Service, a State including within its domain the largest area of cranberry marshes in the world, and also including an extensive area devoted to the cultivation of tobacco. Heretofore I believe that only the air conditions have been taken into consideration in the making of frost forecasts,—such as pressure, temperature, relative humidity, cloudiness, and wind velocity. As a result of my investigations, systematically prosecuted for three years, I found that the conditions of the soil were equally as important as those of the air.

When the high-pressure area is moving in from the West, clear and colder weather anticipated, with the probability that the early morning temperature will permit the formation of frost, the most important elements to be considered in determining whether or not frost will occur, injurious to growing crops, are as follows:—

First.—Has rain recently fallen, and what is the condition of the soil relative to the amount of moisture contained?

Second.—What are the natural properties of the soil relative to the slow or rapid loss of heat by radiation?

Third.—To what degree of heat has vegetation been subjected during the period immediately previous?

The early fall frost, injurious to tender crops, is the one which occurs with the town or telegraphic minimum temperature ranging from 40° to 50°, because, when the early morning temperature in the town falls much lower than 40° Fahrenheit, it is usually so late in the season that all crops are gathered, or if not gathered, they have been destroyed ere this condition arrives. At the time, then, that frost warnings are of most benefit we have to deal with the air at temperatures considerably above the freezing point, and to recall that a deposition of frost requires that the temperature of the top soil, or that of vegetation, be reduced to the freezing point. This, of course, is accomplished by conduction and radiation of heat, which takes place more rapidly from the soil and vegetation than it does from the lower stratum of air to the higher.

Anything that will seriously interfere with a rapid loss of heat after nightfall will tend to prevent the formation of frost. Moisture does this, and if the soil be well charged it partakes greatly of the stable temperature condition of water, and cools but little, if any, below the temperature of the superincumbent air, and no frost will occur even though all other favorable conditions, *e.g.*, clearness, gentle winds, and cool air, obtain. Even a small amount of moisture, say one-half inch of rainfall, will give ample protection if well distributed and precipitated within the 24 hours previous. But when severe drought conditions are prevalent, injurious frosts may occur when the telegraphic temperatures do not show a reading within ten degrees as low as in the first case.

I believe that when estimating the probability or severity of frost, sufficient weight has not been given to the dryness or wetness of the soil and the resultant dissipation or conservation of heat energy, and I call special attention to the point as one of the means for improving the forecast. I have in mind two typical cases. In the first, a high pressure area attended by clear and cool weather drifted from the westward until it covered the State. No rain had fallen with the passage of the low pressure area immediately preceding it; hence the ground was in excellent condition for the rapid loss of heat during the night, and a consequent lowering of the temperature of vegetation to the freezing point. Considerable damage was done to cranberries in unflooded marshes. In the second case, a high pressure area of slightly greater weight and slightly lower temperature covered the region about ten days later, but it was preceded within a few hours by a light but well-distributed fall of rain, averaging about one-half an inch, and no frost occurred. In both cases the wind was gentle from the northwest, and the nights were clear. With slightly lower air temperature and higher barometer in the second condition, heavier frost would have occurred than in the preceding case, had it not been for the thinly-spread moisture of the timely rain conserving heat at the surface of the earth.

Might not this principle be carried further in the improvement of the forecast? Assuming that the caloric energy of the sun is a constant factor, the earth receives each year the same amount or intensity of heat, and as the atmosphere is warmed mainly by contact with or radiation from the earth, seasonal variations of temperature which are marked departures from the normal might result from abnormal terrestrial surface conditions with respect to the conservation of this constant solar energy over large continental areas. Here the excessive or

deficient rainfall during the preceding seasons should receive careful consideration. The subject is one that requires deeper and more detailed investigation than the length of this paper will permit.

I find that the minimum temperatures in cranberry marshes during abnormally dry seasons often fall 15° below the temperatures telegraphed from the cities and towns within a few miles of the marshes. This is due to the fact that when the loose spongy peat, of which the marsh is composed to the depth of several feet, has dried out, the radiation of heat during the night is very rapid and is not counterbalanced by conduction and convection from the marsh. The temperature therefore in cranberry marshes is at all times much lower than that which obtains in marshes composed of heavy black muck, where it preserves a more stable condition, such as is common to air resting over a considerable body of water. A dry cranberry marsh does not therefore enjoy that immunity from frost which wet marshes and watery lands get the benefit of. But, when the ditches are flooded from the reserve water supply on receipt of a frost warning, the water quickly percolates through the peat composing the marsh, and the rapid loss of heat by radiation is checked and the frost diverted.

The degree of heat to which vegetation has been subjected immediately before the frost condition, and the temperature under which it has made its growth, will in a great measure determine the extent of damage to ensue.

By carefully considering the principles herein enunciated, I will say that in 1894, twelve out of fourteen official forecasts of frost were fully verified,—a much greater percentage of accuracy than has ever been attained by simply considering air conditions alone.

MISCELLANEOUS NOTES.

The convention of the American Association of State Weather Services at Indianapolis, Ind., on the 16th and 17th instant, was from all accounts the most successful one yet held by that organization.

The number of State Services represented was larger, and the attendance greater, than at any of the three previous meetings of the Association. The citizens of Indianapolis were most generous in their attentions to the comfort and pleasure of the visitors. A banquet was given in their honor by the Board of Trade and, altogether, the entertainment of the members of the Association was most flattering, and gave evidence of an interest in the Weather Bureau, in the State Weather Service, and in Meteorology, which we believe to be general throughout the country. Such appreciation will be a stimulus to increased effort on the part of the Weather Bureau and State Weather Service workers.

The transactions of the convention are as yet unknown to us, but doubtless much was accomplished in the way of progress. The interchange of ideas and the discussion of proposed improvements, which must result in the bringing together of so many co workers, could not but have been productive of valuable results; and we anticipate a particularly interesting and instructive report of the proceedings.

Nashville, Tenn., was selected as the place of meeting in 1896, and we trust that Baltimore will be the place decided upon for 1897, that being the year of the Baltimore Centennial Exposition.

Mr. James A. Barwick, Director of the California State Weather Service, stopped in Baltimore on his way from the Convention to his old home in Eastern Maryland. We hope that he will interrupt his westward journey by making us another visit.

Dr. H. H. Hopkins, of New Market, Md., favored this office with a call on November 4th.

Review of the Month—October.

WEATHER.

Temperature (degrees).—Monthly mean (entire territory), 50.3, being 4.4 below the normal; highest monthly mean, 56.4, at Solomon's; lowest monthly mean, 41.2, at Deer Park; highest temperature, 82, at Jewell, on the 19th; lowest temperature, 4, at Deer Park, on the 30th; greatest local monthly range, 65, at Deer Park; least local monthly range, 35, at Cambridge; monthly mean range (entire territory), 48.1; monthly mean maximum, 62.6; monthly mean minimum, 38.5.

Precipitation (in inches).—Average (entire territory), 1.96, being .82 below the normal; greatest amount, 3.59, at Mardela Springs; least amount, .44, at Great Falls. Snow, to the amount of a trace, is reported from the following stations: Sunnyside, Oakland, Baltimore, Fallston and Wilmington, Del.

Hail.—At Westernport, on the 31st.

Fogs.—At Baltimore, on the 2nd, 7th, 26th; at Mardela Springs, on the 11th, 20th, 23rd, 25th; at Green Spring Furnace, on the 16th; at Pocomoke City, on the 6th; at Wilmington, on the 2nd, 3rd, 4th, 8th, 12th, 15th, 26th.

Halos, solar.—At Pocomoke City, on the 15th.

Halos, lunar.—At Newark, Del., on the 30th.

Corona, lunar.—At Millsboro, Del., on the

22nd, 27th, 29th, 30th; at Wilmington, Del., on the 30th.

Auroras.—At Millsboro, Del., on the 9th, 18th, 21st; at Fallston, on the 13th.

CROPS.

At the end of October.

In Western Maryland, the rain which came at the close of the month was much needed, for though the low land wheat was coming up, that on the high land had not sprouted, and springs, wells, and streams were very low; killing frost was occurring nearly every morning, but there were no crops to suffer damage.

In Northern-Central Maryland, the farmers were very generally through sowing grain, and corn husking was in progress with varying results, many fields yielding largely and many others poorly. The condition of springs and streams was much improved by the recent rains, and wheat fields, also, will soon show the benefit received.

In Southern Maryland, corn husking was being delayed for cool weather, so that the ears might be stored without fear of damage from moisture and warmth. Heavy rains having fallen at the close of the month, wheat will begin sprouting, and there will be a marked improvement in pasture.

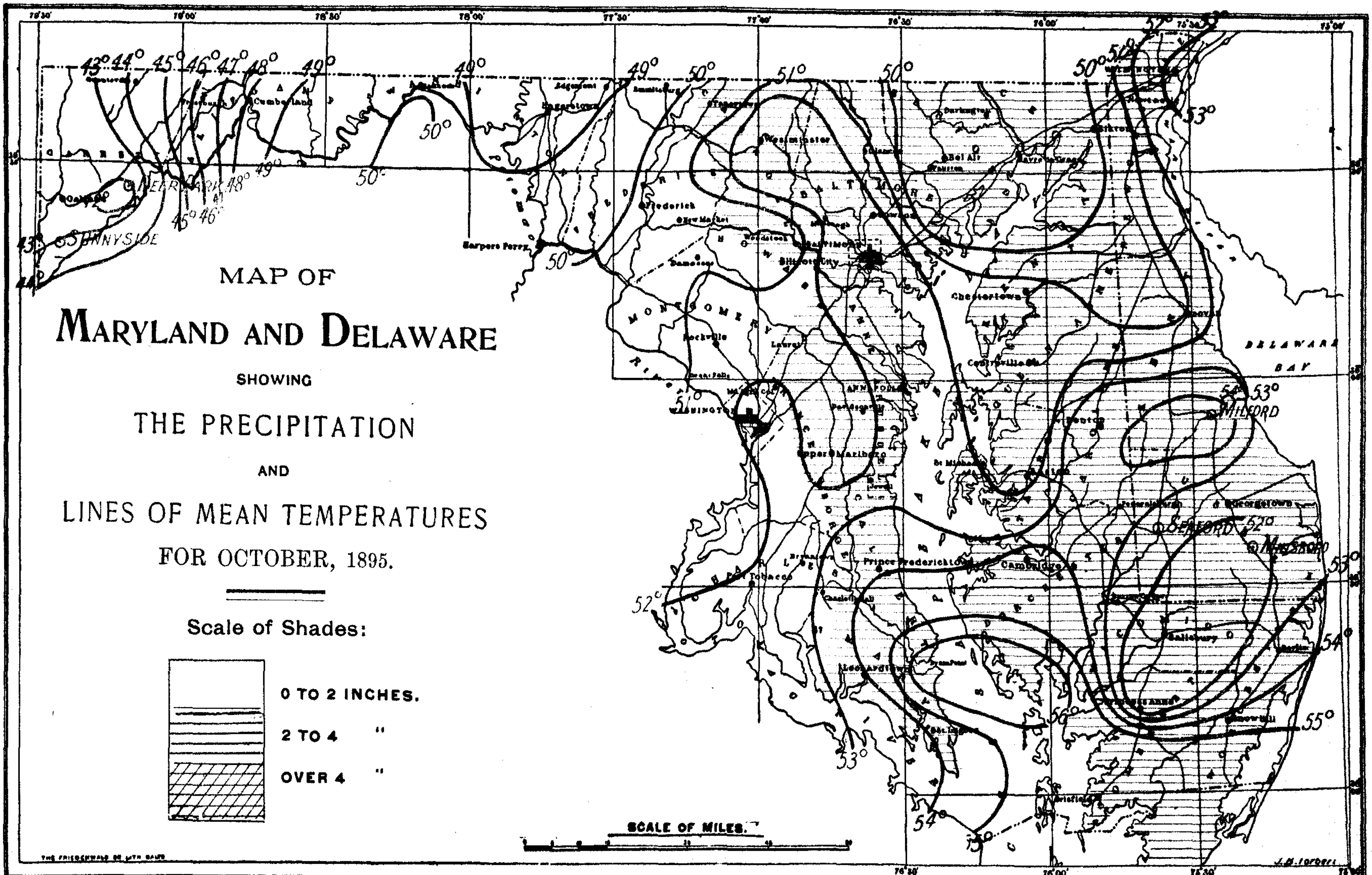
In Eastern Maryland, corn husking was in progress. Wheat was coming up slowly, but, together with pastures, will be much improved by the present rains. Killing frosts have been frequent, and ice formed in places on the morning of the 12th.

Notes by Observers.

Grantsville.—The month of October was remarkable for the number of clear days, low temperature, and severe drought.

Green Spring Furnace.—Streams unusually low. The Potomac lower here than ever before known.

Mardela Springs.—20th, ground frozen. 10th, 11th, 20th, 21st, 29th, 30th, ice. 9th, 24th, 26th, cold wave. 27th, forest fires began. 17th, 26th, 27th, wild geese passed over. But two drier months in past seven years.


MAP OF
MARYLAND AND DELAWARE
SHOWING
THE PRECIPITATION
AND
LINES OF MEAN TEMPERATURES
FOR OCTOBER, 1895.
Scale of Shades:
0 TO 2 INCHES.
2 TO 4 "
OVER 4 "
SCALE OF MILES.
DELAWARE BAY
SUNNYSIDE
MILFORD
SEAFORD
Frederick
Westminster
Chestertown
Cambridge
Salisbury
Prince Frederickto
Rockville
Harpers Ferry

Meteorological and Weather Signal Display Stations of the Maryland State Weather Service.

Stations.	Counties.	Meteorological Observers.	Displaymen.
Annapolis	Anne Arundel	J. E. Abbott	W. M. Abbott.
Appleton	Cecil		W. C. Henderson.
Bachman's Valley	Carroll	J. M. Myers.	
Baltimore		C. P. Cronk. A. T. Brewer.	Weather Bureau.
Baltimore, (The Anchorage)			Thos. Hansen.
Bel Air	Harford		N. N. Nock.
Bel Alton	Charles	Walter Cox.	
Boettcherville	Allegany	F. F. Brown.	
Bradshaw	Baltimore		B. F. Taylor.
Buckeystown	Frederick		A. W. Nicodemus.
Burkittsville	Frederick	J. P. Slifer.	
Cambridge	Dorchester	J. S. Shepherd	Samuel Lehman.
Charlotte Hall School	St. Mary's	J. Francis Coad.	
Cherryfields	St. Mary's	J. Edwin Coad.	
Chestertown	Kent	Hon. M. deK. Smith.	
Cumberland	Allegany	Shriver and Rizer. E. T. Shriver.	
Darlington Academy	Harford	Prof. A. F. Galbreath.	
Deer Park	Garrett	S. P. Specht.	
Delaware City, Del	New Castle		W. E. Reybold.
Denton	Caroline	F. C. Ramsdell.	
Dickerson	Montgomery		W. H. Dickerson.
Distributing Reservoir, D. C		Maj. C. E. L. B. Davis.	
Dover, Del	Kent	Jno. S. Jester.	
Easton	Talbot	Henry Shreve	Henry Shreve.
Fallston School	Harford	G. G. Curtiss, A. M.	
Flintstone	Allegany		N. T. Downes.
Frederick	Frederick	McClintock Young,	"The News."
Frostburg	Allegany		J. N. Benson.
Frederica, Del	Kent		Miss L. T. Frazier.
Garey P. O.	Howard		Walter Dorsey.
Glyndon	Baltimore		J. J. Dyer.
Grantsville	Garrett	J. S. Miller	T. H. Bittinger.
Great Falls	Montgomery	Maj. C. E. L. B. Davis.	
Green Spring Furnace	Washington	E. G. Kinsell.	
Hagerstown	Washington	Prof. C. E. Carl.	
Hampstead	Carroll		H. H. Meals.
Hancock	Washington	Dr. J. S. Diehl.	
Hartly, Del	Kent		Miss C. A. Forde.
Havre de Grace	Harford		W. S. McCombs.
Jewell	Anne Arundel Co	Jos. Plummer.	
Johns Hopkins Hospital, Baltimore		W. L. Woods.	
Kenton, Del	Kent		W. S. Arthurs.
Kirkwood, Del	New Castle	J. S. Carnagy.	
La Plata	Charles	J. S. Turner	J. S. Turner.
Laurel	Prince George's	Dr. T. M. Baldwin.	
Laurel, Del	Sussex		E. D. C. Hegeman.
Lisbon	Howard	W. W. Warfield, Jr.	
Lonaconing	Allegany		J. J. Robinson.
Mardela Springs	Wicomico	A. E. Acworth	L. A. Wilson.
Maryland Agricultural College	Prince George's	Prof. J. H. Patterson.	
McDonogh School	Baltimore	H. Norwig.	
Middletown	Frederick		G. C. Rhoderick, Jr.
Milford, Del	Kent	J. Y. Foulk	J. Y. Foulk.
Millsboro, Del	Sussex	Rev. L. W. Wells.	
Mt. St. Mary's College	Frederick	J. A. Mitchell, Ph. D.	Jos. H. Martin.
Newark College, Del.	New Castle	Prof. Wm. H. Bishop.	
Oakland	Garrett	J. Lee McComas, M. D.	J. L. McComas, M. D.
Odenton	Anne Arundel		E. B. Watts.
Princess Anne	Somerset	Jas. R. Stewart.	
Pocomoke City	Worcester	R. M. Stevenson	R. M. Stevenson.
Pope's Creek	Charles	George Dent.	
Receiving Reservoir, D. C.		Maj. C. E. L. B. Davis.	
Rising Sun	Cecil		Dr. L. R. Kirk.
Salisbury	Wicomico		W. Benjamin. L. W Gunby.
Seaford, Del	Sussex	H. L. Wallace	H. L. Wallace.
Sharpsburg	Washington	R. L. Hiberger.	
Snow Hill	Worcester		Purnell & Vincent.
Solomon's	Calvert	W. H. Marsh, M. D.	
St. Charles Coll., nr. Ellicott City	Howard	Rev. H. M. Chapuis, S. S.	
Sunnyside	Garrett	John G. Knauer.	
Sykesville	Carroll		J. S. Hyatt.
Upper Marlboro	Prince George's	J. B. Perrie.	
Washington, D. C		S. W. Beall.	
Western Port	Allegany	Prof. O. H. Bruce.	
West Friendship	Howard		Postmaster.
Westminster	Carroll	Prof. Roland Watts.	
Westover	Somerset		E. D. Long.
Wilmington, Del	New Castle	F. C. D. McKay	Wm. Lawton.
Woodsboro	Frederick		G. F. Smith.
Woodstock College	Baltimore	T. J. A. Freeman, S. J.	
Woman's College, Frederick	Frederick	Miss W. A. Lantz.	

U. S. WEATHER BUREAU STATIONS FURNISHING REPORTS.

Baltimore, Md	J. B. Marbury. G. N. Wilson.	Weather Bureau.
Norfolk, Va	Jas. J. Gray.	
Philadelphia, Pa	L. M. Dey.	
Washington, D. C	S. W. Beall.	

DAILY PRECIPITATION FOR OCTOBER, 1895.

STATIONS.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Tot
Sunnyside	...	...	...	...	..	....	.04	.30	T	....	....	.33	....	....	T	....	....	....	....	....	....	..	....	....	T	....	.....	.24	....	....	.70	1.61
Oakland	...	...	...	...	..	....	.02	.20	T	...	....	.20	....	....	T	....	....	....	....	....	....	..	....	....	.02	....	.28	...	....	....	.79	1.51
Deer Park	...	...	...	...	..	....	...	...	...	....	....	....	....	.27	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	.72	.99
Grantsville	...	...	...	...	..	....	.20	....	....	....	....	.10	....	....	....	....	....	....	....	....	....	..	....	....	....	....	.12	....	....	....	.80	1.22
West'nport	...	...	...	...	..	T	T	....	....	...	.15	T	....	....	....	....	..	....	....	....	....	..	....	..	....	....	T	....	....	....	1.15	1.30
Boettcherv	...	...	...	...	..	....	....	T	....	.10	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.00	1.10
Cumb. (1)	...	...	..	...	..	....	..	..	....	....	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	1.20
Cumb. (2)	...	...	...	...	..	....	...	....	....	....	..	.22	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	.98	1.20
Oldtown	...	...	...	...	..	....	...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	....
Hancock	...	...	...	...	..	....	.05	.08	....	....	....	T	....	....	....	....	....	....	....	....	....	..	....	....	....	....	.01	....	....	....	1.18	1.32
Gr'nSp.Fur	...	...	...	...	..	....	....	.20	....	....	....	.14	....	....	....	....	....	....	....	....	....	..	....	....	....	....	.05	....	....	....	1.10	1.49
Hagersto'n	...	...	...	...	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	....
Sharpsburg	..	..	..	..	..	....	T	T	....	....	....	.30	....	....	....	....	....	....	....	....	....	..	....	....	....	....	.04	....	....	....	.98	1.32
Burk'sville	...	...	...	...	..	..	....	.07	.08	..	....	.43	....	....	....	....	....	....	....	....	....	..	....	....	....	....	.07	....	....	....	1.03	1.68
Mt.St.M'y's Col.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fred'k	...	...	...	...	..	....	.01	.05	...	....	....	.60	.06	...	...	....	....	....	....	....	....	..	....	....	....	....	.10	....	....	....	.72	1.54
Woman's Col.	...	...	...	...	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	...
Bach. V'y	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
WestMd.Col	...	...	...	...	..	....	....	T	T	...	....	.84	.48	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.08	2.40
Woodst. Col	...	...	...	...	..	....	T	.16	..	....	....	.60	.30	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.10	2.16
Baltimore	...	...	...	...	..	....	T	.23	T	....	....	.50	.33	...	....	....	....	....	....	....	....	..	....	....	....	....	T	T	....	....	1.14	2.20
St.Chas.Col.	...	...	...	...	..	....	....	....	....	....	....	.12	.15	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.03	1.30
Great Falls	...	...	...	...	..	....	....	.13	....	....	....	.25	.06	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	.44
Falls'n Sch.	...	...	...	...	..	....	....	.22	T	....	....	.63	....	...	T	....	....	....	....	....	....	..	....	....	....	....	....	.01	....	....	1.18	2.04
Dan'g'n Aca'y	...	...	...	...	..	....	....	....	....	....	....	†	1.55	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.27	2.82
Annapolis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Jewell	...	...	...	...	..	....	....	.35	..	....	....	.35	.45	...	....	....	....	....	....	....	....	..	....	....	....	....	...	....	....	....	1.20	2.35
Dist. R.,D.C	...	...	...	...	..	....	....	.22	..	....	....	.24	.26	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	.72
Rec. R., D.C	...	...	...	...	..	....	....	.20	..	....	....	.27	.25	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	.72
Wash., D. C.	...	...	...	...	..	....	T	.18	T	....	....	.39	.07	...	....	....	....	....	....	....	....	..	....	....	....	....	...	T	....	....	1.30	1.94
College P'k.	...	...	...	...	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	....
Laurel	...	...	...	...	..	....	....	.20	....	....	....	.40	.50	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	1.20	....	2.30
Up. Marlb.	...	...	...	...	..	....	T	.30	....	....	....	.54	.43	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.15	2.42
La Plata	...	...	...	...	..	....	....	....	..	....	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	..	....	....	....	1.50	1.50
Bel Alton	...	...	...	...	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	..
Pope's Cr'k.	...	...	...	...	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	....
Solomon's	...	...	...	...	..	..	T	.52	T	....	....	1.10	.24	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.18	3.04
Chari. Hall Sch	...	...	...	...	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	....	....
Cherryfields	..	..	..	..	..	..	..	.97	..	..	..	.65	.03	...	....	....	....	....	....	....	....	..	....	....	T	....	....	....	....	....	1.41	3.07
Chestert'n	...	...	...	...	..	....	....	....	....	....	....	....	.80	.70	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.25	2.75
Denton	...	...	...	...	..	....	.27	....	....	....	1.02	.10	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.35	2.74
Easton	...	...	...	...	..	....	....	.33	....	....	....	†	1.21	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.16	2.70
Cambridge	...	...	...	...	..	....	†	.43	....	....	.73	.40	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.20	2.76
Mardela Sp.	...	...	...	...	..	....	....	.89	....	....	....	....	1.73	...	....	....	....	....	....	....	....	..	....	....	....	T	....	....	....	....	.97	3.59
Pri'cess An.	...	...	...	...	..	....	.04	1.30	....	....	....	.41	.20	...	....	..	....	....	....	....	....	..	....	....	....	05	....	....	....	....	.71	2.71
Poc'm'k Cit	...	...	...	...	..	....	....	.56	....	....	....	†	.81	...	....	....	....	....	....	....	....	..	....	....	....	10	....	....	....	....	1.29	2.76
Wilm't. Del.	...	...	...	...	..	....	T	.04	T	....	....	.75	.56	...	....	....	....	..	..	....	....	..	....	....	....	....	....	....	....	....	1.39	2.74
Delaware Col.	...	...	...	...	..	....	....	.24	....	....	....	.63	.70	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	.96	2.53
Newark, Del.																																
Dover, Del.	...	..	...	...	..	....	....	.38	....	....	....	.73	.30	...	...	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.73	3.14
Milford, Del	...	...	...	...	..	....	...	.38	....	....	....	.68	.38	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	.98	2.42
Seaford, Del	...	...	..	...	..	....	T	.53	....	....	....	.79	.30	...	....	....	....	....	....	....	....	..	....	T	....	....	....	....	....	....	....	2.76
Millsb'o, Del	...	...	...	...	..	....	....	.73	....	....	....	.48	.30	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.55	3.06
Phila. Pa.	...	...	...	...	..	...	T	.14	T	....	....	.75	.76	...	....	....	....	....	....	....	....	..	....	....	....	....	....	....	....	....	1.32	2.97
Norfolk, Va	...	...	...	..	..	....	T	.40	....	....	....	.33	T	...	....	....	....	....	....	....	....	..	....	....	T	....	....	T	....	....	1.26	1.99

NOTE.—"T" indicates a trace of rain or melted snow. † Not measured until next observation.

Reports for September, 1895, received too late for earlier publication.

STATIONS.	COUNTIES.	Altitude above sea in ft.	Latitude.	Longitude.	TEMPERATURE. Monthly Mean.	Mean of Max.	Mean of Min.	Max. Degrees	Max. Date.	Min. Degrees	Min. Date.	Monthly Range.	Total Precipitation.	Total Snow-fall.	Clear Days.	Partly Cloudy Days.	Cloudy Days.	Rainy Days. (.01 in. or more)	Prevailing Winds.
EASTERN MARYLAND.																			
Mardela Springs[1].	Wicomico	25	38 30	75 39	72.1	.....	63.4	*94	12	44	16	50	2.35	....	16	12	2	4	N. E. S. E.

*See foot-note on next page.

MONTHLY SUMMARY OF REPORTS FOR OCTOBER, 1895.

STATIONS.	COUNTIES.	Altitude above sea in ft.	Latitude.	Longitude.	TEMPERATURE. Monthly Mean.	Mean of Max.	Mean of Min.	Max. Degrees	Max. Date.	Min. Degrees	Min. Date.	Monthly Range.	Total Precipitation.	Total Snow-fall.	Clear Days.	Partly Cloudy Days.	Cloudy Days.	Rainy Days. (.01 in. or more)	Prevailing Winds.
WESTERN MARYLAND.																			
Sunnyside	Garrett	2440	39°20′	79°21′	43.8	58.8	28.8	70	3, 5, 18, 22	10	30	60	1.61	T	22	4	5	5	S. W.
Oakland	Garrett	2380	39 24	79 18	42.6	59.0	26.2	72	18	9	30	63	1.51	T	23	5	3	6	S. W.
Deer Park	Garrett	2457	39 25	79 13	41.2	57.1	25.1	69	3, 5	4	30	65	.99	..	..	..	..	..	.....
Grantsville	Garrett	....	39 45	79 10	44.3	56.2	32.4	70	2, 3, 5	17	29, 30	53	1.22	....	23	1	7	4	N.W.
Westernport	Allegany	....	39 28	78 2	45.6	60.7	30.5	75	22	16	29	59	1.30	....	....	....	....	..	.....
Boettcherville 1*†	Allegany	....	39 39	78 48	47.7	.....	.....	76	11	18	30	58	1.10	..	..	....	....	....	.....
Cumberland, Shriver & Rizer.	Allegany	650	39 39	78 46	52.6	64.4	40.9	75	19	28	29	47	1.20	....	....	....	....	....	.....
Cumberland, E. T. Shriver.	Allegany	700	39 39	78 45	48.8	59.8	37.8	72	19	22	30	50	1.20	..	27	1	3	2	.....
Hancock	Washington	....	39 40	78 10	50.0	56.0	35.0	79	27	19	29	60	1.32	....	18	12	1	4	W.
Green Sp. Furnace	Washington	500	39 39	77 55	48.7	63.3	34.1	78	19	20	29, 30	58	1.49	....	21	9	1	4	W.
Hagerstown	*Washington*	...	39 39	77 43	.....	.....	.....	...	.....	...	.....	...	.....	...	...	.....	.....	.....	.....
Sharpsburg	Washington	....	39 25	77 45	49.5	62.2	36.8	76	19	22	29, 30	54	1.32	....	24	5	2	3	N.W.
NORTHERN-CENTRAL MD.																			
Burkittsville, o	Frederick	...	39 25	77 35	49.8	61.3	38.3	73	19	27	29	46	1.68	....	8	5	3	5	W.
Mt. St. Mary's Col.	Frederick	720	39 43	77 20	.....	.....	.....	...	.....	...	.....	...	.....	...	...	.....	.....	.....	.....
Frederick	Frederick	280	39 24	77 18	50.2	62.7	37.8	74	27	25	10	49	1.54	....	..	..	..	6	N.W.
Woman's College†	Frederick	280	39 24	77 18	50.9	62.8	39.0	72	3, 8, 19	28	29	44	.....	....	28	2	1	....	.....
Bachman's Val. 1*	Carroll	...	39 37	76 55	.....	.....	.....	...	28	....	....	....	.....	....	....	....	....	....	.....
Western Md. Col. Westminster.	Carroll	....	39 25	77 0	54.3	65.9	42.7	76	19	30	29, 30	46	2.40	T	24	3	4	...	.....
McDonogh School, c	Baltimore	535	39 23	76 44	51.4	61.4	41.4	73	27	32	22, 29	41	.....	....	....	....	....	....	.....
Woodstock Col	Baltimore	392	39 20	76 49	48.2	60.6	35.9	70	3, 7, 19, 27	23	30	47	2.16	....	21	8	2	4	W.N.W.
Baltimore	.....	...	39 17	76 36	53.4	63.0	43.8	74	3, 19	34	29	40	2.20	T	23	6	2	4	N.
Johns Hopkins Hos	.....	....	39 17	76 36	52.0	63 0	41.1	74	3	31	30	43	.....	....	22	2	7	....	.....
Lisbon	Howard	....	.....	.....	51.7	62.2	41.2	73	27	27	29	46	2.09	....	23	5	3	4	N.W.
St. Charles Coll. nr Ellicott City.	Howard	300	39 16	76 44	55.8	64.1	47.4	72	3, 6, 27	36	30	42	1.30	....	28	0	3	3	N.W.
Great Falls 5*.	Montgomery	....	39 0	77 14	51.0	.....	.....	71	27	28	24, 30	43	.44	...	....	....	....	....	.....
Fallston School, 1*	Harford	450	39 31	76 24	49.8	....	.....	70	3	30	29	40	2.04	T	22	8	1	4	N.W.
Darlington Acad'y†	Harford	300	39 39	76 14	49.2	59.9	38.4	73	3	28	22, 24 29, 30	45	2.82	....	27	3	1	3	N.W.
SOUTHERN MARYLAND.																			
Annapolis	Anne Arund'l	20	39 58	76 30	.....	.....	.....	...	.....	...	.....	...	.....	...	...	.....	.....	.....	.....
Jewell	Anne Arund'l	....	38 44	76 36	52.9	63.4	42.4	82	19	31	10, 30	51	2.35	....	24	4	3	4	N.W.
Dist. Res., D. C. 5*	.....	....	38 52	77 0	51.4	....	.....	70	27	29	30	41	.72	..	....	....	....	....	.....
Rec. Res., D. C. 5*	.....	....	38 52	77 0	51.3	...	.....	69	2, 7	31	10, 30	38	.72	....	....	....	....	....	.....
Washington, D. C	.....	112	38 52	77 0	52.1	63.4	40.8	74	19	29	24	45	1.94	....	25	4	2	4	N.W.
Md. Agric't. Col. College Park.	Pr. George's	....	38 58	76 56	.....	.....	.....	...	.....	....	.....	...	.....	....	....	....	....	....	.....
Laurel	Pr. George's	....	39 5	76 45	49.4	62.3	36.6	74	19	21	30	53	2.30	....	22	5	4	4	.....
Upper Marlboro	Pr. George's	....	38 47	76 45	50.8	64.6	37.8	75	7	26	10,29,30	49	2.42	....	24	4	3	4	S. W.
La Plata	Pr. George's	....	38 32	77 0	52.1	65.9	38.3	75	23	28	29	47	1.50	....	....	....	....	....	.....
Bel Alton	Pr. George's	....	38 26	77 1	.....	.....	.....	...	.....	....	.....	...	.....	....	....	....	....	...	.....
Pope's Creek	*Pr. George's*	..	38 22	77 1	.....	.....	.....	...	.....	....	.....	...	.....	....	....	....	....	....	.....
Solomon's	Calvert	20	38 19	76 27	56.4	66.5	46.2	77	3, 6, 7	35	30	42	3.04	...	17	7	7	4	N.W.
Charlotte Hall Sch.	St. Mary's	....	38 28	76 48	.....	.....	.....	...	.....	....	.....	...	.....	....	....	....	....	....	.....
Cherryfields 2*.	St. Mary's	....	38 11	76 24	53.4	.....	.....	....	.....	....	.....	....	3.07	....	20	10	1	4	N.W.
EASTERN MD. AND DELAWARE.																			
Chestertown	Kent	80	39 13	76 4	51.4	61.3	41.4	74	3	30	24, 29	44	2.75	....	29	1	1	3	W.
Denton	Caroline	42	38 47	75 41	53.9	70.2	37.6	81	28	27	9, 28, 29	54	2.74	....	....	....	....	....	.....
Easton	Talbot	35	38 42	76 6	51.8	63.5	40.1	74	3	28	29	46	2.70	....	23	4	4	4	N.W.
Cambridge	Dorchester	....	38 44	76 7	54.3	62.2	46.4	72	3	37	21, 22 29, 30	35	2.76	..	20	9	2	4	N.W.
Mardela Spr., e	Wicomico	25	38 30	75 39	52 2	62.9	41.6	73	27, 28	29	30	44	3.59	....	13	10	8	4	.....
Princess Anne	Somerset	....	38 10	75 35	51.2	65.5	36.8	76	3	23	30	55	2.71	....	16	9	6	6	N.W.
Pocomoke City	Worcester	37	38 5	75 34	55.5	66.8	44.2	74	7, 27	33	10	41	2.76	....	20	7	4	5	S.
Wilmington, Del	Newcastle	115	39 44	75 33	53.1	64.0	42.2	77	3	33	10, 22 24, 30	44	2.74	T	20	10	1	4	N.W.
Newark, Delaware Col., Del.	Newcastle	....	39 40	75 37	49.8	61.7	37.9	74	3	27	22, 24 29, 30	47	2.53	....	21	6	4	4	N.W.
Kirkwood, Del. 1*	Newcastle	....	39 35	75 41	.....	.....	.....	...	.....	....	.....	...	.....	....	....	....	....	....	.....
Dover, Del	Kent	40	39 10	75 30	51.0	60.8	41.3	70	27	32	30	38	3.14	..	23	4	4	4	N.W.
Milford, Del	Kent	....	38 45	75 25	54.1	67.0	41.2	80	3	30	29	50	.....	...	28	1	2	4	W.
Seaford, Del	Sussex	....	38 40	75 35	52.1	63.6	40.6	73	3	30	29, 30	43	2.76	....	....	....	....	....	.....
Millsboro, Del	Sussex	....	38 44	75 15	51.4	63.5	39.4	74	27	29	29	45	3.06	...	24	3	4	4	S. W.
PENNSYLVANIA.																			
Philadelphia	.....	....	.....	.. ...	52.6	61.3	44.0	74	3	34	30	40	2.97	....	21	5	5	4	N.W.
VIRGINIA.																			
Norfolk	.....	..	.....	.....	58.6	66.8	50.4	76	27	42	21	34	1.99	....	19	8	4	3	N. E.
AVERAGES	Western Maryland	....	.....	.....	46.1	59.2	31.9	....	.....	....	.....	58.0	1.33	...	22.9	5.3	3.1	4.0	S. W. W. N.W.
	Northern-Cent'l Md.	....	.....	.....	51.6	62.8	41.0	....	.....	....	.....	43.7	1.72	....	23.3	4.5	3.2	3.5	N.W.
	Southern Maryland	....	.....	.....	52.2	64.4	40.4	....	.....	....	.....	45.8	2.01	....	22.0	5.7	3.3	4.0	N.W.
	East. Md. and Del	....	.....	...	51.4	64.1	40.8	....	.....	....	.....	44.8	2.78	...	21.5	6.2	3.5	3.8	N.W.
	Entire territory	....	...	...	50.3	62.6	38.5	...	.....	....	.....	48.1	1.96	....	22.8	5.4	3 3	3.8	N.W.

* Extremes of temperature from observed readings of dry thermometer. A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. + 4. [2] Mean of 8 a. m. + 8 p. m. + 2. [5] Mean of 7 a. m. + 2 p. m. + 2.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers. Letters of the alphabet are used to denote the number of days that are missing from record; for instance, "a" denotes 1 day missing. An italic letter following the name of a station indicates that two or more observers, as the case may be, are reporting from the same station. ‡ Omitted in computing averages. †Received after report had gone to press and therefore omitted in computing averages and in preparing map.