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The Johns Hopkins University and the Maryland Agricultural College.

CENTRAL OFFICE, JOHNS HOPKINS UNIVERSITY, BALTIMORE, MD.

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VOL. II. MONTHLY REPORT OF OBSERVATIONS, JANUARY, 1893. NO. 10.

Relation of Soils to Meteorological Conditions and to Crop Production.

BY MILTON WHITNEY.

In the May number of this Report I spoke of a thorough and systematic study of the soils of the State, which was being carried on under the auspices of the Agricultural Experiment Station. There have since been many requests for a fuller statement of the results of this work and of the bearing of these results upon practical agriculture.

It is well known that plants require a certain amount of mineral matter for their full life and growth. They must have lime, potash, phosphoric acid, silica, iron, and a number of other like mineral substances which are derived from the soil. It was at one time supposed that the simple chemical analysis of a soil and plant would show what was lacking in the soil for a large crop, and that the mineral matter which was found to be deficient in the soil could readily be supplied in the form of manures or artificial fertilizers. Investigations showed, however, that all soils, even very barren soils, contain a large amount of plant food, and that many barren soils actually contain more plant food than other soils which are known to be very fertile. With the exception of phosphoric acid, potash, lime, and nitrogen, there is usually enough of all the plant foods in the soil for a large crop and in a form in which the plants can take them up. It is ordinarily only the mineral compounds of phosphoric acid, potash and lime, and the organic compounds of nitrogen, which need be applied to the soil in manures and fertilizers.

Nearly all soils, however, contain at least a ton of phosphoric acid, and an equal amount of potash and of lime in one acre, within a depth of one foot from the surface, and they usually contain from 2 to 20 tons of each of these plant foods per acre. It seems strange, indeed, that plants cannot gather all the food they require from this vast quantity, for the amount which they require is relatively so small that its loss cannot be detected with certainty by chemical means after a crop has been removed from the land. It seems strange also that such a small quantity as 20 pounds of potash or of phosphoric acid applied to an acre of land, already containing from 1 to 20 tons of this same material, would have any great effect upon the crop, but in actual practice even such a small quantity as this often makes a good crop where there would otherwise be a failure.

It must be remembered, however, that this phosphoric acid, potash, lime, silica, iron, etc., are combined in the soil in various minerals, such as quartz, feldspar and mica, and that many of these mineral matters of the soil are very insoluble and are not in such a form as can readily be taken up and assimilated by plants. It is generally believed now, therefore, that only a small part of the plant food in the soil is in a form which can readily be assimilated by plants. It is also believed that plants differ in their capacities of dissolving and assimilating this food material in the soil, and that such a plant as rye, for example, can readily gather its food from a soil too poor in available plant food to produce a crop of wheat, because the rye has greater powers of absorbing its food than wheat has.

It is generally believed by agricultural chemists that when soils are "worn out" or "exhausted," this *available food supply* has been used up, and the soil must be allowed to rest until more of the mineral matters have been changed to a form more readily available to plants, or plant food must be added to the soil in the form of fertilizers or manures.

According to these ideas, the reason wheat cannot be as successfully grown on our light truck lands as on our heavy limestone soils of Western Maryland is because there is not sufficient available plant food in the light truck soils for successive wheat crops, and these lands would therefore give small yields or require very large additions of available plant food for a fair crop. This is a very significant fact, however, that even if as much plant food were added to this light truck soil as would be required by a large wheat crop, this would not insure a large yield of wheat by any means, so there is some other factor, besides the mere amount of plant food in the soil, which controls the development of the crop and which determines that 40 bushels of wheat can be as easily produced on the one soil as 10 bushels can on the other. Let us inquire, then, what are the real conditions which control the development of plants, and the peculiar fitness of certain soils for certain classes of plants.

In a greenhouse, where all the conditions of plant growth are under nearly perfect control, the same kind of soil may be used to grow almost any kind of plant, whether it be oranges, bananas, pineapples, roses, geraniums, lettuce, or radishes. The same kind of soil may be used, but each kind of plant will require certain conditions of moisture and heat, and when these conditions are changed the development of the plant may be largely controlled. If a geranium is wanted for a simple foliage plant it can be kept from blooming and developed to a very large size with a great number of leaves by keeping the soil moderately warm and moist. If it is desired to have the plant bloom and flower profusely the soil must be kept drier and cooler. Thus the development of the plant is under nearly perfect control, and it is very customary for florists to force their plants to any kind of development by the simple control of moisture and heat; to make large and leafy plants of them, or to keep them smaller by checking this excessive growth of foliage and make them put all their substance into a profusion of flowers and fruit.

We see these same effects in nature. In very heavy, wet soils and in wet seasons plants are inclined to grow very large, and they do not put on as much fruit as they should, considering the size of the plant and the amount of food material they have gathered from the soil and air. Under these conditions tobacco plants are large and rank, the leaves are coarse and sappy and do not cure well or take on good color. On drier soils and in drier seasons the leaves have a finer texture and a brighter color. The cotton plant shows this influence of the wetness or dryness of the soil and of the season to a very marked extent, and wheat shows it, although to a less extent. Indeed it is well-known that the "*season*," that is, the conditions of moisture and heat, have far more effect upon the crop than fertilizers usually have, and it is not at all unusual to find the *difference* between a crop on the same soil in a favorable and in an unfavorable season two or three times as much as the actual yield in the unfavorable year. The effect of fertilizers themselves is very largely dependent upon the *season*. We find then that in nature as in the greenhouse, the development of plants and the yield of crops is very largely dependent upon the conditions of moisture and heat under which they are grown.

We have a greater number of geological formations in Maryland than in any other State, and this gives a great number of distinct types of soils. These range in texture from the very light, sandy soils of the pine-barrens and of the truck lands, to the very heavy limestone soils of Western Maryland. The light sandy soils are so open and porous that water readily descends through them after a rain. The heavy limestone soils, on the other hand, are so close in texture and so retentive of moisture that the rainfall passes down through them very slowly. The rainfall does not do the crops any good until it enters the soil. Even assuming, therefore, that we have the same amount and distribution of rainfall over the whole State, the soils are so different in their retentive powers that some will maintain much more of this rainfall for the crop than others.

For example, the limestone soil will maintain, on an average, from 18 to 20 per cent. of water, or about 400 tons of water per acre one foot deep; while the light truck soils will maintain only about a quarter of this amount, that is, about 5 or 6 per cent. of moisture, or say 100 tons of water per acre. The limestone soil to a depth of one foot maintains an amount corresponding to 4 inches of rainfall, while the light sandy truck land maintains an equivalent of only 1 inch of rainfall. Now the difference in the effect on a crop of a season when there are 4 inches of rainfall a month and when there is only 1 inch of rainfall a month is very great. For if we have an average of 4 inches of well distributed rainfall a month, a good wheat crop is assured on the limestone soils, but if we have an average of only 1 inch of rainfall a month the crop will be a failure. As a matter of fact we have, on an average, about 4 inches of rainfall a month in Maryland, and this is sufficient for a good wheat crop on the limestone soils, but, as we have seen the [illegible] sandy truck lands are so porous that [illegible] this water down very freely and only maintain for the crop an amount equal to about 1 inch of the rainfall. The effect is nearly the same as if the soil was uniform in both cases, and 4 inches of rain had fallen on the crop on the limestone soil but only 1 inch had fallen on the other crops.

Now we have seen that if there should be as much difference as this in the amount of water supplied to plants in a greenhouse, that those plants which received the most water would develop into large leafy plants which would be late in coming to maturity, while the plants receiving the less amount of water would be smaller but there would be a greater tendency to fruit and the plants would mature much earlier. This is precisely the effect on the two soils under consideration. When wheat is sown on the sandy truck soil it does not tiller well, but throws up one or two stalks which attain hardly any size before each takes on a seed head and the plant ripens. The conditions have not been favorable for the development of a sufficient amount of foliage to gather enough plant food from the soil and atmosphere for a large crop, but the plant has been forced to maturity before it has attained sufficient size. The crop is large in proportion to the amount of food material which has been gathered by the plant, but there is relatively so little of this that it gives a very small yield per acre. On the heavy limestone soil, on the other hand, the crop grows slowly, gets a good root development, tillers well, and produces a mass of foliage which gathers a quantity of food material from the soil and air.

The conditions in these light sandy soils, while unfavorable, as a rule, to wheat and grass, are distinctly favorable for forcing crops to an early development, and this is what gives them their great value for early truck. By forcing these vegetables to an early maturity the crop is put on the market two or three weeks earlier than they can be produced on the heavier soils of the State, and it gets the benefit of a high market price; while the same crop grown on a limestone soil would be so late in coming to maturity that it would have to compete with all other parts of the State, and there would likely be a glut in the market and the crop would bring a very low price.

In the deterioration of lands these same effects are shown. The texture of the soil changes so much that it has a very different appearance to the eye, and a soil which is "worn out" or "exhausted" can generally be very quickly detected by a simple inspection. The development of the crop is also very different, indicating that the relation of the soil to moisture and the amount of moisture it can maintain for a crop has been changed.

Fertilizers have a very marked effect on the texture of soils, as some fertilizers, such as lime with organic matter, for example, will make the soil much more retentive of moisture, while others, as, for example, lime alone, will make the soils looser and more loamy and less retentive of moisture. This physical action of fertilizers in changing the texture of soils and their power of supplying water to crops is probably much more important than their value as mere plant foods.

It seems, therefore, that if the physical conditions of moisture and heat are favorable to the proper development of crops, that plants can, in general, get all the food they need from nearly all soils; that these conditions may change with any change in the texture of the soils, and that the development of the plants and the yield of crops will thereby be affected favorably, or otherwise; that we have in our common manures and fertilizers very powerful and potent means of maintaining or of changing the texture of the soils and thereby changing the conditions of moisture and heat which they can maintain for the crop, and that it is through this physical effect of manures and fertilizers, in controlling the supply of moisture and heat within the soil, under existing climatic conditions, that the chief value of fertilizers and manures lies, rather than in the relatively small amount of plant food which they add to the soil.

This is a brief statement of the views and generalizations I have arrived at as a result of these soil investigations, but, of course, much yet remains to prove these generalizations, and one of the most important things is to study the actual conditions in the soils in the different soil formations of the State, having different agricultural values. We shall be very glad to get help in this from the farmers in the different agricultural regions. We are anxious to have observations made on the moisture and temperature in the different soil formations; and we should be very glad to arouse an interest in this work and to get farmers sufficiently interested to take these observations for us, to record the temperature of the soil and the amount of moisture it contains, by the methods which we have adopted. This work should be done, if possible, in connection with the observations on the rainfall and the temperature of the air, which are now being made throughout the State under the auspices of the Maryland State Weather Service.

Letters.

WHY DOES WATER REMAIN UNFROZEN IN A TEMPERATURE BELOW FREEZING?

My letter of December 1st was not intended for publication. My inquiry was directed to you, but through your action in giving it a place in your report, it has brought me some very interesting and instructive reading. I like the idea of this exchanging of ideas, and these discussions, as a part of your report, very much.

May I be allowed to write a little further in relation to one of my inquiries, viz. "Why does the water remain unfrozen in a temperature far below freezing?"

I will give a little experience I had in the severe climate of Northern Middle Wisconsin, where I passed several winters.

I arose one morning about 8 A. M., to find my mercurial thermometer, hanging on the door post, with northern exposure, indicating 40° below zero. As this instrument could indicate nothing lower, and should not have been so low by one degree, I suppose, I do not know how cold it actually was. The sun was now rising and shone unclouded. Through the calm air there were slowly falling scattered crystals of ice, some as large as snowflakes, many smaller, some long in form, as if many crystals were clinging together. Their descent seemed slower than that of the ordinary snowflake, and they could be seen on the surface of the snow that covered the ground. They were ice-crystals, and always glittering intensely in the sun; at certain angles of vision they gave iridescent colors. I brought a shallow basin of water, and, upon throwing the water high in the air, it came down in ice-fragments.

Now, off in the N.W., extending above the horizon some 10° or more, was a bank of dull gray winter-clouds. Had the globules of water that formed that cloud been congealed the sun would have made it too dazzling to look upon, but it was of a dull gray.

Must a new law be formulated that water will not congeal under some circumstances in space 40° below zero? As I stated in my previous letter, I have felt and seen a dense mist all about me in a temperature of 25°. Here certainly were globules of water unfrozen, while water froze in exposed dishes and troughs.

I believe most heartily in the capacity of the atmosphere for dust-particles, and shall till I forget how the East Indian volcanic eruption filled the whole atmosphere of the entire earth with ashes, and affected our sunsets for a month. Possibly every little, microscopic globule of water is attached to and buoyed up by a little particle of ashes or dust. It seems to me that a solid globule of water, however small, a thousand times heavier than the surrounding medium, must necessarily fall; certainly no mathematical analysis can sustain it.

I am satisfied that we, as yet, know very little about the atmosphere. Regarding the earth which it envelops, it seems a tenacious, elastic shell. It is not stripped from the earth, but maintains its equal form and depth, with the earth moving 68,000 miles an hour in space.

This I suppose indicates the absence of a resisting medium in space, and here comes in a question I would like to ask in another letter, if I am not getting outside of the province of meteorology—and I hope not, so long as I am on the air.

I believe, also, in the incalculable electrical capacity of the air. Indeed, why may we not suppose the solar system a sublime dynamo, and the ever-blazing sun the burning center, forever sustained by the motion of its satellites. This idea first struck me in the glare and heat of last summer. I have been discussing it in private correspondence for some months. It is merely imagination, we have no facts.

Very respectfully,

G. G. Curtiss.

OAKLAND SCHOOL, FALLSTON, MD.

Miscellaneous Notes.

It will be observed that the State Service has been increased by 7 stations since the issue of the previous report. This is really a good showing, and it is hoped that other additions to the list may continue to be made monthly.

The additional stations and observers are: Cambridge, Mr. Calvert Orem; Glyndon, Mr. A. W. Nyce; Millsboro, Del., Rev. Lewis W. Wells; Oakland, Mr. James D. Hamill; Salisbury, Col. Lemuel Malone; Sunny Side, Mr. John G. Knauer; Westminster, Mr. John T. Cassell.

The observers of this Service, and their friends, are cordially invited to visit the Central Office whenever it may suit their convenience and pleasure.

Observers will confer a favor, each month, by promptly forwarding their meteorological forms.

It is much desired that observers who have been taking observations of the moisture of the atmosphere will continue these observations.

Review of the Month.

WEATHER.

General Remarks.—During the month 11 areas of low barometric pressure and 10 areas of high barometric pressure passed from west to east across the country, causing the non-periodic meteorological disturbances occurring in Maryland, the District of Columbia, and Delaware; the low areas bringing warmer weather with snow or rain, and the high areas, colder weather, with, as a rule, an absence of precipitation. The most severe storms were those of the 1st, 6th, 9th, 12th, 15th, and 29th.

Precipitation (in inches).—Average, 1.94; greatest amount, 3.50, at Sunny Side; least amount, 0.72, at Cumberland (E. T. Shriver). The greatest fall of snow during the month, in Maryland, 36. is reported by the observer at Oakland, Garrett Co. The next greatest fall, 13.7, was at Cambridge, Dorchester Co. Only 6 is reported from Cumberland, which seems remarkable considering the situation of that place. Boettcherville, close by, reports 12 5. Baltimore reports 8.1. The greatest depth of snow in Delaware was 17.0, at Seaford. The observer at Penn's Grove, N. J., reports 16.0, which probably approximates closely with the fall in Northern Delaware.

As seen by the map and table, pages 82 and

83, the precipitation of the month was quite equally distributed over the territory. It was greatest, however, over Delaware, Eastern Maryland, and small portions of Southern and Northern Central Maryland, as exhibited by the shading. The distribution of the precipitation throughout the month, as shown by the table, was unusually even, except for the week from the 21st to the 27th. During this time no more than a trace fell at any station.

Temperature (degrees).—The month of January, 1893, will long be remembered for its accompaniment of extremely cold weather, which is well known not to have been at all local in character, nearly every section of the country having been invaded by a temperature very low in comparison with previous records. Probably not since January, 1856, has there been experienced in Maryland, the District of Columbia, and Delaware such a protracted period of severe weather. It is certain that not during the life of the Weather Bureau, which came into existence in 1870, has anything approaching a parallel been experienced. There have been lower temperatures in previous years, but they endured for a day or two only, being quickly succeeded by comparatively warm weather; the mean of several days, or of an entire month, places the recent frigid period far in the lead.

The mean temperature of the month at Baltimore was 25, and nothing approaches nearer to it than 29 in 1886 and in 1888. This is a decided difference in mean temperatures, especially between lowest mean temperatures. The mean of the month at Washington was still lower, 24, and the next lowest, 28, which occurred in 1881. A minimum temperature of 6 below zero was recorded at Washington on the 18th, while the lowest at Baltimore was 1 above zero, on the 16th.

Mean monthly (for entire territory covered), 22.9; highest monthly mean, 27.0, at Cambridge; lowest monthly mean, 13.1, at Sunny Side. Highest temperature, 58, at Cumberland (H. Shriver), at Edgemont and Leonardtown, on the 27th; lowest temperature, 17 below zero, at Denton, and at Millsboro, Del., on the 18th, and 17th, respectively. Greatest local monthly range, 73, at Denton; least local monthly range, 25, at Cambridge. Mean monthly range, 56.9. Mean maximum, 31.9. Mean minimum, 16.4.

The lines of mean temperature for the month, illustrated on the map, are comprised between the isotherms of 21 and 26 inclusive. These lines show the temperature along the shores of the Bay to have been considerably higher than in the interior, and, without doubt, this tempering influence extended throughout the greater portion of the territory covered by these observations.

Wind.—Prevailing direction northwest. Total movement in miles, Baltimore, 6510; Norfolk, Va., 6247; Washington, D. C., 5549.

Hail.—At Barron Creek Springs, on the 30th; at New Market, on the 30th; at Penn's Grove, N. J., on the 30th.

Sleet.—At Fallston, on the 28th; at Frederick, on the 1st, 2nd, 29th; at Glyndon, on the 29th; at Jewell, on the 28th, 29th; at Mt. St. Mary's, on the 29th; at Oakland, on the 30th; at Westminster, on the 1st.

Halos.—Lunar, at Cumberland (H. Shriver), on the 24th; at Glyndon, on the 31st; at Mt. St. Mary's, on the 29th.

Solar.—At Cumberland (H. Shriver), on the 13th.

Corona.—At Penn's Grove, N. J., on the 31st.

Polar Bands.—At Cumberland (H. Shriver), on the 24th, 26th.

Average number of clear days, 12; fair days, 10; cloudy days, 9; rainy days (.01 of an inch or more), 8.

CROPS.

Mr. Albert E. Acworth, of Barron Creek Springs, Wicomico Co., sends the following report, made Feb. 1st:

The wheat fields are bare, and only now and then a drift of snow can be seen. From the 18th to the 27th the ground was sufficiently covered to benefit wheat. As the snow on the 18th fell on a crusted surface of prior snow, it did more injury than good.

Mr. Calvert Orem, of Cambridge, Dorchester County, makes the following report:

The wheat looks fair, and was protected by the snow, else it would have been greatly injured. The peach-buds have been killed in some sections, but it will take some time to determine the extent of the damage.

Prof. A. F. Galbreath, of Darlington, Harford Co., reports as follows (January 31st):

The ground was covered with snow during the greater portion of the past month, and the wheat has come out looking very well.

Dr. William H. Marsh, of Solomon's, Calvert Co., says:

The ground was covered with snow from January 5th to the 24th, somewhat evenly, but in some places there were heavy drifts. It was a great protection to crops during the severe freeze.

Mr. John G. Knauer, of Sunny Side, Garrett Co., sends the following report, made February 1st:

The ground was covered with snow during the entire month. All crops that needed protection had not suffered up to this date.

Notes by Observers.

Baltimore.—The temperature remained below freezing from the 4th to the 21st. From the 10th to the 18th the mean did not rise above 18°, and during this time the Bay and its tributaries were frozen over; the ice blockade lasted until near the close of the month.

Barron Creek Springs.—9th, steamer to Claiborne stopped. 13th, many birds frozen. 31st, Barron Creek and Nanticoke river not open. Total snowfall during the month, 11.2 inches. This is the coldest January that I have on record. My records cover the past 23 years.

Cambridge.—The first of the year gave us .96 of an inch of rain. 2nd, north winds and colder. 5th, the northeast winds and snow lowered the temperature to 20 degrees. 11th, at 8 A. M. the thermometer registered 8 degrees. 12th, at 8 A. M. fine round snow was observed falling from a clear sky, it ended about 9 P. M. From the 12th a continuation of cold weather for 14 days. The coldest morning was the 18th, when the temperature fell to 4 degrees. From the 20th to the 28th we had beautiful, clear weather. 13.7 inches of snow fell during the month. We had fine sleighing for 10 days. The snow has almost disappeared. Taking the month through it was fine, dry, cold, winter weather.

Cumberland (H. Shriver).—6th, Zodiacal light. 9th, high winds during the night. 10th, N.W. gusts. 18th, the thermometer registered in various places 0° to —10 degrees. The lowest at this place was —3 degrees. 19th, pretty rose-colored sunset. 21st, parhelia near sun, 4.15 P. M. Rivers and creeks frozen during the month; ice 1 to 15 inches thick and has no appearance of moving.

***Darlington.**—Mean monthly temperature 21.8°; highest, 50° on the 2nd; lowest, —5 on the 18th. Total precipitation 2.28 inches. Prevailing direction of wind N.W.

Fenby.—The month of January was remarkable for the continuous cold term, beginning on the 2nd at 9 P. M., and ending on the 23rd, being three weeks of freezing weather without an intermission. Ice was formed on the mill-ponds 15 to 18 inches thick. The lowest temperature was —8 degrees on the 16th. Many water-pipes were frozen. Many of our roads were blocked by snow-drifts and are still unfit for travel.

Oakland.—Mean monthly temperature at 7 A. M., 11.8 degrees; highest 50 degrees, on the 27th, 28th, 29th; lowest —26 degrees, on the 17th. Total precipitation, 3.60 inches. Total snowfall, 36 inches. 1st, rain and wind storm. Snow and wind from the 2nd to the 16th inclusive. Severe cold 16th to 18th inclusive. Cold and snow from the 19th to 24th inclusive. Thaw and rain from the 25th to 31st inclusive.

Penn's Grove, N. J.—The past month has been the coldest January since 1881. On the 18th the minimum temperature was —3 degrees. The ice in the Delaware River is very heavy. The eastern channel was closed during the entire month, and the western channel was kept open by the city ice-boats. Total snowfall during the month 16 inches.

Solomon's.—On the night of the 10th the Patuxent River was frozen over at its mouth for the first time in twelve years, and continued so until the 30th.

*Report received after summary had gone to press.

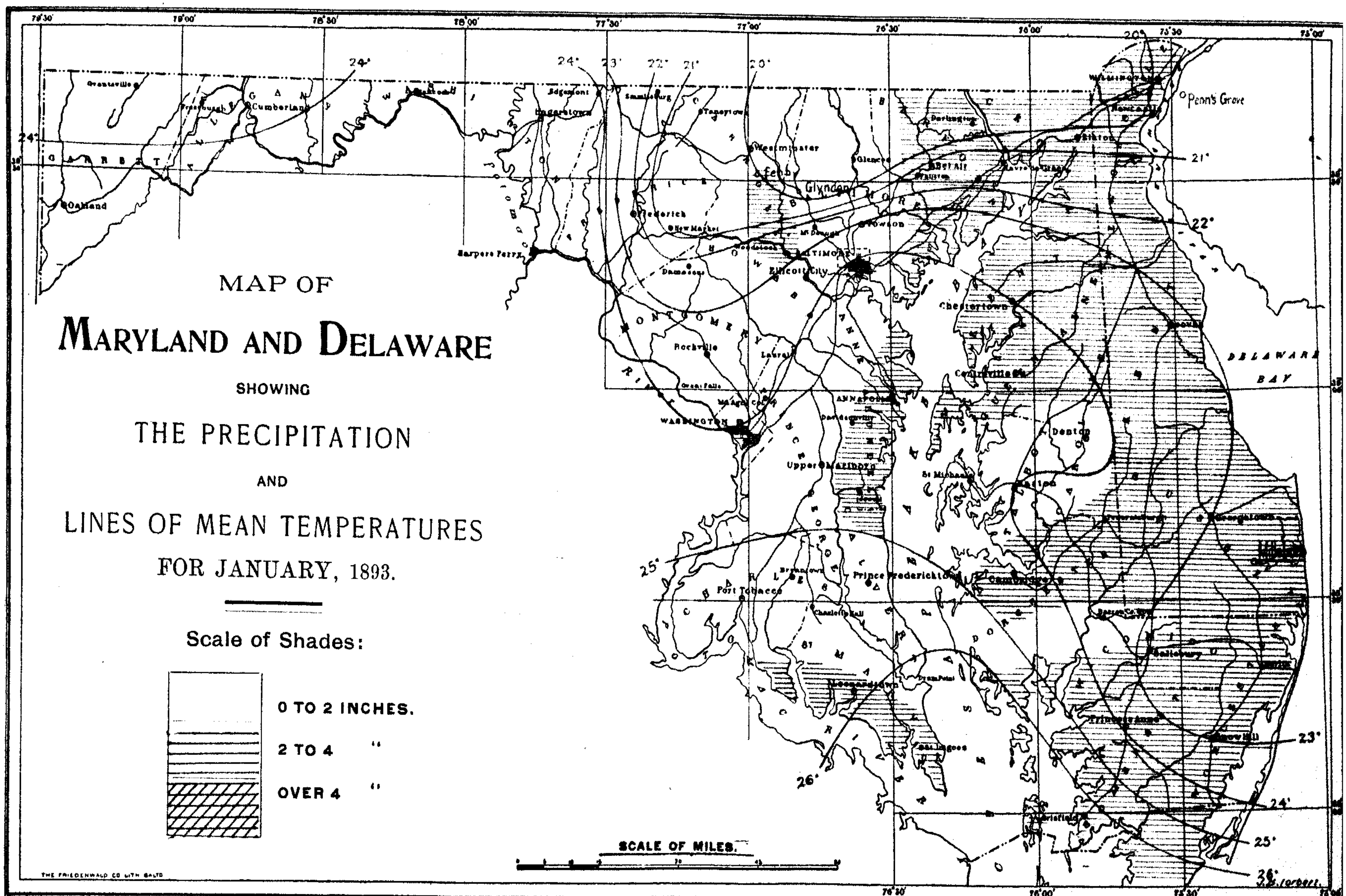
Table giving Comparisons and Means of Relative Humidity for the year 1892.

STATIONS.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
† Baltimore	79	78	73	65	69	77	72	73	72	67	76	74	73
* Barron Creek Springs	85	87	84	72	72	80	78	82	78	71	77	84	79
* McDonogh	80	80	74	69	66	75	73	82	80	72	76	70	75
† Norfolk, Va.	72	75	73	77	74	85	84	81	80	76	81	79	78
† Washington, D. C.	74	73	70	65	70	75	76	73	74	68	70	74	72
* ‡ Woodstock	79	81	79	77	77	80		80	80	75	80	79	79

† Monthly mean from observations at 8 A. M. and 8 P. M.

* Monthly mean from observations at 7 A. M., 2 P. M. and 9 P. M.

‡ July missing.


MAP OF
MARYLAND AND DELAWARE
SHOWING
THE PRECIPITATION
AND
LINES OF MEAN TEMPERATURES
FOR JANUARY, 1893.
Scale of Shades:
0 TO 2 INCHES.
2 TO 4 "
OVER 4 "
SCALE OF MILES.
Cumberland
Oakland
Frederick
Westminster
Glyndon
Towson
Ellicott City
Rockville
Laurel
Washington
Annapolis
Upper Marlboro
Chestertown
Centreville
Denton
Easton
St. Michaels
Cambridge
Salisbury
Princess Anne
Snow Hill
Leonardtown
Port Tobacco
Prince Frederick
Penn's Grove
DELAWARE
BAY
Harpers Ferry
Hagerstown
Damascus
Newcastle
24°
23°
22°
21°
20°
25°
26°
THE FRIEDENWALD CO. LITH. BALTO.

MONTHLY SUMMARY OF REPORTS, JANUARY, 1893.

Stations.	Countie	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.	Clear Days.	Fair Days.	Cloudy Days.	Rainy Days.	Prevailing Wind.
Baltimore	....	179	39°17′	76°36′	24.6	30.6	18.5	52	26	1	16	51	1.78	13	10	8	16	N.W.
Barron Ck. Springs	Wicomico	25	38 30	75 39	23.5	32.8	14.2	56	1, 27	—10	18	66	1.64	9	17	5	13	N.W.
Boettcherville	Alleghany	......	39 39	78 48	20.7	....	...	54	27	—14	18	68	1.20	....	....	....	....	......
Cambridge	Dorchester	......	39 33	76 6	27.0	33.7	20.4	53	29	4	18	25	2.71	19	0	12	7	N.W.
* Cumberland (a)	Alleghany	700	39 39	78 46	25.3	32.8	17.8	58	26	— 3	18	61	1.30	...	....	....	...	......
Cumberland (b)	Alleghany	700	39 39	78 46	22.8	28.5	17.0	55	26	— 5	18	60	.72	11	7	13	4	.. ...
† Denton	Harford	42	38 47	75 41	24.5	....	....	56	27	—17	18	73	1.90	....	....	....	....	......
Dist. Res., D. C.	....	.....	38 52	77 0	23.6	....	....	53	27	— 5	18	58	2.16	....	....	....	....	......
Dover, Del	Kent	......	39 9	75 31	23.9	32.2	15.6	54	1	— 5	17	59	2.39	17	10	4	12	N.W.
Easton	Talbot.	35	38 42	76 6	23.9	30.6	17.2	52	2	— 1	18	53	1.29	18	7	6	7	N.W.
Edgemont	Washington	......	39 45	77 29	24.3	32.3	16.3	58	26	— 4	16	62	....	....	....	....	....	......
Fallston	Harford	450	39 31	76 24	22.0	....	....	46	1	— 3	16	49	2.43	11	13	7	5	N.W.
Fenby	Carroll	950	39 33	77 5	20.5	....	....	51	27	— 8	16	59	2.31	8	15	3	8	N.W.
Frederick	Frederick	280	39 24	77 18	22.7	28.5	16.9	47	26, 27	— 3	18	50	1.82	17	7	7	8	......
Glyndon	Baltimore	660	39 27	76 41	19.6	...	....	....	......	....	......	....	1.19	11	11	9	6	N.W.
Great Falls	Montgomery	......	39 9	77 14	23.6	....	...	53	27	— 8	18	61	1.84	....	....	....	....	......
Jewell	Anne Arundel	......	38 44	76 36	24.6	...	....	....	......	....	......	....	2.05	19	0	12	7	.....
Kirkwood, Del	New Castle	....	39 35	75 40	20.8	....	....	50	26	— 4	16, 18	54	....	....	....	....	....	......
Leonardtown	St. Mary's	......	38 18	76 40	25.6	34.4	16.9	58	27	— 2	18	60	2.18	17	7	7	6	N.W.
McDonogh	Baltimore	535	39 23	76 44	22.6	30.3	14.8	49	27	— 3	16	52	.84	....	....	....	....	......
Millsboro, Del	Sussex	......	38 35	75 15	23.2	34.1	12.4	54	27	—17	17	71	2.18	18	6	7	8	N.
Mt. St. Mary's	Frederick	720	39 41	77 21	21.2	28.2	14.1	48	26	— 6	16	54	2.36	5	10	16	7	N.W.
New Market	Frederick	500	39 23	76 27	20.9	....	....	49	27, 30	— 4	18	53	2.40	14	7	10	5	N.W.
Penn's Grove, N. J.	Salem	......	39 50	75 33	25.0	32.1	18.0	52	1	— 3	18	55	2.23	8	16	7	8	N. E.
Rec. Res., D. C.	....	......	38 52	77 0	24.0	....	...	52	27	— 6	18	60	2.19	....	...	....	....	......
Salisbury	Wicomico	.....	38 26	75 35	22.7	....	....	45	24, 26	— 7	18	52	2.21	17	0	14	13	N.W.
Seaford, Del	Sussex	......	38 40	75 35	24.4	34.8	14.1	57	2	— 5	17	62	2.13	....	....	....	....	......
Solomon's	Calvert	20	38 19	76 27	26.2	33.8	18.5	50	1, 2	4	16, 18	46	1.53	4	15	12	7	N.W.
Sunny Side	Garrett	.. ...	39 22	39 26	13.1	....	....	42	28	—12	18	54	3.50	6	11	14	14	N.W.
Taneytown	Calvert	......	39 40	77 9	....	....	....	....	......	....	......	....	1.96	...	....	....	....	......
Washington, D. C	....	112	38 52	77 0	24.6	32.5	16.8	57	27	— 6	18	63	1.85	12	10	9	10	N.W.
Westminster	Carroll	......	39 35	77 3	19.8	...	....	46	26	— 7	16	53	1.73	10	12	9	8	N.W.
Woodstock	Baltimore	392	39 20	76 49	22.8	....	....	49	27	—14	18	63	2.07	4	17	10	7	N.W.
‡ Norfolk, Va	....	34	36 51	76 17	30.5	38.7	22.3	67	27	6	17	....	2.55	12	9	10	11	N.W.
Averages	....	......	......	......	22.9	31.9	16.4	....	......	....	......	56.9	1.94	12.1	9.5	9.1	8.4	N.W.

*2 days missing. †4 days missing. ‡Omitted in computing averages.

DAILY PRECIPITATION FOR JANUARY, 1893.

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	Total.
Baltimore	.91	...	...	T	.06	T	...	...	.14	.06	T	.46	...	.02	.02	...	T	...	T	...	...	...	T	...	...	...	...	T	.11	...	T	1.78
Barron Ck. Spr	.72	...	...	...	...	.10	...	...	.07	...	...	.18	...	...	.08	...	...	...	.10	...	...	...	...	...	...	...	...	...	.39	T	...	1.64
Boettcherville	T	...	T	...	.55	...	...	...	T	...	...	.40	...	.15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.10	...	...	1.20
Cambridge	.96	...	...	...	...	.30	...	T	.30	...	...	.50	...	.10	...	...	...	...	.15	...	...	...	...	...	...	...	...	...	.40	...	...	2.71
Cumberland	...	...	...	...	.20	...	...	...	...	...	.30	...	...	.10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.12	.72
Denton	1.00	...	...	.10	T	.03	...	...	.20	...	...	.20	...	.10	...	...	...	...	.10	...	...	...	T	...	...	...	...	.17	...	...	...	1.90
Dist. Res., D. C.	.10	1.03	...	...	.12	.10	...	...	...	.32	...	.30	.09	...	.04	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.06	...	2.16
Dover, Del	.86	...	...	...	...	.45	...	...	.20	...	...	.45	...	...	.07	...	...	...	.04	...	...	...	...	...	...	...	...	...	.32	...	...	2.39
Easton	1.00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.29	...	...	1.29
Fallston	1.50	...	...	...	...	...	...	...	.20	...	.45	...	.11	...	...	...	...	T	...	...	...	...	T	...	...	...	...	.17	...	...	...	2.43
Fenby	1.13	...	...	.20	.10	T	...	...	.21	...	.20	.21	...	...	.21	...	...	...	...	...	...	...	...	...	...	...	...	...	.05	...	...	2.31
Frederick	.99	...	...	...	.07	...	...	...	.04	...	...	.25	...	.04	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.43	...	...	1.82
Glyndon	...	...	...	.33	.10	T	...	...	...	.33	...	.16	...	.16	...	...	T	...	...	...	...	T	...	...	...	...	...	T	.11	...	...	1.19
Great Falls	.14	.94	...	...	.14	.14	...	...	...	.12	...	.16	.13	...	.04	...	...	...	.03	...	...	...	...	...	...	...	...	...	...	...	...	1.84
Jewell	.75	...	...	T	...	.20	...	T	.40	...	...	.60	...	T	...	...	...	...	T	...	...	...	...	...	...	...	...	T	.10	...	...	2.05
Leonardtown	.95	...	...	...	.21	...	...	...	.18	...	...	.36	...	.14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.34	...	...	2.18
McDonogh	...	...	...	.07	.13	T	...	...	.18	...	...	.23	...	.08	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.15	...	...	0.84
Millsboro, Del	.65	...	...	...	.13	.16	...	...	...	.10	...	.38	...	...	.25	...	...	...	.25	...	...	...	...	...	...	...	...	...	.26	...	...	2.18
Mt. St. Mary's	1.27	...	...	...	.30	...	...	...	.10	...	...	.35	T	T	T	...	...	...	T	...	...	...	...	...	...	...	...	...	.34	...	...	2.36
New Market	1.23	...	...	...	...	.32	...	...	.15	...	.35	...	...	.35	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.40
Penn's Gr., N. J	1.11	...	...	...	.11	.11	...	...	.06	.10	...	.37	...	...	.07	...	...	...	...	...	...	...	...	...	...	...	...	...	.30	...	...	2.23
Rec. Res., D. C.	...	1.18	...	...	.14	.10	...	...	...	.20	...	.35	.07	...	.05	...	...	...	.02	...	...	...	...	...	...	...	...	...	...	.08	...	2.19
Salisbury	.17	...	.20	...	...	...	...	...	.10	...	.20	...	.10	.60	...	...	.20	.40	...	.20	...	...	...	...	...	...	...	...	.04	...	...	2.21
Seaford, Del	.80	...	...	.08	...	.17	...	...	.10	...	.37	...	...	...	.14	...	...	...	.19	...	...	...	...	...	...	...	...	...	.28	...	...	2.13
Solomon's	.67	...	...	.09	.06	...	.07	...	...	...	...	.22	...	T	...	...	...	...	.20	...	...	...	...	...	...	...	...	T	.22	T	...	1.53
Sunny Side	.50	.20	.10	.10	.50	.20	...	...	.40	...	...	.60	.20	.10	.30	...	...	...	.10	...	...	T	T	...	...	...	...	...	.10	.10	...	3.50
Taneytown	1.57	...	...	T	...	...	...	...	.02	...	...	.02	.01	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.34	...	...	1.96
Washington, D. C.	.90	...	...	.05	.12	.04	...	T	.17	.04	...	.44	...	.02	.01	...	T	...	T	...	...	...	T	...	...	...	...	T	.06	...	T	1.85
Westminster	.85	...	...	.05	.03	...	...	...	.20	...	...	.20	...	.10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.30	...	...	1.73
Woodstock	.90	...	...	.08	.10	...	...	...	.25	...	.50	...	...	.10	...	...	T	...	...	...	...	...	...	...	...	...	...	...	.14	...	...	2.07
Norfolk, Va	.13	.01	.06	.12	.14	.06	...	T	...	...	...	.04	...	...	.20	...	...	...	.98	...	...	...	...	...	...	...	...	...	.70	.11	...	2.55

NOTE.—"T" indicates a trace of rain or snow.

A. T. B.