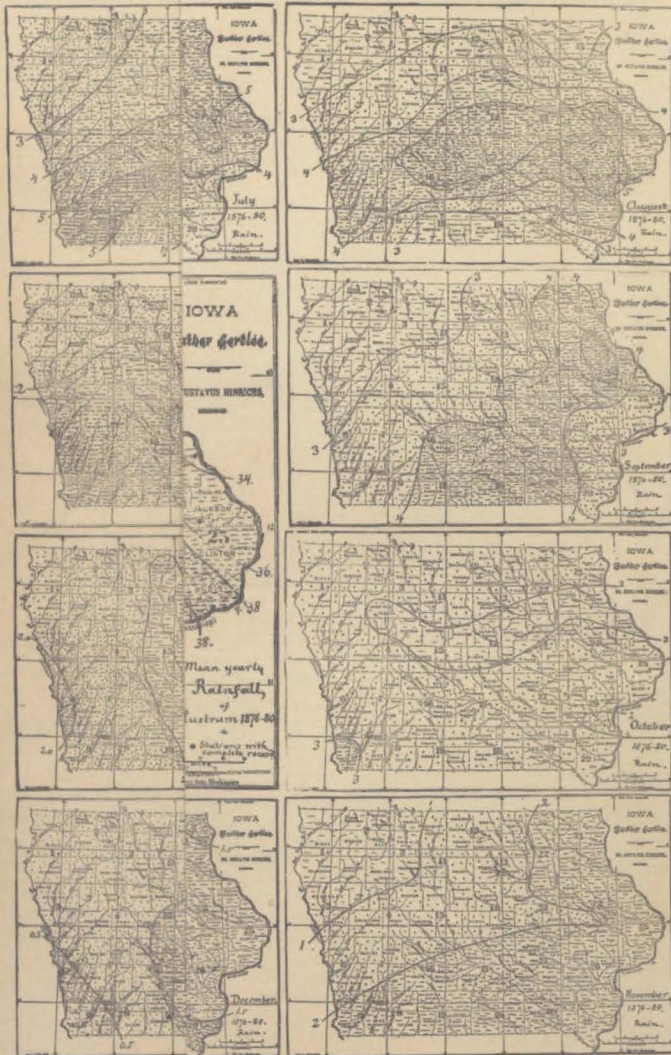


RAIN-FALL IN IOWA, FOR THE LUSTRUM 1879 TO 1880, FOR EACH MONTH AND FOR THE YEAR.



FOR THE YEAR.

SECOND BIENNIAL REPORT

OF THE

CENTRAL STATION

OF THE

IOWA WEATHER SERVICE.

PRINTED BY ORDER OF THE GENERAL ASSEMBLY.

DES MOINES:
 F. M. MILLS, STATE PRINTER.
 1882.

To His Excellency, JOHN H. GEAR, Governor of Iowa:

SIR—I have the honor to submit to you the second biennial report of the Central Station of the Iowa Weather Service.

Very respectfully yours,

GUSTAVUS HINRICH,
Director Iowa Weather Service.

CENTRAL STATION I. W. S.,

IOWA CITY, IOWA, October, 1881.

SECOND BIENNIAL REPORT.

THE Iowa Weather Service has continued its work without interruption during the two years covered by this report. As the service grows older, the experience of its observers increases, and makes the returns of the stations of higher value. At the Central Station the work becomes more systematized, so as to allow more to be done by the same force. Finally, the first five years of continued and uniform observations having been made, in all parts of this great State, we have for the first time in the history of our State the means of obtaining reliable and sufficiently detailed data for the mean distribution of rain-fall in Iowa. The result of these observations have, at the Central Office, been tabulated and reduced, and will be found further on in this report represented in figures and maps. Great improvement has been made in the monthly Bulletin of the service, and considerable progress has been accomplished in the publication of the final report. While originally not intended, it has yet been possible, from the very limited means at disposal, to furnish the observers at many stations with good instruments. Very much of the increased efficiency of this Service is due to the increased accommodations provided for the Central Station by the building erected in 1879, in which now four rooms are almost exclusively devoted to this Service.

But, above all, the work of the Service depends upon the persons who have, as volunteer observers, taken upon themselves the duty of regular observations, and upon the fact that the Director is as yet physically able to continue the work voluntarily begun. It may, however, be very soon timely to suggest that the volunteer observers should receive appropriate compensation for their labor, whereby still greater efficiency of the work performed would undoubtedly accrue; and as the Director advances in age, he finds it increasingly burdensome to do the great work required, and would be very glad to be enabled to discontinue some of his hard professional work, if the work done by him for this Service were appropriately salaried.

In Missouri, Nebraska, Kansas, and New Jersey, a State Weather Service has been organized similar to our own, and in several other States efforts are being made in the same direction. While serving as a model at home, our Service enjoys the highest consideration abroad.

THE VOLUNTEERS.

Any person who desires to co-operate with the Service, with a view of becoming a volunteer observer, is furnished with directions for non-instrumental observations of sky, wind, and all the meteorological phenomena, and with appropriate blanks for the record of his regular observations, as well as with stamped envelopes for the mailing of his monthly reports to the Central Office.

The regular hours of observation are 8 A. M., noon, and 8 P. M. Of these, the noon observation is obligatory for all who intend to act as observers, while the morning and evening observations are elective. As, however, the record of phenomena is a continuous one, the omission of the stated morning and evening observation is of less importance.

Upon the receipt of the first monthly report from such a person, his name is enrolled as VOLUNTEER on the books of the Service, and especially also on the mailing lists, in virtue of which he will receive one copy of all publications of the Service as they appear.

During this period the volunteer is expected to make himself thoroughly familiar with the observation and proper record of the weather so far as it can be done without instruments. In this regard our Service differs essentially from most others. We earnestly insist upon the great importance of this work, and consider it of higher value than the instrumental work, as it is generally done before such training in the non-instrumental observations has been obtained. For this reason we have generally found new observers, trained in this school of the volunteer, more valuable to the service than old observers who, by the general custom, have thought the mere reading of barometer and thermometer sufficient, while in point of fact these readings are quite frequently without value.

The following is, in brief, an enumeration of the work which each volunteer is to practice. He must, at the stated hours, estimate the amount of cloud in *fifths* of the entire sky, and determine the direction and estimate the force of the wind. He must make a record of these observations on the blanks furnished him for the purpose. In addition, he must keep a general lookout for all notable changes of the weather, as to noted cloud-forms and wind-storms, as well as in regard to all meteorological phenomena, such as rain, snow, hail; dew, frost, silver-thaw, sleet; thunder, lightning, thunder-storms and thunder-bolts; solar and lunar halos and coronae, rainbows; zodiacal lights,

aurora. He must give time of occurrence of these phenomena and estimate their intensity. He is also expected to give special and full information in regard to effects of wind, hail, and thunder-storms, and to report upon specially noted conditions of streams and rivers. It is finally desirable to furnish a general monthly notice on the condition of the principal crops as dependent on the season, and to note the arrival and leaving of birds, the times of first appearance of leaves and flowers, and ripening of fruits, of some of the principal plants. All these observations are to be recorded at the time when made, so as not to obtain erroneous data. Promptly at the close of each month, the volunteer is expected to make a plainly written, accurate copy of his individual record of observations, partly on the monthly blank-sheet furnished and partly on the note-slips furnished in large number, so that each one can be used for one subject only. His report and the note-slips are to be mailed in one of the stamped and addressed envelopes on the first of each month, in order that the report may be of service at the Central Office in the preparation of the monthly Press Bulletin.

As such a record, if expressed in ordinary language, would necessarily be very bulky, and not only difficult to write but also inconvenient to read rapidly, we have adopted from the start the international meteorological symbols, which are as follows:

● Rain.	* Snow.	▲ Hail.
△ Dew.	⊥ Hoar Frost.	∇ Silver Thaw.
≡ Fog.	∞ Haze.	/ Storm (of Wind).
< Lightning.	† Thunder.	⚡ Thunder-storm.
⋄ Northern Light.	♋ Zodiacal Light.	○ Solar Halo.
∩ Lunar Halo.	☾ Lunar Corona.	~ Rainbow.
TB Thunderbolt.	PB Polar Bands.	

If the phenomenon is very faint, a ° follows the symbol. Thus ●°, a slight rain; ∩°, a faint lunar halo.

If the phenomenon is intense, the symbol is followed by v. Thus *v, heavy snow; ⋄v, a brilliant aurora.

If the phenomenon was of ordinary intensity, the symbol only is given.

Full definition of each phenomenon has been given in the Report for 1878, on pages 7 to 12, also in the Report for 1879, on pages 5 to 10. In addition, the following rules are to be observed in regard to the notation of time, date, and the counting of the number of days.

Time is local mean time, given in hours and minutes. P. M. is denoted p. A. M. is abbreviated a, according to international rule.

Thus 5.30 a, stands for 5 hours 30 minutes, A. M.; and 7 h. 29 m. P. M. is written 7.29 p. A *dash* indicates continuance of the phenomenon. Thus * 2-3 p. reads snow-fall from 2 P. M. till 3 P. M. Also ≡ 7a— reads a fog noted at 7 A. M. and continuing, the ending not stated.

To avoid mistakes, the time between noon and 1 P. M. is counted from 0 p. Thus 15 minutes past 12 o'clock, noon, is really 15 minutes past zero, P. M., and should be written 0.15 p. In the same manner the hour from midnight to 1 A. M., will be 0 a; thus 0.45 a, means 45 minutes past midnight.

The *date* is the calendar date, beginning midnight, 0 a of date, and continuing until the following midnight, which is 12 p. of date, or 0 a of next date. A line in the report is exclusively devoted to the date marked at its beginning.

The word *night* should not be used, as it leads to errors in date—when the hour is not well known because too near midnight, the signs a^e and p^s are to be used as follows: a^e, *quite early* on date, soon after midnight, and the early morning hours generally; p^s, *quite late* on date, the late hours of evening of date till midnight.

A day is counted a *rain-day* if 0.01 inch, or more of rain-fall (*i. e.*, rain, melted snow, or hail) fell during the twenty-four hours preceding noon of date.

A day is counted *cloudy*, if it averaged 4-5 of overcast in cloudiness; a day is *clear*, if its cloudiness averaged 1-5 of overcast. Days averaging over 1-5 and less than 4-5 in cloudiness, are counted *fair*, but need not be recorded. As in this service, overcast is represented by 5, overcast represents for three daily observations 15 in the sum of cloudiness; hence a day is counted clear if its sum of cloudiness is equal to 3 or less, and it will be counted cloudy if its sum of cloudiness equals or exceeds 12.

At the Central Station, overcast is marked 10; hence, a clear day has a cloudiness of 6 or less, a cloudy day has a cloudiness of 24 or more.

The blank-form used by volunteers is printed below:

Month.....188..		Station.....																																						
DATE	SKY.			WIND.			PHENOMENA IN SYMBOLS.																																	
	8	12	8	8 a	12 a	8 p	Kind, Degree, Time.																																	
1																																								
2																																								
3																																								
4																																								
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31																																								
MEANS																																								
Means.																																								
*For number of days give Sums not Means.																																								
<table border="1"> <tr> <td>Clear</td> <td>Cloudy</td> <td>Rain-fall</td> <td>Hail</td> <td>Thin, and Lightning</td> <td>North</td> <td>Northeast</td> <td>East</td> <td>Southeast</td> <td>South</td> <td>Southwest</td> <td>West</td> <td>Northwest</td> <td>Calm</td> </tr> <tr> <td colspan="5">NUMBER OF DAYS.*</td> <td colspan="8">NUMBER OF TIMES.</td> </tr> </table>													Clear	Cloudy	Rain-fall	Hail	Thin, and Lightning	North	Northeast	East	Southeast	South	Southwest	West	Northwest	Calm	NUMBER OF DAYS.*					NUMBER OF TIMES.								
Clear	Cloudy	Rain-fall	Hail	Thin, and Lightning	North	Northeast	East	Southeast	South	Southwest	West	Northwest	Calm																											
NUMBER OF DAYS.*					NUMBER OF TIMES.																																			

IOWA WEATHER SERVICE, ORGANIZED AND DIRECTED BY DR. GUSTAVUS HINRICHS, AT IOWA CITY, IOWA.

Signed.....

Volunteer I. W. S.

It cannot be considered strange that many persons who apply to the Central Office, expressing their willingness to act as observers, decline to act when they learn from our circulars what their duties will be even while only preparing themselves as volunteers for the much more extended and laborious duties of volunteer observer. At the same time, in view of the above given mere outline of the work that is to be done in this service without instruments, it will readily be granted that this work must be essential in all meteorological study, and indeed of greater importance than a mere column of thermometer and barometer readings. When it is considered that these phenomena generally are the least extensive geographically, and also embrace the most seriously destructive ones, we doubt not that all will consider the position invariably held by the Iowa Weather Service to be practically both wise and sound.

The following is the list of the volunteers of the Service at present:

NAME.	POST-OFFICE.	COUNTY.
J. A. Wintermute	Shelby	Shelby.
W. H. Smith, M. D.	Shell Rock	Butler.
Ira Brashears	Sanborn	O'Brien.
Julius Riley	Osceola	Clarke.
A. J. Hathaway	Castana	Monona.
George W. Hinckle, M. D.	Grainville	Wayne.
Edward Dale	Sibley	Osceola.
Hiram Thomley	Waldale	Woodbury.
J. H. McLean	Red Oak	Montgomery.
D. H. Witter	Council Bluffs	Pottawattamie.
E. H. Calkins	Burlington	Des Moines.
Jonathan Thatcher	Keosauqua	Van Buren.
Levi Coningors	Libertyville	Jefferson.
Omar Wilson	Brighton	Washington.
J. S. Williams	Eugene	Ringgold.
C. H. Young	St. Charles	Madison.
Edd. R. Guthrie	Hartford	Warren.
H. G. Griffith, M. D.	Burlington	Des Moines.
Miss Edith F. McDill	Afton	Union.
B. F. Garretson	Osceola	Clarke.
Edward Hagemann	Burlington	Des Moines.

The following have also volunteered, but have not yet fulfilled the conditions necessary for enrollment:

NAME.	POST-OFFICE.	COUNTY.
H. J. Davis	Cedar Falls	Black Hawk.
R. P. Speer	Cedar Falls	Black Hawk.
Alexander Peidie	Emmettsburg	Palo Alto.
W. E. Humphreys	Waukeo	Dallas.
G. Wernli	Lemars	Plymouth.
H. O. Bales	Millersburg	Iowa.
W. A. Ross	Dexter	Dallas.
J. D. Lockwood	Mapleton	Monona.
H. W. Waterbury	Fayette	Fayette.
J. N. Muncey	Jesup	Buchanan.
John W. Wright	Knoxville	Marion.

THE VOLUNTEER OBSERVERS.

In from four to ten months the volunteer will have sufficiently mastered the details of the work enumerated in the preceding section to be advanced to the rank of a volunteer observer.

Before his desire to be so ranked can be gratified, it is necessary that he should give the Director of the service proper assurances that the Station will be reasonably permanent in his own charge, and he must also promise that he will earnestly try to find and to train a successor if for any reason he should wish to discontinue the observations or remove from the place. Besides it is necessary that the volunteer have trained a member of his family or some reliable neighbor to attend properly to the observations during any temporary absence or disability.

When these conditions have been complied with, the request of the volunteer will be granted, and his name will be enrolled in the list of VOLUNTEER OBSERVERS of the Service.

The duties of the volunteer observer are the same as those of the volunteer, with the addition of regular instrumental observations. These are, in the order of importance and the succession in which they are taken up: measurement of rain-fall and determination of the temperature of the air; thereafter observation of relative humidity, evaporation, and pressure. The instruments required for this purpose are: Rain-gauge, thermometer in shade, wet bulb thermometer, evaporimeter, and barometer. In addition it is recommend to obtain a wind-vane with force plate soon after the rain-gauge.

With the exception of the barometer, which, contrary to general opinion, is the least important instrument in climatological studies, these instruments will be furnished by the service to such volunteer observers as desire not to procure instruments of their own, upon the following conditions:

The volunteer observer must promise to keep the instruments in good order, and hold them subject to recall by the Director in case of continued incomplete report or discontinuance of observations. Furthermore, the instruments are not to be used in behalf of any other meteorological service but this State Service. When the volunteer observer shall have completed one lustrum, (five years, beginning on 1 or 6,) and furnished the Central Office the corresponding five, fully reduced, yearly report for each instrumental reading for at least the noon observation, the instrument will be considered the property of the observer, except that it shall not be used in behalf of any other service; in case it be so used, it shall be returned to the Central Station.

While these simple and certainly fair rules govern this part of the work of the Service, it has thus far been impossible to enforce them in all cases, a fact very largely owing to the impossibility of proper inspection of stations, to which reference will be made further on.

It must also be borne in mind that instruments are furnished only so far as the means at disposal allow it, and so far as the returns from the stations prove the observer competent to use the same to advantage. In this regard, plainly and well written reports, accurately summed up, are above all necessary. Finally, the instruments are furnished only in the order stated, namely rain-gauge, thermometer with shade, psychrometer (dry and wet bulb thermometers) with shade, evaporimeter.

The first general distribution of instruments was made in early summer. The following gives a list to date:

THERMOMETER WITH SHADE.

OBSERVER.	STATIONS.	COUNTY.
J. J. Pocock	Lemars	Plymouth.
Fred L. Rice	Spirit Lake	Dickinson.
C. W. Jarvis	Emmet	Emmet.
Sidney Smith	Sac City	Sac.
Caleb Brown	Rose Hill	Mahaska.
Mrs. Melissa Lewis	Hamlin	Audubon.
Geo. F. Hard	Atlantic	Cass.
Seth Dean	Glenwood	Mills.
R. R. Hanley	Sidney	Fremont.
J. M. Elder	Concord	Hancock.
Frank E. Landers	Webster City	Hamilton.
C. P. Rogers	Marshalltown	Marshall.
Gregory Marshall	Cresco	Howard.
A. A. Veblen	Decorah	Winneshiak.
C. F. Waldron	Brush Creek	Fayette.
Miss Rachel Larrabee	McGregor	Clayton.
Frank H. Carter	Elkader	Clayton.
Gershon H. Hill	Independence	Buchanan.
Geo. Baur	Winterset	Madison.
James O. Crosby	Garnaville	Clayton.
B. F. Hoyt	Manchester	Delaware.
Joseph Dysart	Dysart	Tama.
Jacob K. Wagner	Blairtown	Benton.
M. M. Moulton	Monticello	Jones.
A. B. Bowen	Maquoketa	Jackson.
Theo. W. Bennett	Crawfordsville	Washington.
Chas Wachsmuth	Burlington	Des Moines.
G. B. Brackett	Denmark	Lee.
Miss Mary Hamilton	Bloomfield	Davis.
Enoch Lewis	Ida Grove	Ida.
O. E. Daniels	Albion	Marshall.
E. T. Preston	Newton	Franklin.
D. Prindale	Fort Dodge	Jasper.
Peter Wuest	Homestead	Webster.
May U. Remley	Anamosa	Iowa.
		Jones.

PSYCHROMETERS WITH SHADE (DRY AND WET BULB THERMOMETER.)

OBSERVER.	STATION.	COUNTY.
M. J. Campbell	Sibley	Osceola.
Charles Rice	Smithland	Woodbury.
Edwin Miller	Grant City	Sac.
A. T. Flickinger	Council Bluffs	Pottawattamie.
James Barr	Algona	Kossuth.
Charles Stryker	Creston	Union.
John C. Wright	Clear Lake	Cerro Gordo.
C. E. Bessey	Ames	Story.
Mrs. Martha A. Goddard	Centerville	Appanoose.
Francis H. Robbins	Waukon	Allamakee.
Thomas M. Irish	Dubuque	Dubuque.
Luke Roberts	Clinton	Clinton.
F. M. Witter	Muscataine	Muscataine.
Conrad Schadt	Amama	Iowa.
George D. Clarke	Fairfield	Jefferson.
A. S. Stuver	Newton	Jasper.
Luther P. Fitch	Charles City	Floyd.
Miss Mary Hamilton	Bloomfield	Davis.

EVAPORIMETERS WITH EXTRA RAIN-COLLECTOR.

OBSERVER.	STATION.	COUNTY.
Miss Anna Hinrichs	Iowa City	Johnson.
A. T. Flickinger	Council Bluffs	Pottawattamie.
C. E. Bessey	Ames	Story.
Francis H. Robbins	Waukon	Allamakee.
Thomas M. Irish	Dubuque	Dubuque.
D. S. Sheldon	Davenport	Scott.
George D. Clarke	Fairfield	Jefferson.
Edwin Miller	Grant City	Sac.

It will readily be understood that the labor of a volunteer observer rapidly increases with the number of instruments he has in charge. For every reading taken must be recorded in his yearly record-book, afterward copied in the monthly report, summed and reduced at least twice, and again copied on the yearly instrumental report.

The plain writing of all numbers, and the accurate summing up of columns, cannot too strongly be insisted upon in work of this character. It is very much to be regretted that our schools, as a rule, pay very little attention to this matter, though it is of equal importance in all vocations where records are to be kept. Even where the hand-writing is elegant, the reading of the same but too often is difficult or uncertain on account of variable forms of the figures entered, or on account of the flourishes disfiguring the same. It may sound odd to refer to to such a matter here, but when thousands of columns of

figures are to be examined monthly, plain and perfectly distinct form, as well as proper size and the entire absence of flourishes, is of great moment. The form of figures printed below in the photo-electrotype of a monthly station report is the one we recommend; it is written by myself, using the Soennecken fluent-writing pen, which almost compels the writer to write plainly, and has the advantage of writing as fast as with pencil and without any pressure whatever, and holding ink sufficient for a monthly column of two places.

The following is the photo-electrotype spoken of, and which serves our observers as a model. It is a reduction to half scale, from my own careful manuscript copy of the observer's report:

Month June 1881 Station Dubuque

DATE	SKY.		WIND.		OBSERVATIONS		DATE	PHENOMENA IN SYMBOLS
	☁	☁	☁	☁	☁	☁		
1	1	1	1	1	1	1	1	
2	2	2	2	2	2	2	2	
3	3	3	3	3	3	3	3	
4	4	4	4	4	4	4	4	
5	5	5	5	5	5	5	5	
6	6	6	6	6	6	6	6	
7	7	7	7	7	7	7	7	
8	8	8	8	8	8	8	8	
9	9	9	9	9	9	9	9	
10	10	10	10	10	10	10	10	
11	11	11	11	11	11	11	11	
12	12	12	12	12	12	12	12	
13	13	13	13	13	13	13	13	
14	14	14	14	14	14	14	14	
15	15	15	15	15	15	15	15	
16	16	16	16	16	16	16	16	
17	17	17	17	17	17	17	17	
18	18	18	18	18	18	18	18	
19	19	19	19	19	19	19	19	
20	20	20	20	20	20	20	20	
21	21	21	21	21	21	21	21	
22	22	22	22	22	22	22	22	
23	23	23	23	23	23	23	23	
24	24	24	24	24	24	24	24	
25	25	25	25	25	25	25	25	
26	26	26	26	26	26	26	26	
27	27	27	27	27	27	27	27	
28	28	28	28	28	28	28	28	
29	29	29	29	29	29	29	29	
30	30	30	30	30	30	30	30	
31	31	31	31	31	31	31	31	

Summed
Total

Average

No. of days

No. of hours

No. of minutes

No. of seconds

No. of tenths

No. of hundredths

No. of thousandths

No. of ten thousandths

No. of hundred thousandths

No. of millionths

No. of billionths

No. of trillionths

No. of quadrillionths

No. of quintillionths

No. of sextillionths

No. of septillionths

No. of octillionths

No. of nonillionths

No. of decillionths

No. of undecillionths

No. of duodecillionths

No. of tredecillionths

No. of quattuordecillionths

No. of quindecillionths

No. of sexdecillionths

No. of septendecillionths

No. of octodecillionths

No. of nineteenthillionths

No. of twentiethillionths

No. of twenty-firstillionths

No. of twenty-secondillionths

No. of twenty-thirdillionths

No. of twenty-fourthillionths

No. of twenty-fifthillionths

No. of twenty-sixthillionths

No. of twenty-seventhillionths

No. of twenty-eighthillionths

No. of twenty-ninthillionths

No. of thirtiethillionths

No. of thirty-firstillionths

No. of thirty-secondillionths

No. of thirty-thirdillionths

No. of thirty-fourthillionths

No. of thirty-fifthillionths

No. of thirty-sixthillionths

No. of thirty-seventhillionths

No. of thirty-eighthillionths

No. of thirty-ninthillionths

No. of fortiethillionths

No. of forty-firstillionths

No. of forty-secondillionths

No. of forty-thirdillionths

No. of forty-fourthillionths

No. of forty-fifthillionths

No. of forty-sixthillionths

No. of forty-seventhillionths

No. of forty-eighthillionths

No. of forty-ninthillionths

No. of fiftiethillionths

No. of fifty-firstillionths

No. of fifty-secondillionths

No. of fifty-thirdillionths

No. of fifty-fourthillionths

No. of fifty-fifthillionths

No. of fifty-sixthillionths

No. of fifty-seventhillionths

No. of fifty-eighthillionths

No. of fifty-ninthillionths

No. of sixtiethillionths

No. of sixty-firstillionths

No. of sixty-secondillionths

No. of sixty-thirdillionths

No. of sixty-fourthillionths

No. of sixty-fifthillionths

No. of sixty-sixthillionths

No. of sixty-seventhillionths

No. of sixty-eighthillionths

No. of sixty-ninthillionths

No. of seventiethillionths

No. of seventy-firstillionths

No. of seventy-secondillionths

No. of seventy-thirdillionths

No. of seventy-fourthillionths

No. of seventy-fifthillionths

No. of seventy-sixthillionths

No. of seventy-seventhillionths

No. of seventy-eighthillionths

No. of seventy-ninthillionths

No. of eightiethillionths

No. of eighty-firstillionths

No. of eighty-secondillionths

No. of eighty-thirdillionths

No. of eighty-fourthillionths

No. of eighty-fifthillionths

No. of eighty-sixthillionths

No. of eighty-seventhillionths

No. of eighty-eighthillionths

No. of eighty-ninthillionths

No. of ninetiethillionths

No. of ninety-firstillionths

No. of ninety-secondillionths

No. of ninety-thirdillionths

No. of ninety-fourthillionths

No. of ninety-fifthillionths

No. of ninety-sixthillionths

No. of ninety-seventhillionths

No. of ninety-eighthillionths

No. of ninety-ninthillionths

No. of one hundredthillionths

No. of one hundred-firstillionths

No. of one hundred-secondillionths

No. of one hundred-thirdillionths

No. of one hundred-fourthillionths

No. of one hundred-fifthillionths

No. of one hundred-sixthillionths

No. of one hundred-seventhillionths

No. of one hundred-eighthillionths

No. of one hundred-ninthillionths

No. of one hundred-tenthillionths

No. of one hundred-eleventhillionths

No. of one hundred-twelfthillionths

No. of one hundred-thirteenthillionths

No. of one hundred-fourteenthillionths

No. of one hundred-fifteenthillionths

No. of one hundred-sixteenthillionths

No. of one hundred-seventeenthillionths

No. of one hundred-eighteenthillionths

No. of one hundred-nineteenthillionths

No. of one hundred-twentiethillionths

No. of one hundred-twenty-firstillionths

No. of one hundred-twenty-secondillionths

No. of one hundred-twenty-thirdillionths

No. of one hundred-twenty-fourthillionths

No. of one hundred-twenty-fifthillionths

No. of one hundred-twenty-sixthillionths

No. of one hundred-twenty-seventhillionths

No. of one hundred-twenty-eighthillionths

No. of one hundred-twenty-ninthillionths

No. of one hundred-thirtiethillionths

No. of one hundred-thirty-firstillionths

No. of one hundred-thirty-secondillionths

No. of one hundred-thirty-thirdillionths

No. of one hundred-thirty-fourthillionths

No. of one hundred-thirty-fifthillionths

No. of one hundred-thirty-sixthillionths

No. of one hundred-thirty-seventhillionths

No. of one hundred-thirty-eighthillionths

No. of one hundred-thirty-ninthillionths

No. of one hundred-fortiethillionths

No. of one hundred-forty-firstillionths

No. of one hundred-forty-secondillionths

No. of one hundred-forty-thirdillionths

No. of one hundred-forty-fourthillionths

No. of one hundred-forty-fifthillionths

No. of one hundred-forty-sixthillionths

No. of one hundred-forty-seventhillionths

No. of one hundred-forty-eighthillionths

No. of one hundred-forty-ninthillionths

No. of one hundred-fiftiethillionths

No. of one hundred-fifty-firstillionths

No. of one hundred-fifty-secondillionths

No. of one hundred-fifty-thirdillionths

No. of one hundred-fifty-fourthillionths

No. of one hundred-fifty-fifthillionths

No. of one hundred-fifty-sixthillionths

No. of one hundred-fifty-seventhillionths

No. of one hundred-fifty-eighthillionths

No. of one hundred-fifty-ninthillionths

No. of one hundred-sixtiethillionths

No. of one hundred-sixty-firstillionths

No. of one hundred-sixty-secondillionths

No. of one hundred-sixty-thirdillionths

No. of one hundred-sixty-fourthillionths

No. of one hundred-sixty-fifthillionths

No. of one hundred-sixty-sixthillionths

No. of one hundred-sixty-seventhillionths

No. of one hundred-sixty-eighthillionths

No. of one hundred-sixty-ninthillionths

No. of one hundred-seventiethillionths

No. of one hundred-seventy-firstillionths

No. of one hundred-seventy-secondillionths

No. of one hundred-seventy-thirdillionths

No. of one hundred-seventy-fourthillionths

No. of one hundred-seventy-fifthillionths

No. of one hundred-seventy-sixthillionths

No. of one hundred-seventy-seventhillionths

No. of one hundred-seventy-eighthillionths

No. of one hundred-seventy-ninthillionths

No. of one hundred-eightiethillionths

No. of one hundred-eighty-firstillionths

No. of one hundred-eighty-secondillionths

No. of one hundred-eighty-thirdillionths

No. of one hundred-eighty-fourthillionths

No. of one hundred-eighty-fifthillionths

No. of one hundred-eighty-sixthillionths

No. of one hundred-eighty-seventhillionths

No. of one hundred-eighty-eighthillionths

No. of one hundred-eighty-ninthillionths

No. of one hundred-ninetythillionths

No. of one hundred-ninety-firstillionths

No. of one hundred-ninety-secondillionths

No. of one hundred-ninety-thirdillionths

No. of one hundred-ninety-fourthillionths

No. of one hundred-ninety-fifthillionths

No. of one hundred-ninety-sixthillionths

No. of one hundred-ninety-seventhillionths

No. of one hundred-ninety-eighthillionths

No. of one hundred-ninety-ninthillionths

No. of one hundred-millionth

In addition to the observations recorded on this blank, many volunteer observers also fill the blank "Form C" printed below; in the last column evaporation is generally entered. Finally, some observers also use the "Form D," similar to "C," for the record of maximum and minimum temperatures.

DATE.	OBSERVATIONS AT 8 A. M.			OBSERVATIONS AT 8 P. M.		
	Press.	Temp.	Humid.	Press.	Temp.	Humid.
	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						
I						
II						
III						
8 A.						
MEANS						
8 P.						
Mon						

IOWA WEATHER SERVICE, ORGANIZED AND DIRECTED BY DR. GUSTAVUS HINNICH, AT IOWA CITY, IOWA.

FIRST DECADE

SECOND DECADE

THIRD DECADE

MONTHLY MEANS

Form C.]
Signed,

Volunteer Observer I. W. S.

It will also be seen that if the volunteer observer makes observations filling the Forms "A," "B" [see photo-electrotype copy], "C" and "D," and in addition sends a number of "Note Slips," with special verbal notes on more important phenomena, as indicated for volunteers, his entire monthly report is the result of much labor, and gives data of great permanent value. It will also be readily admitted that the filing, copying, recording and studying of a number of such reports, which has to be done by the Director during the first week of each month, is a work of great magnitude.

PENTADE STATIONS.

In order to enable the Director to follow the course of the weather throughout the State more closely than monthly reports will allow, he has selected twelve stations, the volunteer observers at which furnish him, on postal card blanks, a report for each five days of each month; namely, for the 1 to 5, 6 to 10, 11 to 15, 16 to 20, 21 to 25, and 26 to close of month. This makes seventy-six pentade reports per month. The following is the blank form used for the fifth pentade. The others differ only in the printed dates.

Month of _____, 1881.

Date	SKY.			WIND.			AT NOON.				PHENOMENA. Kind, Degree, Time.	
	8	12	8	8a	12a	Sp	Press	Temp	Humid	Rain		
21												
22												
23												
24												
25												

Description of Phenomena.

These pentade card reports are furnished by the pentade station observers in addition to their full monthly reports. The following is the list of these observers, which, by removal from the State, by protracted sickness, by death, and by other causes, has changed somewhat in time.

PENTADE STATIONS.

During Last Months of 1879, until September, 1880.

No.	STATION.	OBSERVER.	REMARKS.
1	Sibley	M. J. Campbell	
2	Smithland	Charles Rice	
3	Council Bluffs	A. T. Flickinger	
4	Fort Dodge	Solon D. Prindle	
5	Earlham	Abijah Johnson	
6	Nashua	William Perrin	
7	Newton	A. S. Stuver	
8	Centerville	Thomas M. Goddard	
9	Waukon	Francis H. Robbins	
10	Amama	Conrad Schade	
11	Mt. Pleasant	Hiram M. Bassett	
12	Dubuque	Thomas M. Irish	
13	Davenport	D. S. Sheldon	

PENTADE STATIONS SINCE SEPTEMBER, 1880.

No.	STATION.	OBSERVER.	DIVISION OF STATE.
1	Sibley	M. J. Campbell	Western Iowa.
2	Smithland	Charles Rice, M. D.	Western Iowa.
3	Atlantic	George F. Hard	Western Iowa.
4	Algona	James Barr, M. D.	Northern Iowa.
5	Charles City	Luther P. Fitch, M. D.	Northern Iowa.
6	Waukon	Francis H. Robbins	Northern Iowa.
7	Newton	A. S. Stuver	Middle Iowa.
8	Amama	Conrad Schade	Middle Iowa.
9	Dubuque	Thomas M. Irish	Middle Iowa.
10	Centerville	Mrs. Martha F. Goddard	Southern Iowa.
11	Mt. Pleasant	Hiram M. Bassett, M. D.	Southern Iowa.
12	Davenport	D. S. Sheldon	Southern Iowa.

As Station 2, Grant City, Edwin Miller, V. O., served from May to August, 1881, while observer at Smithland was in New York. Station Osage, Professor George D. Pettingill, has been taken as No. 5 since January, 1881, because it was impossible for Dr. Fitch to find the time necessary for making these numerous additional reports; namely, seventy-two per year.

These pentade reports are printed in full in the report of the Service, by dates.

The following is a list of the volunteer observers who have been doing duty during the past two years. The names printed in capitals mark observers having completed one lustrum of observations:

VOLUNTEER OBSERVERS.

NAME.	STATION.	COUNTY.
Guy P. Arnold	Garden Grove	Decatur.
JAMES BARR, M. D.	ALGONA	Kossuth.
Hiram M. Bassett, M. D.	Mt. PLEASANT	Henry.
Geo. Baur	Winterset	Madison.
A. H. Beales	Waverly	Bremer.
Theo. W. Bennett, M. D.	CRAWFORDSVILLE	Washington.
C. E. Bessey, Prof.	AMES	Story.
A. B. BOWEN, M. D.	MAQUOKETA	Jackson.
Col. Gust. B. Brackett	Denmark	Lee.
Caleb Brown, M. D.	Rose Hill	Mahaska.
A. D. Bundy, M. D.	St. Ansgar	Mitchell.
M. J. Campbell	Sibley	Osceola.
Robt. M. Carothers	Vinton	Benton.
Frank H. Carter	Elkader	Clayton.
E. W. Clarke, M. D.	Grimell	Poweshiek.
Geo. D. CLARKE	FARFIELD	Jefferson.
Alonzo Collin, Prof.	Mt. Vernon	Linn.
Henry H. Colt	Nora Springs	Floyd.
Geo. H. Couch	GRAND JUNCTION	Greene.
James O. Crosby	Garnaville	Clayton.
D. W. CROUSE, M. D.	WATERLOO	Black Hawk.
O. E. Daniels	Hampton	Franklin.
Seth Dean	Glenwood	Mills.
Joseph Dyaart	Dysart	Tama.
J. M. Elder	Concord	Hancock.
LUTHER P. FITCH, M. D.	Charles City	Floyd.
Frank A. Fletcher	Iowa City	Johnson.
A. T. Flickinger	Council Bluffs	Pottawattamie.
Chas. H. Goddard	Swan Lake	Turner Co., D. T.
Mrs. Martha F. Goddard	Centerville	Appanoose.
H. L. Grant	Waverly	Bremer.
Jas. E. Gray	Columbus City	Louisa.
Miss Mary Hamilton	Bloomfield	Davis.
Richard H. Hanley M. D.	Stidney	Fremont.
Geo. F. Hard	Atlantic	Cass.
James Harkness	Hesper	Winnebuck.
Wm. H. Holmick	Columbus City	Louisa.
Gershom H. Hill, M. D.	INDEPENDENCE	Buchanan.
T. H. Hollister	Eldora	Hardin.
CERTIS HADGHTON	BROOKVILLE	Jefferson.
Brooks F. Hoyt, B. Ph.	Manchester	Delaware.
H. C. HUSTMAN, M. D.	OSKALOOSA	Mahaska.
MISS ANNA HINCHES	IOWA CITY	Johnson.
G. R. Irish	IOWA CITY	Johnson.
TROS. M. IRISH, PROF.	DUBUQUE	Dubuque.
C. W. Jarvis	Emmet and Swan Lake	Emmet.
Jos. E. Jones	Stellapolis	Iowa.
Abijah Johnson, M. D.	EARLHAM	Madison.
Henry W. Knight	Nashua	Chickasaw.
Frank E. Landers	Webster City	Hamilton.
MISS AUGUSTA LARRABEE	CLEMONT	Fayette.
MISS RACHEL LARRABEE	MCGREGOR	Clayton.

*Reads the River Gauge daily, from the Centennial Bridge over the Iowa River, west of Iowa City.

VOLUNTEER OBSERVERS—CONTINUED.

NAME.	STATION.	COUNTY.
ENOCH LEWIS, M. D.	ALBION	Marshall.
Mrs. Melissa Lewis	Hamlin	Audubon.
Theodore Marks	Hopkinton	Delaware.
GREGORY MARSHALL	CRESCO	Howard.
EDWIN MILLER	GRANT CITY	Sac.
S. C. Mitchell	Leon	Decatur.
L. S. Mitchell	Brush Creek	Fayette.
Giles C. Moorehead, M. D.	Ida Grove	Ida.
M. M. MOULTON	Monticello	Jones.
C. Narvesen, Prof.	Decorah	Winneschik.
Geo. D. Pettigill, Prof.	Osgage	Mitchell.
C. G. Perkins	Onawa	Monona.
Chas. H. Philippott	New London	Henry.
J. J. Pocock	Lemars	Plymouth.
E. S. PRESTON	NEWTON (near)	Jasper.
D. Prindle	FORT DODGE	Webster.
OLON D. PRINDLE	FORT DODGE	Webster.
Mrs. MAY U. REMLEY	ANAMOSA	Jones.
J. W. Replogle	Hampton	Franklin.
F. Reppert	Muscataine	Muscataine.
Thos. Rigg, M. D.	TIPTON	Cedar.
Chas. Rice, M. D.	Smithland	Woodbury.
Fred. L. Rice	Spirit Lake	Dickinson.
FRANCIS H. ROBBINS	WAUKON	Allamakee.
Lake Roberts	Clinton	Clinton.
C. P. Rogers, PROF.	Marshalltown	Marshall.
J. F. Sanborn	Tabor	Fremont.
OSBRAD SCHAFF	AMASA	Iowa.
D. S. SHELTON, Prof.	DAVENPORT	Scott.
SIDNEY SMITH	SAC CITY	Sac.
T. V. Smith	Farley	Dubuque.
Jacob F. Stern	Logan	Harrison.
CHAS. S. STRYKER	CRESTON	Union.
A. S. Stuver	Newton	Jasper.
Andrew A. Veblen, Prof.	Decorah	Winneschik.
CHAS. WACHSMUTH	BURLINGTON	Des Moines.
JACOB K. WAGNER, M. D.	Blairstown	Benton.
C. F. Waldron, M. D.	Brush Creek	Fayette.
Wm. Ward	Wesley	Kossuth.
C. L. Watrous	Des Moines	Polk.
Chas. L. Werner	South Amara	Iowa.
G. Z. Whitey	Hampton	Franklin.
JAMES S. WHITTAKER	Corydon	Wayne.
F. M. WITTER, PROF.	MUSCATINE	Muscataine.
Geo. H. Wright	Sioux City	Woodbury.
John C. Wright, M. D.	Clear Lake	Cerro Gordo.
Peter Wuest	Homestead	Iowa.

Volunteer observers having furnished full reports of rain-fall for an entire lustrum in this service from 1876 to 1880, inclusive, so that the mean rain-fall of their station can be determined, are distinguished in the above list by having their name and that of the

station printed in CAPITALS. If at any station the observers changed, but the results of the station are complete, the name of the station only is printed in capitals.

From the above list the service has lost by death SOLON D. PRINDLE and JAMES HARKNESS. Brief biographies of these very faithful and efficient observers were published in the *Iowa Weather Bulletin* for September, 1880. Several observers have removed from the State; so notably, Dr. Johnson, of Earlham, who removed to Colorado; Superintendent H. L. Grant, of Waverly, who removed to Peoria, Illinois; and Professor A. A. Veblen, of Decorah, who removed to Minnesota.

It is difficult to outsiders to conceive how much the work at this office is increased by tardiness of report, and by neglect of observers to train competent successors before they leave the service. May the Director express the hope that both these causes will gradually diminish in magnitude, as the work of the Service becomes better understood.

I cannot close this list of observers without giving expression to the fact that the volunteer observers have done valuable work for our State in furnishing reliable data to the climatological history of the same.

CROP REPORTERS.

During the year 1880 regular crop reports were received, and the results published in the monthly Press Bulletins of the Service. These reports were the first regular monthly crop reports ever obtained from independent sources in Iowa. They would have been continued in 1881, but for the fact that the Agricultural Society appropriated money* for this purpose, and thus relieved us of this great extra labor. The society has been able to secure many more reporters, but the scale has been different, and no report for divisions of the State have thus far been issued; but the State has been summed as a whole. It is, therefore, impossible to compare the condition of the crops with the principal determining cause, the condition of the weather in a given territory.

The following are the directions under which our crop reporters have done their work:

"The crop reporter will, during the growing season, watch the

*This appropriation is, I understand, \$600. The total appropriation for our weather service is only \$1,000 per annum.

progress of each crop in his township, and in neighboring townships, so far as possible. He will be doubly attentive toward the close of each month, so as to be able to express a pretty well-founded estimate on the condition of each crop as compared to the general average condition of the same crop in the same neighborhood for the past years. If the crop is about equal to this normal or standard condition, not differing more than five per cent either way, enter the word *good* opposite the name of the crop. If, however, the crop appears to be about ten per cent *above* the average season, write the words *very good* opposite the name of that crop; use the same words when your estimate runs from six to twelve per cent above average or good. If the crop be as much short of average, call it *fair* in the report. A crop which is about one-sixth above—that is, from thirteen to twenty per cent high—is reported *excellent*; if as far below average, it is marked *poor*. If a crop appears throughout the neighborhood over twenty per cent above its average condition for the season, it may be marked *abundant*; if over twenty per cent below average the crop should be reported as follows:

"*Very poor*, if only three-fourths to two-thirds of an average crop; *partial failure*, if only about half an average crop; and *failure*, if only about one-fourth of an average crop is apparent.

"Each reporter must make up his mind for himself, as to which one of these words will most properly apply to each given crop reported by him; he should then simply enter this particular *word*, plainly written, without any kind of verbal addition or explanation. If the crop reporter, being experienced and on the ground, cannot choose the proper word, it will be impossible to do so for him here. The proper estimation or valuation of the crop rests necessarily *entirely* upon him.

"The following table may serve for ready reference. A crop is reported—

"*Abundant*, if it is *over* one-fifth above average.

"*Excellent*, if it is about one-seventh above average.

"*Very good*, if it is about one-tenth above average.

"*Good*, if it is about equal to average.

"*Fair*, if it is about one-tenth *below* average.

"*Poor*, if it is about one-fifth *below* average.

"*Very poor*, if it is from one-fourth to one-third *below* average.

"*Partial failure*, if it is only about half an average.

"*Failure*, if it is only about one-fourth of an average crop.

"REMARKS.—In the blanks for remarks, enter briefly, in plain and legible handwriting, any additional notes on the crops, and special effects of weather and insects on the same—first giving favorable, then unfavorable, influences, if any noted. Be as brief and clear as if writing a telegram.

"In giving the condition of the fruits, use the same scale of words, and name the fruits of the season reported.

"The crop reporter should invariably *sign* his name to his report, for without this signature it will be impossible to tell where the report came from; the number stamped at the top of the card, after the word "from," indicates merely the county. Also, invariably write the name of the *MONTH for noon of the last day of which the report is drawn up*.

"It is exceedingly important that the report should be *received* by me on or before the third of each following month; hence, it should be mailed *on* the last day of the month, if possible.

"Crop Reporters of the Iowa Weather Service receive the Monthly Bulletin of the Service free; if they receive this Bulletin already, in any other capacity than as crop reporters, the Bulletin will be sent to any address given at the time of volunteering. We cannot change the address afterward.

"A small supply of extra postal cards is furnished for additional reports, notes of storms, and other meteorological phenomena; I shall also be pleased to receive more extended information by letter. It is hoped that crop reporters will take a pride in being prompt, and will aid in developing the Service by interesting additional crop reporters and observers.

"The condition of the crops at any time is, to a very large extent, a measure of the *sum* of the atmospheric conditions of the current growing season. For this reason, we have volunteered to conduct this work until the State shall have made proper special provisions for the same.

"The following report, transcribed from an actual report of last year, may serve as an example to new crop reporters:

I. W. S. CROP REPORT

19-1

From Union county on the last day of July, 1879.

SCALE IN WORDS.	CROP.	CONDITION.
Abundant.	Corn.....	Very good.
Excellent.	Winter wheat.....
Very good.	Spring wheat.....	Fair.
Good.	Oats.....	Poor.
Fair.	Hay.....	Fair.
Poor.	Pasture.....	Poor.
Very poor.		
Partial failure.		
Failure.		
As defined in the directions.		

REMARKS.—Dry; good for putting up hay and grain; too dry for grass and corn. Wind-storm of 28th blew down corn. Corn worms in roots doing damage.

Fruit:
Signed:

CHAS. S. STRIKER, *Crop Reporter, I. W. S.*

We expect to publish a few of our crop maps of Iowa for comparison with the weather maps.

The following is the list of crop reporters who have served during the year 1880:

LIST OF CROP REPORTERS.

NAME.	POST-OFFICE.	COUNTY.
J. A. Alexander.....	Crawfordsville.....	Washington.
G. A. Appelman.....	Clermont.....	Fayette.
P. T. Bailey.....	Sibley.....	Osceola.
Geo. Baur.....	Winterset.....	Madison.
F. F. Beebe.....	Beebetown.....	Harrison.
C. E. Bessey.....	Ames.....	Story.
D. A. Blanchard.....	Lewisburg.....	Wayne.
Caleb Brown.....	Rose Hill.....	Mahaska.
David F. Bruner.....	Toledo.....	Tama.
Wm. Bowman.....	Maquoketa.....	Jackson.
W. K. Bowman.....	Waverly.....	Bremer.
W. H. Brainerd.....	Grinnell.....	Poweshiek.
A. A. Buckman.....	Harlan.....	Shelby.
A. D. Bundy.....	St. Ansgar.....	Mitchell.
J. E. L. Carey.....	Tipton.....	Cedar.
E. B. Chase.....	Algona.....	Kossuth.
P. B. Clark.....	Taber.....	Fremont.
Henry H. Colt.....	Nora Springs.....	Floyd.
Geo. H. Couch.....	Grand Junction.....	Greene.
B. F. Clayton.....	Macedonia.....	Pottawattamie.
Seth Doant.....	Glenwoodia.....	Mills.
Eli E. Dotson.....	Colfax.....	Jasper.
Joseph Dysart.....	Dysart.....	Tama.
J. M. Elder.....	Concord.....	Hancock.
Thos. J. Evans.....	Stellapolis.....	Iowa.
S. A. French.....	Faulkner.....	Franklin.
M. B. Frisbie.....	Walnut.....	Pottawattamie.
J. E. Gray.....	Columbus City.....	Louisa.
W. F. Hadley.....	Winterset.....	Madison.
W. J. Hammond.....	Guthrie Center.....	Guthrie.
J. J. Hamilton.....	Bloomfield.....	Davis.
Ed. Hartsack.....	Clarion.....	Wright.
A. J. Hathaway.....	Castana.....	Monona.
Geo. Hayes.....	Clear Lake.....	Cerro Gordo.
Gershon H. Hill.....	Independence.....	Buchanan.
Adam Hirn.....	Amann.....	Iowa.
B. F. Hoyt.....	Manchester.....	Delaware.
James Hughes.....	Centerville.....	Appanoose.
R. W. Humphrey.....	Charles City.....	Floyd.
M. L. Ink.....	Mt. Vernon.....	Linn.
G. R. Irish.....	Iowa City.....	Johnson.
C. W. Jarvis.....	Emmet.....	Emmet.
W. W. Jones.....	Alden.....	Hardin.
J. R. Kenyon.....	New Hampton.....	Chickasaw.
Frank Landers.....	Webster City.....	Hamilton.
Frank Larrabee.....	McGregor.....	Clayton.
Chas. W. Law.....	Davenport.....	Scott.

CROP REPORTERS—CONTINUED.

NAME.	POST-OFFICE.	COUNTY.
J. W. Leake	Clinton	Clinton.
Mrs. Melissa Lewis	Hamlin	Audubon.
B. S. Lauthan	Toledo	Tama.
A. T. McCargar	Spencer	Clay.
R. McColman	Maple Grove	Madison.
Robert W. McGee	Ida Grove	Ida.
S. P. McNeill	Decatur Grove	Decatur.
Samuel McNutt	Muscabine	Muscabine.
Theodore Marks	Hopkinton	Delaware.
Gregory Marshall	Cresco	Howard.
J. Merchant	Atlantic	Cass.
M. H. Merrill	Decomb	Winneshiek.
Edwin Miller	Grant City	Sac.
N. F. Miller	Knoxville	Marion.
S. C. Mitchell	Leon	Decatur.
D. M. Moniger	Albion	Marshall.
B. Moore	New York	Wayne.
H. J. Moore	Newell	Buena Vista.
O. A. Moore	Lamars	Plymouth.
M. M. Moulton	Monticello	Jones.
Theo. W. Parker	Des Moines	Polk.
G. D. Pattengill	Osage	Mitchell.
Charles Paulk	Waukon	Allamakee.
J. A. Perkins	Cedar Rapids	Linn.
William Perrin	Nashua	Chickasaw.
S. H. Pettibone	Algona	Kossuth.
C. H. Philpot	New London	Henry.
C. C. Platter	Red Oak	Montgomery.
George Rae	Dow City	Crawford.
Ransom Brothers	Farley	Dubuque.
Julius Riley	Osceola	Clarke.
S. G. Rogers	Logan	Harrison.
Lysander S. Sackett	Garnaville	Clayton.
John Sax	Primrose	Lee.
A. B. Scott	Fairfield	Jefferson.
L. W. Scott	Hesper	Winneshiek.
E. H. Smith	Dubuque	Dubuque.
Sidney Smith	Sac City	Sac.
W. G. Smith	Lamoiville	Marshall.
David Stanton	Earlham	Madison.
T. E. Stevens	Mt. Pleasant	Henry.
S. Stewart	Oakley	Lucas.
Jesse K. Strawbridge	Iowa City	Johnson.
W. Sutherland	Estherville	Emmet.
C. S. Striker	Creston	Union.
Thomas S. Taylor	Denmark	Lee.
Hiram Thornley	Wolftale	Woodbury.
F. A. Tiedemann	Pleasant Grove	Des Moines.
A. P. Walker	Solon	Johnson.
J. W. Wallace	Hampton	Franklin.
L. W. Waugh	Spirit Lake	Dickinson.
A. J. Westbrook	Newton	Jasper.
C. Whittemore	Kniffin	Wayne.
James Wood	Anamosa	Jones.

CORRESPONDENTS.

The number of correspondents of the Service is very great. We receive information from many quarters, and are often asked for information not only concerning our immediate work, but about many other things. The great extent of this correspondence is very burdensome, and much has been left unanswered simply because it was impossible to do otherwise.

However, letters descriptive of meteorological occurrences, if brief and to the point, and plainly written, will always be welcome, and their receipt will be promptly acknowledged by card. To more completely gather this class of information, it is proposed to organize a body of regular correspondents for this purpose, mainly on the basis of the above list of crop reporters, whose work was discontinued early this summer.

STUDENTS IN METEOROLOGY.

The efficiency of the Service implies that volunteers and volunteer observers are, to a considerable extent, studying practical meteorology. In this sense our Service is, no doubt, a great school, the influence of which will be felt in due time.

In addition, we have at the State University a small class in meteorology during each spring term. This class is fully instructed in the observation of phenomena, in the ordinary instrumental observations, and in many of the processes of reduction and discussion that may be classed as office-work in meteorology.

The following is a list of these classes:

Frank Bond, Fred. Bond, Frank Buerckle, A. Dean Robinson, and G. S. Trowbridge, in 1879.

Geo. K. Reeder, of Cedar Rapids, and August L. Schricker, ofavenport; in 1880.

Miss Grace Hebard, of Johnson, and Messrs. Will E. Crane, of Cerro Gordo, Alberto A. Ladd, of Clayton, Geo. L. Leslie, of Muscatine, and Fred O. Newcomb, of Butler county, during the spring of 1881.

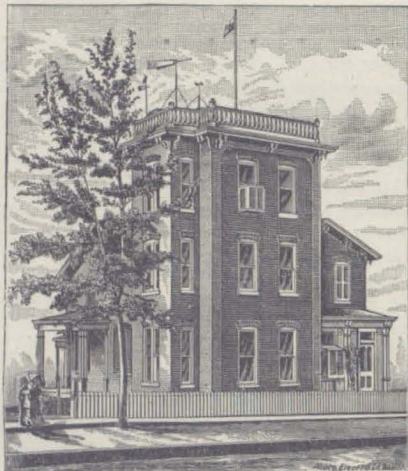
The work of permanent value done by the class of 1880 was the reduction of the mean daily temperature at Iowa City from the observations of Prof. T. S. Parvin during the ten years, 1861-1870; the values being taken from his original record.

The class of 1881 has in a like manner reduced the two o'clock observations of Prof. Parvin, made during the same period of years.

Opportunities for practical instruction in this work are exceedingly rare in this country.

CENTRAL STATION.

The act of the Seventeenth General Assembly of Iowa, establishing the Central Station and appointing the Director of the Iowa Weather Service, did not appropriate means for the erection of such an institution, nor give any compensation to the Director, whose very extensive duties were defined by the same act. But the chief institution of the meteorological system of a great State cannot be crowded into a spare-room. The problem of providing the necessary room was very pressing even during the first year of the Service as a State institution. During the summer months of the year 1879 the Director, therefore,



had erected a three-story structure in the entering angle of his residence; the two upper stories and the flat roof or terrace of this structure were set apart for the use of the Service, and have been so occupied since September, 1879. But the growth of the Service has required two additional rooms to be devoted to this purpose, as well as a small hall, making, in all, four rooms, a fine terrace and a hall so used; that is, one room more than the entire addition erected in 1879, and represented as seen from the northeast in the cut here inserted. It may

not be improper to state that in furnishing this Central Station to the State Service the Director has, by his labor in other fields, to earn annually at least \$150 to meet the expenses which this institution necessitates.* Is not this burden too much for a citizen without fortune, and will it not be growing heavier as he increases in age?

On the roof or terrace of this building are the instruments which require full exposure, such as wind-vanes, wind force plate, Robinson's anemometer, insolation thermometer, radiation thermometer, rain-gauge, evaporimeter, and the like; also, a flag-staff for the display of flag and lantern signals. Besides, this terrace is the place for observation of sun-spots, and of all general meteorological phenomena, as it furnishes a fine view of the entire landscape and a free view of the sky, the building standing near the edge of the bluff east of the Iowa River.

The room immediately below this terrace is the meteorological *observatory* proper. The windows furnish a fine view of the sky in all directions, and an arrow on the ceiling marks the direction of the wind. Standard mercurial barometers and aneroids give the pressure of the air, while temperature and humidity are observed on a full set of standard thermometers, a psychrometer and an improved hair-hygrometer in the case attached to the east window of the north wall. Here are also many additional instruments, and meteorological collections have been begun, such as wind-worn and polished rocks, specimens of wood showing the effects of tornadoes and of lightning and especially a fine collection of meteorites from all parts of the globe. It is hoped that the State in a near future will provide the necessary means for self-registering instruments, for which an excellent installation can be obtained in this observatory.

The terrace and the observatory just described complete the CENTRAL STATION, as this term is generally used; but in the act referred to this term is made to include also what technically is known as the CENTRAL OFFICE; namely, "the chief office intrusted by the government with the management, collection, and publication of the meteorological observations of the country," here the State of Iowa.† Our Central OFFICE proper occupies the room immediately below the Observa-

*The amount of interest actually paid is \$120; increased taxes and heating are certainly over \$30. No reference is had to the furniture or to the large number of instruments and appliances used exclusively for this State work.

†Report of the Permanent Committee of the First International Meteorological Congress at Vienna, for the year 1874.—London, 1875, page 67.

tory; south of it, in the old part of our dwelling, is a hall with a small meteorological REFERENCE LIBRARY and filing cases containing parts of reports, ready or nearly ready for the State Printer. East of this hall is a room containing the great file of all STATION REPORTS in filing cases, the stock of blanks of all kinds, and the stock of instruments for stations; also, electrotypes and photo-electrotypes of maps, and files of meteorological publications from all parts of the world. A room to the west of this hall contains the stock of publications of the Service not yet distributed, and serves as MAILING ROOM and as office for the clerk. All of these rooms are very crowded.

The most valuable property in these rooms is the great file of OBSERVATORY STATION REPORTS. The original reports of each month are in a single filing case, in which the individual reports are arranged in the same order in which the stations are numbered in the "Summary of all Stations" of pages 6 and 7 of each monthly report published. These cases are arranged in the order of time, so that the original report of any station for any given month can be instantly produced for reference or study. This file contains now nearly six thousand full monthly reports, representing about one hundred and eighty thousand days of observation. The pentade reports and descriptive note are filed in the same manner in other filing cases, largely increasing the number of meteorological documents above the figure of reports just given.

Another interesting feature is the stock of BLANKS for observers, Central Station and Central Office; the number of forms in actual use is very considerable, and represents in the course of a year a large outlay from the small appropriation at disposal. Would it not be well to furnish the Weather Service with blanks and all other stationery direct by the proper State authority, without drawing for this purpose upon the special appropriation?

The work done in the mailing room is very considerable, averaging over one thousand separate parcels a month, or a quarter-hundred thousand during the biennial period. All parcels are very carefully wrapped and plainly addressed.

OFFICE PRINTING, by means of the electric pen and duplicating press, has been much reduced; also, hektograph process is but little used now.

THE TESTING OF INSTRUMENTS, especially thermometers, represents a considerable amount of work. As the means at disposal do not allow the purchase of high-priced instruments, suitable instruments are by test selected from cheaper sources. However, the instruments actually

sent out to observers compare, on account of this selection, favorably in their working with instruments used elsewhere.

The subject of CORRESPONDENCE has been referred to above. It is simply impossible to attend to all that is wanted in this line without seriously neglecting work which is essential to the very continuance of the Service. It should never be forgotten that in this work there is no cessation; every day brings its load of facts and data which have to be properly classified, recorded and disposed of.

In order to make the kind and magnitude of the common work required to be done at the Central Office more generally understood, it may be best to indicate what is necessary to prepare manuscript of one number of the Monthly Bulletin of the Service.

On the first of each month, the very full record kept at the observatory of the Central Station is transcribed upon special blanks, four sheets quarto; then all columns are summed up and checked. This prepares the manuscript of four pages of each monthly report, precisely as printed on the pages 2, 3, 4 and 5 of each monthly number. The careful copying, and the summing up of two hundred columns of figures, ten in height each, constitute quite a job. In addition, maxima and minima have to be sought, wind directions have to be separated and summed, and number of days have to be counted, before the summary of the observation of the Central Station is complete. Thereafter the decade means, and the monthly means obtained therefrom, are recorded in full, first in the order in which they occur, that is forming great tables of the year. The pages printed on pages 210-216 in the Report for 1878 may serve as an example; in each fourth quarterly number of the Report these seven tables will be found. Thereafter all these values are entered in another record, which gives the values for each period in the consecutive years, so as to enable a comparison to be made for each single decade and for the entire month as to the different years. A very brief extract of the monthly tables of this kind is printed on the second page of each monthly bulletin, and also on the eighth page of each monthly Report for 1881. By comparing these values with the *means* for many years of previous observation, it will be seen whether the given period is warm or cold, wet or dry, and to what extent any element or the weather was above or below the normal value. All this work was necessary to obtain the few introductory lines of the Press-Bulletin of the month, expressive of the general character of the month.

While this work has been going on at the Central Office, the *station*

reports of the volunteer observers have been coming in with every mail. From each envelope the contents are carefully removed, first examined as to proper naming of station and month on each paper contained in the same, and thereafter the several papers are assorted; namely, monthly reports, forms A and B; additional instrumental report, forms C and D; note-slips on phenomena; note-slips on official correspondence. The first are generally dated by the official stamp, to show date of receipt; the last are put aside for action and reply after the Bulletin shall have been completed; the third—namely, note-slips on phenomena—are re-examined and assorted according to kind of phenomena and dates; the second, additional and instrumental reports, are laid over for special study and reduction.

The first, namely the principal Monthly Reports of stations (forms A and B, see electrotype printed pages 9, 15), are now taken up, and their contents carefully examined, and a summary made upon the office blank CO, 1, printed here. The summary is taken directly from the individual entries of the observer, not by copying the observer's own summary.

Month _____	Station _____	No. _____		
IOWA WEATHER SERVICE. Monthly Summary made at the Central Office, from the original entries of the Observer's Report. CO, 1.	RAIN-FALL.		PHENOMENA: DATE AND TIME.	
	Decade I.....		∞ _____	☰ _____
	Decade II ...		L _____	● ² _____
	Decade III ..		PB _____	/ _____
	Month.....		(_____	▲ _____
Greatest Amt.:	Date:	e _____	TB _____	
NUMBER OF DAYS.		O _____	K ³ _____	
☉ ▲ *	* ▲ ☿	☿ _____	☿ ³ _____	
Mean Temperature at Noon: _____	Observer _____	Report _____		

When these summaries are compiled, the results entered upon these cards are transcribed to a tabular form, which is found printed on pages 6 and 7 of each monthly report under the heading "SUMMARY OF ALL STATIONS." After having served this purpose, the same cards are again used for the entry of the decade rain-fall upon a special large manuscript table, enabling the Director to judge of the distribution of

rain-fall in the State by decades or ten-day periods. Finally these cards are distributed by *stations* for the current year, while the original reports received from the observers are filed by months, as has been explained before.

The tables of summaries having been completed, the values herein collected are again read off and entered upon blank maps of Iowa. For this purpose the large map (scale thirty miles to the inch) sent with the first number of the report for 1878, is used. In this manner we obtain for each month the following series of maps: 1, total rain-fall; 2, greatest amount of rain-fall on one day; 3, date of this day; 4, number of days with snow; 5, number of days with hail; 6, number of days with thunder and lightning; and 8, mean temperature at noon. This series of maps is invariably constructed and compiled by the drawing of lines for equal value and proper shading of the field thus determined.

But quite generally additional maps have to be constructed, to represent noted phenomena, such as the observation of meteors, aurora, and the distribution of first or last frosts, of early snow-fall, of heavy rain-storms, marked hail-streaks, etc., etc. Finally, on township blank maps, details in regard to wind and other storms are entered for any single date.

In addition to all this, the pentade reports from twelve stations have been received throughout the month, and have been copied in full by dates on blanks at the time. Thus eight pages folio of manuscript tables have been constructed for the month, exactly as printed on the last eight pages of each monthly report (pages 9 to 16 inclusive). Whenever called for, the condition at noon for any one date, together with the phenomena preceding and following this instant are entered upon blank maps of half scale (sixty miles to the inch). Months with noted atmospheric disturbances call for many such additional maps.

With all these data sifted, tabulated and mapped before him, the Director again examines the note-slips on phenomena; and clippings from newspapers on especially noted phenomena are now added, since our papers generally give quite elaborate accounts of local damage by flood and storm, and also generally notice remarkable meteorological displays.

When all this matter has been carefully studied, the balance of the PRESS BULLETIN is written, and the greatest possible effort made to present the most marked features of this mass of facts in the clearest

manner and the smallest number of words. Very few people have an idea of the pains that are taken in this matter, and the extent of fact that is crowded into the few lines of such a Bulletin.

The Press Bulletin now goes to the local printer, who furnishes immediately a sufficient number of ADVANCE PROOFS FOR PUBLICATION, which are mailed to all dailies of Iowa, and a number of weeklies which have promised to regularly insert these bulletins in full or nearly so. Upon the same terms, these advance proofs will be sent to any other Iowa paper not now on the mailing list of the Service. By this means the general condition of the weather that has prevailed, as compared to preceding years, becomes known to a very large circle of readers in Iowa.

The service is under great obligation to the publishers of the following weekly papers for the receipt of the same:

State Register, Des Moines; *Gazette*, Davenport; *Courier*, and *Democrat*, Ottumwa; *Republican*, Cedar Rapids; *Der National Demokrat*, Dubuque; *Journal*, Sioux City; *Times-Republican*, Marshalltown; *Homestead*, Des Moines; *Republican* and *State-Press*, Iowa City.

At times the value of this information is belittled, and predictions are demanded. But so long as newspapers are read through they give only information of what has occurred, and so long as actual election returns are prepared to ante-election guesses, and above all, so long as any civilized commonwealth gathers statistics to outline its own history, so long will the work of observation and recording of the actual condition of the weather, and the proper publication of the results thereof, remain the first and most important duty of any weather service.

While the advance-proof of the Press Bulletin is being printed and mailed, the preparation of the manuscript for the balance of the weather bulletin continues. This work is hurried as much as possible, and generally the entire Bulletin is mailed by the tenth of the month. The edition printed is one thousand, now generally four pages octavo, but the number for June, 1881, was 12 pages. The mailing of the Bulletin, in 800 separately addressed and stamped parcels, closes this work for the month.

If all observers mailed their reports on the first, or latest on the second, all reports would be received on the fourth, or latest the fifth, except in extraordinary cases. It would then be possible to finish all

the tables, maps, and cards at one time, and a larger number of stations could be managed. But, unfortunately, quite a number of observers are habitually tardy, and the disposal of these TARDY REPORTS, entails a great deal of extra labor and worry. Several plans have been tried to remedy this evil, but thus far with indifferent success.

Having thus briefly indicated the work which is done during the first decade of each month at the Central Station in the preparation of the BULLETIN, the work remaining to be done for the REPORT should be pointed out. Tables and maps are completed as far as possible with the returns from tardy stations, and additional notes are prepared that could not find room in the Bulletin. More complete history of noted storms and phenomena have to be drawn up, for which tables, maps, plans, etc., must be prepared. Also the larger manuscript maps have to be reduced to a smaller scale and carefully drawn with photo-engraving ink in order that photo-electrotypes may be obtained from the same. The amount of very tedious and difficult drawing that has been done in this manner at the Central Office is very considerable; but, since the means of the Service allow no other way to map illustration, this work, however onerous, must continue to be done.

In addition to all this, the results of like period for different years have to be reduced, for each station separately, in order to arrive at general results and normals. The 26,082 rain-fall observations made by this Service in Iowa during the lustrum from January 1, 1876 to December 31, 1880, and received at this office on nearly five thousand individual monthly reports, have thus been fully reduced, from the separate rain-fall measurements up to the normal monthly mean for each station.

On pages 3-11 of the Report for 1881, the general monthly results are given in tabular form, and yearly the rain-maps are printed from photo-electrotypes obtained from my pen-drawings. While referring to these data and to a more complete exposition of the results now being prepared for a future number of the Report, it is deemed advisable to give here the monthly maps showing the distribution of the rain-fall in Iowa during this period of five years. See map facing the title page.

These maps, giving a graphical representation of all the rain measures taken in Iowa by this service for the lustrum 1876-80, show: that the summer rains greatly predominate; during the winter months the rain-fall is greatest in the eastern parts of the State; that from March the rains spread farther west, till in May the greatest rain-fall occurs in the southwestern parts of the State; that the rain-fall in June is most marked both in the southwest and northwest, but less so in central Iowa; that these features become more pronounced in July, when a broad belt from southeast to northwest receives the least rain; that in August the rain-fall is most abundant in the middle and eastern tiers of the State, comprising our great corn belt; that in September the belt of greatest rain-fall exhibits again a southwest-northeasterly outline, from which, by the diminution of rain-fall at the approach of the cold season, the winter distribution results.

The mean yearly rain-fall for the entire State is represented by the middle map for the same period. It will be noticed how remarkably diversified the State is in regard to the rain-fall; while generally increasing in a southeasterly direction, it is apparent that powerfully modifying causes are in operation.

A comparison of this map, representing the distribution of the yearly rain-fall in Iowa, with the following little map, exhibiting the

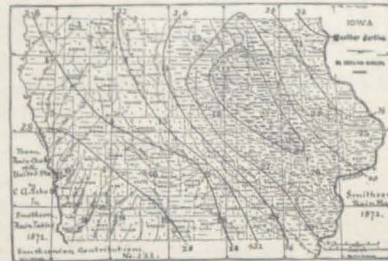


distribution of timber in Iowa, according to the State census of 1875, will reveal so close a similarity in the specific form of the curves, that we cannot help but conclude, that the amount of timber and the yearly rain-fall are closely related, a circumstance to which the Director has already repeatedly referred to in former publications.

These rain maps are not only the first maps of the kind ever published for our own State, but they are the only monthly rain maps,

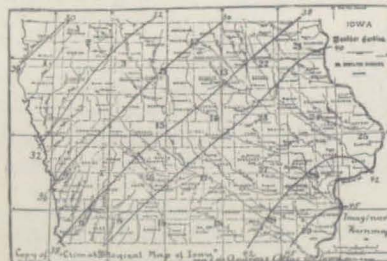
based upon uniform, reliable, and extended observations for an equally large area of the United States. This remark applies with equal force

to the map representing the yearly rain-fall; it will readily be seen that the rain-fall map published by the Smithsonian Institution in 1872, has only a few points of resemblance. It was



not to be expected that the few irregular observations upon which the same is based could lead to a reliable result in so intricate a subject.

But the most remarkable rain map of Iowa ever published is found in thousands of Iowa homes; namely, a half-page map in Andreas'

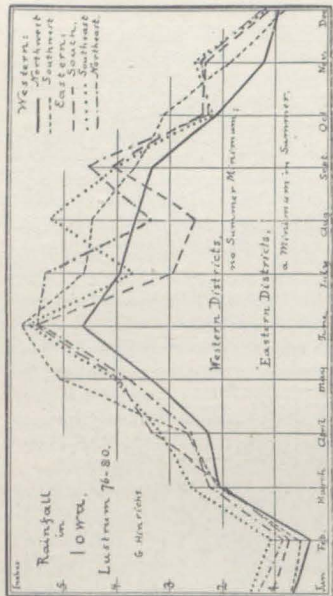


Atlas of Iowa, page 9. I here give an accurate, though greatly reduced, copy of this remarkable work of imagination, in order that it may be contrasted with the graphical representation of facts given in the central map

of the group considered above. In nature, fact is always more strange than fiction.

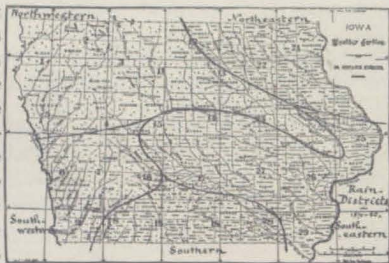
So far as the monthly distribution of rain-fall is concerned, the result of the observations of the Service show that in western Iowa no

marked minimum of rain-fall occurs in



east, and is most lasting in the south, where it extends over both July and August.

It thus appears that we may distinguish five well marked rain districts in Iowa. The boundaries of these districts, for the lustrum 1876-80, are drawn upon the map and inserted. As the seasons from year to year differ somewhat



summer, but that the rain-fall in April is but little greater than in March, while in eastern Iowa we find such a minimum in summer, but have higher rain-fall in April than in March. The tendency to a spring drouth thus is greater in the west, but summer drouths are more likely to occur in the east of Iowa. It will also be noticed by a closer inspection of the diagram given (which graphically represents the figures printed at the close of the table on page 5, of Report for 1881) that the rain-fall in the southwest is in all months greater than that of the northwest. Finally, the diagram exhibits the fact, that the summer minimum occurs in July in the southeast, in August in the north-

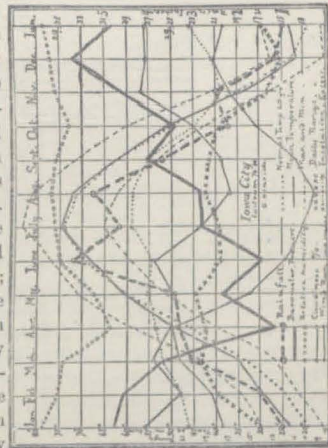
in their character, these boundaries will fluctuate correspondingly, in harmony with the character of the prevailing wind.

In addition to the reduction of the rain-fall observations made in Iowa, the earlier observation at Iowa City have also been reduced at the Central Office. The general results, so far as temperature and rain-fall are concerned, have been published in the report for 1881, on page 13, in tabular form. These values will constitute the **TWENTY YEARS' NORMALS FOR IOWA CITY**, wherewith all other observations are compared. This is the longest series of observations completely reduced for any point in Iowa.

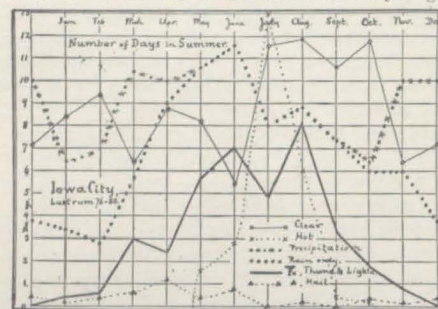
The observations made at the Central Station, during the lustrum 1876-80, have also separately been quite fully reduced. The results of this work are given in tabular form on pages 14, 15 and 16 of the Report for 1881, and graphically in the three pen-drawings here inserted.

The first of these diagrams shows that the pressure of the air is lowest during the spring month April, and in June, months not unfrequently marked by destructive tornadoes. The barometer gradually rises during the summer and fall months, with a small reversion in October; it reaches its highest position in December. The annual variation of the other elements is equally well represented in this diagram; namely, the rain-fall, relative humidity, cloudiness, total run of the wind; also, the twenty years' normal and mean temperatures for the lustrum, the mean maximum and minimum temperatures, the mean daily range, and noon excess of insolation. It will readily be noted that the air is driest in spring, and the sky is clearest in late summer, when also the wind is lowest.

The second of these diagrams represents the general character of our *summers* by giving the mean monthly number of days for each of



the principal elements, as observed during the five years of the lustrum 1876-80. Thus it will be seen that the hot days begin with May, and



are most numerous in July. The number of clear days is remarkably great from July to October; a feature very characteristic of our climate. The curve representing the number of days with thunder and

lightning is also very interesting and characteristic; for not only is this number quite high throughout the summer, but it shows a marked minimum in August.

The third of these diagrams represents in the same manner the most

characteristic features of our

winter to the

eye. The number

of very cold

days is high in

December and

January; the

number of days

with frost very

gradually in-

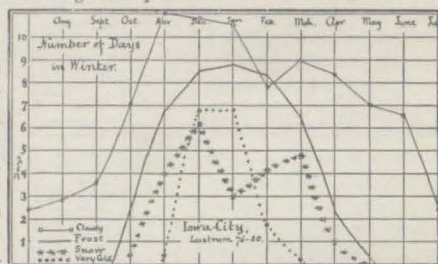
creases till January, and thereafter diminishes with equal regularity.

The curve representing the number of cloudy days shows that on the whole our winter is the cloudy season.

Many other examples of the work done at the Central Station might be mentioned, but this already bulky report would become too much so.

The work which has to be done at this office is very great and growing.

In former years, some leisure was left me, even after doing much remunerative work in chemical analysis, as all able chemists do who receive but a moderate salary as professors. Now, this additional re-



munerative work has been given up in favor of unpaid work done for this Service. May not a great State make the burden less oppressive by giving a reasonable compensation? Would such a policy not be good economy?

In conclusion it is necessary to refer to the regular PUBLICATIONS of the Service; namely, the BULLETIN and the quarterly REPORT.

The MONTHLY BULLETIN of the Iowa Weather Service is solely intended to furnish, at the earliest date possible, a reliable exposition in brief of the actual condition of the weather in this State for the month concerned. Each BULLETIN is based upon fully a quarter thousand individual reports and special notes received from all parts of the State.

The BULLETIN is now, since January, 1881, a four-page octavo, which, in case the weather was unusually varied, is increased to eight, ten, or even twelve pages. It is mailed to all State officers and State institutions, members of the General Assembly, observers and correspondents, and to meteorological institutions and meteorologists at home and abroad. It is highly estimated, and exerts a great influence for good in the work of the observers of the Service. The current volume, inclusive of the September BULLETIN, now embraces fifty pages and a cover giving a view of the Central Station and a model monthly report for the instruction of the observers. It is very desirable that the cost of this publication should not be met from the general appropriation of the Service. The cost of postage for mailing is too high, but the postal authorities at Washington have, thus far, refused to class this BULLETIN as second-class matter, although the mails do carry the *Monthly Weather Review*, issued by the Military Weather Service (a branch of the Signal Service of the Army), as second-class matter at pound rates. It is an incontrovertible fact that both publications are of the same nature, issued in the same manner, and distributed in the same manner; but our State Volunteer Service is compelled to pay circular rate of postage, while the military service is allowed to send its monthly publication at pound rates.

The quarterly WEATHER REPORT is necessarily later in its appearance, and during the first years of the service the work of organization and development imperatively took precedence. However, our Service is more nearly abreast with the current phenomena in its REPORT than many others, and during the summer vacation the Director has devoted his entire time to the progress of this work of publication.

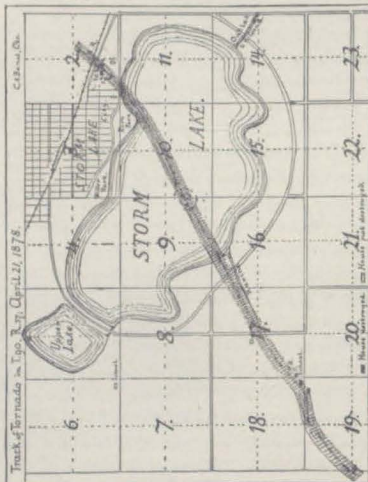
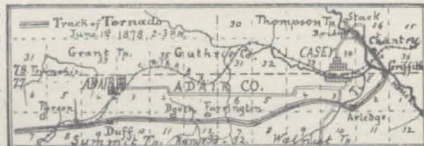
The following numbers of the REPORT have, thus far, been published:

REPORT FOR 1878.—No. 1, January, February, March, April; No. 2, May, June, July, August; No. 3, September, October, November, December.

Of the concluding No. 4, the summaries and most of the description of the great Easter storm, with maps, are printed. Additional maps have been drawn and photo-electrotyped this summer, so that the work of printing may now be resumed and readily completed. As

examples I insert here the map representing the track of the tornado which, on June 1, 1878, traveled the northern part of Adair county and curiously moved around the town of Casey. This saving of Casey may have been due to the peculiar direction of the water-courses shown on the map.

In the great Easter storm the town of Storm Lake was directly in line of the tornado's track; but probably the influence of the lake drew the track slightly southward, so as to save the town. The photo-electrotype of my pen-drawing, based upon Observer BOND's sketch, is here inserted as an additional example of this part of the REPORT, which now will be entirely finished shortly. THE REPORT FOR 1879 is also completed so far as the three numbers are concerned, giving the full report for the twelve months of the



year; but No. 4 is not yet finished, though the manuscript tables are all ready. The special account of the meteor of May 10th will be the principal subject of general interest in this number.

THE REPORT FOR 1880 is in an advanced state of preparation at this office, but it was deemed best to first finish the preceding reports and to bring the REPORT FOR 1881 as nearly up to date as possible. Accordingly, No. 1 and 2 of this report are published, embracing all data of the monthly reports for the first eight months of this year; namely, from January to August, inclusive. The first sixteen pages of this report give the results for the past lustrum above illustrated by maps and diagrams.

It is reasonably to be expected that under the more nearly perfected system now in operation, all numbers now behind; namely, No. 4 for 1878, No. 4 for 1879, and Nos. 1-4 for 1880, will be issued before August, 1882.

It may be proper to add a word in regard to the maps and other illustrations in the reports. It was found that no provision had been made for illustrations, so that the cost of all so furnished had to be drawn from the appropriation. After much work the photo-electrotypes made from my pen-drawings have been found to be the most available—cheap enough in point of cost, and, if examined through an ordinary reading glass, plain enough for study. The original working maps drawn by me are to the scale of thirty miles to the inch. These maps are reduced to half, or sixty miles to the inch, in my final and very careful pen-drawings. These are, by the Photo-electrotype Company of Boston, again reduced to half size; *i. e.*, to a scale of 120 miles to the inch, many of which maps are inserted in the body of this report. As the preparation of the final drawing for the photo-electrotype is additional work for me—work which would rate at fully twice the cost of the electrotypes obtained—I would greatly prefer some other method, such as lithographing, which could be done from my working drawing. But it is impossible to find the means for this work.

Finally, it must be said, that, in order to place the work of the Service upon a proper basis of merit, everything of a general nature has been carefully excluded from the body of the reports so far published. If, however, when the reports shall have been brought completely up to date, extra time shall be found, it will be used to furnish, for the fourth annual number of each yearly volume, such more general information and theory as will reflect the present and foreshadow the

probable coming condition of the science of meteorology. But however tempting it may be to turn aside from the drudgery of the summing of facts and observations to the more entertaining exposition of principle and theory, I trust that I shall always feel it my duty first to attend to the necessary work of making the report a faithful exposition of the actual condition of the weather in our State of Iowa, so that our Weather Reports will continue to be of value long after views and theories shall have passed away.

APPROPRIATION.

The appropriation made in section four of the act establishing the Iowa Weather Service has been drawn and expended as shown by the classified synopsis of expenditures, the complete list of individual vouchers sent to the Auditor of State, and the list of warrants received from the same.

I. SYNOPSIS OF EXPENDITURES.

POSTAGE: 4,500 postal cards	\$ 45.00	
5,000 wrappers	56.00	
18,300 stamps	281.50	
		\$ 382.50
PUBLICATION AND BLANKS: Stationery	\$185.05	
Printing	399.60	
Engraving, cuts	151.82	
		796.47
CLERK HIRE	520.00	
INSTRUMENTS	188.90	
INSPECTOR OF STATIONS	21.60	
ALL OTHER EXPENDITURES	124.75	
Total		\$1,974.22

II. LIST OF VOUCHERS.

No.	PERSON.	OBJECT.	Amount.
119	B. Owen, P. M.	500 stamps	\$ 5.00
120	B. Owen, P. M.	300 stamps	5.00
121	J. P. Irish	Printing	30.25
122	Expressage	On instrument	3.00
123	B. Owen, P. M.	700 stamps	10.00
124	United States Express Company	From State Binder	1.00
125	Matt. Parrott, State Binder	Extra copies	1.50
126	B. Owen, P. M.	1,400 stamps	30.00
127	G. Hinrichs, Jr.	Clerk, Sept., Oct., Nov.	60.00
128	Republican Pub. Co., Iowa City	Printing blanks	18.00
129	J. P. Irish	Printing	25.00
130	George H. Bliss, Chicago	Electric pen, supplies	2.50
131	J. Bowles	Mimograph	3.50
132	B. Owen, P. M.	200 stamps	6.50
133	Pryce and Schell	Howe package scale	1.20
134	United States Express Company	Instruments to observers	10.00
135	B. Owen, P. M.	400 stamps	10.00
136	James Lee	Paper and binding	21.60
137	Mrs. J. G. Fink	Stationery	23.69
138	Republican Publishing Company	Printing	3.00
139	G. Hinrichs, Director	Petty expenses	3.30
140	B. Owen, P. M.	400 stamps	5.00
141	B. Owen, P. M.	500 stamps	5.00
142	Mills & Company, Des Moines	Engraving and printing	57.40
143	B. Owen, P. M.	500 stamps	5.00
144	B. Owen, P. M.	1,000 postal cards	10.00
145	J. G. Fink	Stationery	10.15
146	James Lee	Binding	38.70
147	James Lee	Paper, blank books	24.00
148	J. P. Irish	Printing	11.50
149	B. Owen, P. M.	800 stamps	10.00
150	Culver, Page, Hoyne & Co., Chicago	Filing cases	13.50
151	Theo. Goldschmid, Philadelphia	Hair hygrometer	12.00
152	B. Owen, P. M.	800 stamps	10.00
153	B. Owen, P. M.	500 postal cards	5.00
154	B. Owen, P. M.	500 postal cards	5.00
155	G. Hinrichs, Director	Traveling expenses	12.00
156	G. Hinrichs, Director	Expressage, petty expenses	4.25
157	G. Hinrichs, Jr.	Clerk, December, 1879	20.00
158	Iowa City Republican Publishing Co.	Printing	10.25
159	J. G. Fink	Thermometers	31.55
160	Marsh & Holubar	Rain-collectors, evaporimeters	15.75
161	J. P. Irish	Printing	13.00
162	G. Hinrichs, Jr.	Clerk, January, February	5.00
163	B. Owen, P. M.	500 stamps	5.00
164	B. Owen, P. M.	500 cards, 500 stamps	10.00
165	Rand, McNally & Co., Chicago	Maps	8.80
166	B. Owen, P. M.	Money-order (fee)	1.20
167	American Express Company	Instruments to stations	4.45
168	United States Express Company	Instruments to stations	5.05
169	B. Owen, P. M.	500 stamps	5.00

LIST OF VOUCHERS.—CONTINUED.

No.	PERSON.	OBJECT.	Amount.
170	B. Owen, P. M.	500 stamps.	\$ 5.00
171	J. P. Irish	Printing	17.00
172	Republican Publishing Co.	Printing	8.25
173	J. A. Pickering	Signal lanterns.	19.93
174	Rand, McNally & Co., Chicago.	Map U. S.	4.00
175	G. Hinrichs, Jr.	Clerk, March, April	50.00
176	B. Owen, P. M.	400 stamps.	10.00
177	G. Hinrichs, Director	Petty expenses	2.05
178	Marssh & Holubar	Thermometer shades.	23.88
179	J. Ricord, P. M.	400 stamps.	10.00
180	J. Ricord, P. M.	500 stamps.	5.00
181	T. J. Rigg	Signal-oil	2.00
182	S. L. Sounders	Oil-can	.65
183	O. Startzman	Repairing	1.00
184	Anna Hinrichs, Jr.	Clerk, May, June.	40.00
185	J. P. Irish	Printing	13.00
186	J. Ricord, P. M.	250 stamps.	5.00
187	J. Ricord, P. M.	150 stamps.	4.50
188	H. W. Boerner & Son.	Mimograph	4.55
189	J. Ricord, P. M.	500 stamps.	5.00
190	Barnhart Bros. & Spindler, Chicago.	Weather symbols, type	9.90
191	J. Ricord, P. M.	500 stamps.	5.00
192	J. Ricord, P. M.	500 stamps.	5.00
193	J. P. Irish	Printing	13.00
194	Republican Co.	Printing	21.00
195	Anna Hinrichs, Jr.	Clerk, July, August	40.00
196	J. G. Fink	Stationery	15.28
197	J. G. Fink	Thermometers	17.85
198	Express Co.	Expressage	1.85
199	G. Hinrichs, Director	Petty expenses	1.80
200	Iowa City post-office.	500 stamps.	5.00
201	Iowa City post-office.	600 stamps.	10.00
202	Iowa City post-office.	400 stamps.	10.00
203	J. Ricord, P. M.	800 stamps.	20.00
204	J. P. Irish	Printing	13.00
205	Iowa City post-office.	1,000 cards	10.00
206	Iowa City post-office.	500 stamps.	15.00
207	Will Hohenschuh	Three boxes	1.50
208	Republican Publishing Co.	Printing	45.25
209	Anna Hinrichs, Jr.	Clerk, Sept., Oct., Nov., 1880.	60.00
210	Theo. J. Goldschmid, Philadelphia.	Barometer	10.25
211	John Kendall & Co	Barometer, thermometers	29.62
212	James Lee	Stationery	14.12
213	J. Ricord, P. M.	500 stamps.	5.00
214	Smith & Mullen.	Stationery	4.55
215	J. Ricord, P. M.	500 stamps.	5.00
216	G. Hinrichs, Director	Petty expenses	.85
217	G. Hinrichs, Director	Traveling expenses	9.60
218	Iowa City post-office.	1,000 stamps.	10.00
219	J. P. Irish	Printing	20.50
220	J. Ricord, P. M.	1,000 wrappers.	11.20
221	Anna Hinrichs, Jr.	Clerk, Dec., '80, Jan. '81.	50.00
222	Iowa City post-office.	500 wrappers	5.60
223	J. P. Irish	Printing	15.50
224	Iowa City post-office.	500 wrappers.	5.60
225	Anna Hinrichs, Jr.	Clerk, Feb., March, 1881.	50.00
226	Republican Publishing Co.	Printing	6.35
227	F. Seeman	Binding	8.50

LIST OF VOUCHERS.—CONTINUED.

No.	PERSON.	OBJECT.	Amount.
228	Mrs. J. G. Fink	Stationery	\$ 20.46
229	Iowa City post-office.	300 stamps	5.00
230	John P. Irish	Printing	14.00
231	Iowa City post-office.	500 wrappers	5.60
232	J. Ricord, P. M.	500 wrappers	5.60
233	Anna Hinrichs, Jr.	Clerk, April, May	50.00
234	James Lee	Stationery	4.00
235	Iowa City post-office.	500 stamps, 500 wrappers	20.60
236	J. Ricord, P. M.	1,000 postal cards	10.00
237	Republican Publishing Company.	Printing	15.60
238	J. Ricord, P. M.	600 stamps	10.00
239	Director.	Petty expenses	3.95
240	United States Express Company.	Expressage	.80
241	American Express Company.	Expressage	1.75
242	Iowa City post-office.	1,000 wrappers	48.00
243	Keuffel & Esser, New York.	Instruments	14.00
244	W. C. Chalfant.	Weather symbols, type	14.62
245	Barnhart Bros. & Spindler, Chicago.	Photo-electrotypes and express.	43.10
246	Photo-electrotyping Company, Boston.	Printing	31.40
247	J. P. Irish	500 wrappers.	5.60
248	Iowa City post-office.	300 stamps	5.00
249	Republican Publishing Company.	Printing	23.75
250	Photo-electrotyping Company, Boston.	Photo-electrotypes and express.	26.30
251	Anna Hinrichs, Jr.	Clerk, June, July.	50.00
252	Republican Publishing Company.	Printing	31.00
253	Express Company.	Expressage	4.90
			\$1,974.22

III—VOUCHERS SENT TO AUDITOR OF STATE.

1880.	Jan. 1.	Vouchers Nos. 119-139.	\$ 206.04
	April 26.	Vouchers Nos. 140-159.	268.75
	July 24.	Vouchers Nos. 159-177.	266.05
	Oct. 30.	Vouchers Nos. 178-190.	245.26
1881.	Jan. 12.	Vouchers Nos. 200-216.	259.14
	July 27.	Vouchers Nos. 217-239.	357.66
	Sept. 29.	Vouchers Nos. 240-254.	311.32
			\$1,974.22

IV—STATE WARRANTS RECEIVED FROM AUDITOR OF STATE.

1880.	Jan. 6.	Warrant 31429	\$ 248.60
	April 29.	Warrant 33127	286.19
	July 26.	Warrant 33910	266.05
	Nov. —	Warrant —	245.26
1881.	Jan. 15.	Warrant 35591	259.14
	July 30.	Warrant 37681	357.66
	Sept. 30.	Warrant 37478	311.32
			\$1,974.22