

FIRST 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.
1880.

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

SIR—I have the honor to submit to you the first biennial report of the Central Station of the Iowa Weather Service, established by chapter 45, of the Acts of the 17th General Assembly.

Very respectfully yours,

GUSTAVUS HINRICHS,

Director I. W. S.

CENTRAL STATION I. W. S.,

IOWA CITY, IOWA, October, 1879.

FIRST BIENNIAL REPORT.

INTRODUCTION.

THE people of any great State depend for prosperity very largely upon the condition of the weather. However skillfully we may cultivate the soil, and however faithfully we may sow and plant, unless fertilizing rains and the all developing energy of the sun favor us throughout the season, we shall reap but a slight reward for skill and labor. And even the state of health of body and mind is profoundly influenced by these atmospheric conditions; the generally dry state of the atmosphere, the prevailing clear sky, transmitting the purifying activity of the sunbeam with but a small loss, together with the bracing winds and miasma-killing cold of winter, are beginning to produce a generally favorable influence on the race now forming here and in the neighboring portions of the northwest.

The great importance of the ever varying conditions of the weather has been recognized by almost all civilized states and nations by the establishment and support of special institutions for the accurate observation, and the proper reduction and publication, of these conditions of the weather, leading as far as possible to the discovery of the laws regulating these changes. Every series of statistical results of meteorological observations, carried on according to a uniform plan for a series of years is of the highest value both to science and practice, a value which constantly increases with time.

One of the most recent foundations of this kind is the weather service of our own State. Although covering the large territory of the State, fully equal to a kingdom in extent, the means at the disposal of the service are but small, very small indeed if compared to the endowment of other institutions of a like character. These two facts, of recent establishment and very limited means, should not be lost sight of when critically examining the results of our weather service.

It has been my earnest endeavor to learn what we can successfully

do within our sphere, and to urge all who co-operate to pay the greatest attention to that which is the most important. In this manner we have secured quite a liberal representation of stations in all portions of the State, and have promptly received very full reports at the close of each month. The most notable results of these station reports have been published in a "Bulletin," and have also quite extensively been re-published by the press of the State, while the more complete data are embodied in the "Reports" of the service, which reports are being published as fast as possible.

It is hoped that the work done will prove of credit to our State abroad, and will be kindly received at home.

VOLUNTEER OBSERVERS.

During the past two years, one hundred and forty-five persons have enrolled themselves as volunteer observers of this service. A majority of these have been regularly supplied during temporary absence from home by an associate observer, specially trained for the purpose.

The Service depending entirely on volunteers for its station reports, a larger aggregate body of observers is necessary than the number of stations represented. All changes in the corps of observers cause additional work at the Central Station, but these changes are unavoidable, for in our comparatively new State people change residence more frequently than in older states; besides, some observers will drop out by neglect, or by disease, and two have been lost by death. In a few cases persons have volunteered to act as observers, but found the task too great.

To reduce the changes of observers to the least possible, we have, for 1879, introduced the system of volunteering for a year by filling out and signing the blank form printed on opposite page. The results of this system have been very satisfactory, both in reducing to a considerable extent the work of management at the Central Station, and in giving the volunteer observer a more definite understanding of what he is expected to do. It will be noticed that, while the volunteer observer determines for himself the amount of work he engages to do for the service, he promises to carry on the work selected by himself for one year.

[COPY OF BLANK FORM.]

IOWA WEATHER SERVICE, DR. G. HINRICHS, DIRECTOR.

VOLUNTEER OBSERVER'S PERSONAL RECORD FOR 1879.

Full name of Volunteer Observer, written *plainly*.

Business Avocation, _____

Post-office Address, Town, _____, County, _____

The Central Office furnishing me the necessary Book of Record, Blank of Report and Notes, Stamped Envelops, addressed to Central Office; also one copy free of all official publications of said office, I hereby promise to carefully and regularly observe, accurately, distinctly, and neatly to record, faithfully to copy and revise this report monthly, and promptly at the close of each calendar month to mail this copy as *Report*, to the Central Office, to the extent as indicated by my written "Yes," in the blank below:

Weather Station. Rain Station.	1. Rainfall, amount, measured at noon.	Write "Yes" after those you volunteer to do, write "No" after each you will not do.
	2. Phenomena, their kind, intensity, and time of occurrence, (especially \bullet \ast \blacktriangle ∇ \lt \llcorner \lrcorner V and R) also ∞ \equiv L V and V (halos and coronae.)	
	3. Sky and wind, daily at noon.	
	4. Thermometer, daily at noon. In addition to the preceding, also—	
	5. Sky and wind at 8 a. and 8 p.	
	6. Temperature at 8 a. and 8 p.	
	7. Barmometer at noon.	
	8. Barmometer at 8 a. and 8 p.	
	9. Any additional regular observation. (state which).	

In case of my absence, or if otherwise prevented from performing this voluntarily assumed duty, the Associate Observer, _____

who has been trained during _____ months, by me in this work, will see that no break in the record of this station will occur.

Signed, _____

Dated, _____

NOTE.—Please to promise no more than you think you are able to do. Continued, prompt, and regular reports of a rain station are more valuable than interrupted or tardy reports from a weather station.

The following is a complete alphabetical list of volunteer observers for the preceding two years. It would be interesting to add the number of reports contributed by each one of these observers, but in the Report of the Service the annual synopsis distinctly exhibits these facts for each entire calendar year, so that the work of making such exhibit for the fiscal year is hardly necessary.

VOLUNTEER OBSERVERS, IOWA WEATHER SERVICE.

NAME.	POST-OFFICE.	COUNTY.
Al Adams, editor.....	Dakota.....	Humboldt.
S. S. Ainsworth.....	West Union.....	Fayette.
Guy P. Arnold, farmer.....	Garden Grove.....	Decatur.
M. V. Ashby, surveyor.....	Afton.....	Union.
James Barr, M. D.....	Algona.....	Kossuth.
Hiram M. Bassett, M. D.....	Mt. Pleasant.....	Henry.
George Baur, farmer.....	Near Winterset.....	Madison.
J. T. Beem, attorney.....	Marengo.....	Iowa.
Theodore W. Bennett, M. D.....	Crawfordsville.....	Washington.
C. E. Bessey, professor.....	Ames.....	Story.
Charles A. Bond, B. Ph.....	Storm Lake.....	Buena Vista.
F. J. Boutin, teacher.....	Hampton.....	Franklin.
A. B. Bowen, M. D.....	Maquoketa.....	Jackson.
A. H. Box.....	Floris.....	Davis.
Col. G. B. Brackett.....	Denmark.....	Lee.
Caleb Brown, M. D.....	Rose Hill.....	Mahaska.
G. S. Brown, jeweler.....	Cherokee.....	Cherokee.
Wm. D. Brown, C. E.....	Dallas Center.....	Dallas.
M. J. Campbell.....	Sibley.....	Osceola.
Robt. M. Carothers.....	Vinton.....	Benton.
Prof. G. C. Carpenter.....	Indianola.....	Warren.
Hiram Carpenter, farmer.....	Near Webster City.....	Hamilton.
Frank H. Carter, cashier.....	Elkader.....	Clayton.
Luther L. Cassidy, C. E.....	Winterset.....	Madison.
Geo. D. Clark, druggist.....	Fairfield.....	Jefferson.
Prof. Alonzo Collin.....	Mt. Vernon.....	Linn.
H. H. Colt, editor.....	Nora Springs.....	Floyd.
Wm. A. Cook, druggist.....	Washington.....	Washington.
E. J. Couch, farmer.....	Grand Junction.....	Greene.
Edward E. Crady, druggist.....	Sioux City.....	Woodbury.
E. S. Creswell, farmer.....	Creston.....	Union.
B. H. Criley, M. D.....	Dallas Center.....	Dallas.
D. W. Crouse, M. D.....	Waterloo.....	Black Hawk.
O. E. Daniels.....	Hampton.....	Franklin.
Prof. W. C. Davis.....	Red Oak.....	Montgomery.
Seth Dean.....	Glenwood.....	Mills.
James P. Dickinson, [farmer.....	Guttenberg.....	Clayton.
H. G. Dorchester.....	Bellevue.....	Jackson.
Hon. Joseph Dysart.....	Dysart.....	Tama.
A. J. Earl.....	Anita.....	Cass.
J. M. Elder, attorney.....	Concord.....	Hancock.
J. P. Farnsworth, M. D.....	Clinton.....	Clinton.
Luther P. Fitch, M. D.....	Charles City.....	Floyd.
Frank Fletcher, student.....	Iowa City.....	Johnson.
A. T. Flickinger, attorney.....	Council Bluffs.....	Pottawattamie.

VOLUNTEER OBSERVERS, IOWA WEATHER SERVICE—CONT.

NAMES.	POST-OFFICE.	COUNTY.
Thos. M. Goddard, attorney.....	Centerville.....	Appanoose.
Prof. H. L. Grant.....	Waverly.....	Bremer.
John W. Gustine, M. D.....	Carroll.....	Carroll.
Oscar F. Hale.....	St. Joseph.....	Kossuth.
Chas. S. Hall, engineer.....	Eldora.....	Hardin.
Miss Mary Hamilton, A. B.....	Bloomfield.....	Davis.
R. R. Hanley, editor.....	Sidney.....	Fremont.
Geo. F. Hard, horticulturist.....	Des Moines.....	Polk.
James Harkness, farmer.....	Hesper.....	Winneschiek.
Henry Hatch.....	Wittemore.....	Kossuth.
Chas. A. Helmick, student.....	Columbus City.....	Louisa.
Prof. W. H. Herrick.....	Grinnell.....	Poweshiek.
Emmett F. Hill.....	Spirit Lake.....	Dickinson.
Gershom H. Hill, M. D.....	Independence.....	Buchanan.
Miss Anna Hinrichs.....	Iowa City.....	Johnson.
Gustavus Hinrichs, Jr.....	Iowa City.....	Johnson.
Curtis Houghton, farmer.....	Near Fairfield.....	Jefferson.
B. F. Hoyt, B. Ph., naturalist.....	Columbus.....	Nebraska.
H. C. Huntsman, M. D.....	Oskaloosa.....	Mahaska.
Gilbert R. Irish, farmer.....	Near Iowa City.....	Johnson.
Prof. Thos. M. Irish.....	Dubuque.....	Dubuque.
C. W. Jarvis, farmer.....	Emmet.....	Emmet.
Abijah Johnson, M. D.....	Earlham.....	Madison.
Joseph E. Jones, M. D.....	Stellapolis.....	Iowa.
M. H. Kling.....	Mason City.....	Cerro Gordo.
H. S. Kridelbaugh, M. D.....	Clarinda.....	Page.
Frank Landers, farmer.....	Webster City.....	Hamilton.
Miss Augusta Larrabee.....	Clermont.....	Fayette.
Miss Rachel Larrabee.....	McGregor.....	Clayton.
Frank Larrabee.....	McGregor.....	Clayton.
Mrs. K. E. Law.....	Forest City.....	Winnebago.
M. F. LeRoy, attorney.....	Manchester.....	Delaware.
Enoch Lewis, M. D.....	Albion.....	Marshall.
John Lewis, M. D.....	Hesper.....	Winneschiek.
Norman Lewis, farmer.....	Hamlin.....	Audubon.
Mrs. Melissa Lewis.....	Hamlin.....	Audubon.
B. S. Louthan, M. D.....	Dysart.....	Tama.
Mrs. B. S. Louthan.....	Dowville.....	Crawford.
J. B. McCartney.....	Villisca.....	Montgomery.
Frank McClintock.....	West Union.....	Fayette.
Chas. McCormick, teacher.....	Atlantic.....	Cass.
Wm. J. McGee, surveyor.....	Farley.....	Dubuque.
Theodore Marks, horticulturist.....	Hopkinton.....	Delaware.
Gregory Marshall, farmer.....	Cresco.....	Howard.
James C. Michener, M. D.....	Adel.....	Dallas.
Edwin Miller, P. M.....	Grant City.....	Sac.
S. C. Mitchell, merchant.....	Leon.....	Decatur.
Giles C. Moorehead, M. D.....	Ida Grove.....	Ida.
John R. Morledge, attorney.....	Clarinda.....	Page.
M. M. Moulton.....	Monticello.....	Jones.
Mrs. R. P. Tilden Nipher.....	Near Iowa City.....	Johnson.
C. G. Perkins, P. M.....	Onawa.....	Monona.
Hon. Wm. B. Perrin.....	Nashua.....	Chickasaw.
J. J. Pocock, druggist.....	Le Mars.....	Plymouth.
E. T. Preston, farmer.....	Near Newton.....	Jasper.
Solon, B. Prindle, druggist.....	Fort Dodge.....	Webster.

VOLUNTEER OBSERVERS, IOWA WEATHER SERVICE—CONT.

NAMES.	POST-OFFICE.	COUNTY.
J. Duncan Putnam, naturalist.....	Davenport.....	Scott.
Mrs. May U. Remley.....	Anamosa.....	Jones.
Chas. Rice, M. D.....	Smithland.....	Woodbury.
Thos. D. Rigg, M. D., druggist.....	Tipton.....	Cedar.
Francis H. Robbins, druggist.....	Waukon.....	Allamakee.
Luke Roberts.....	Clinton.....	Clinton.
Prof. C. P. Rogers.....	Marshalltown.....	Marshall.
J. F. Sanborn, M. D., dentist.....	Tabor.....	Fremont.
Conrad Schadt, druggist.....	Amana.....	Iowa.
Schiller C. Schramm.....	Fort Madison.....	Lee.
Elijah Seeley.....	Rolfe.....	Pocahontas.
O. H. Seeley, farmer.....	Kasson.....	Madison.
Rev. Thomas L. Sexton.....	New London.....	Henry.
Prof. D. S. Sheldon.....	Davenport.....	Scott.
Charles L. Sherman, druggist.....	Anita.....	Cass.
H. N. Sill, M. D.....	Strawberry Point.....	Clayton.
Sidney Smith, merchant.....	Sac City.....	Sac.
Jacob Stern, farmer.....	Logan.....	Harrison.
Mrs. S. F. Stewart.....	Chariton.....	Lucas.
S. O. Stockslager, M. D.....	Florence.....	Benton.
Chas. S. Stryker, farmer.....	Creston.....	Union.
A. S. Stuver, attorney.....	Newton.....	Jasper.
Benjamin Talbott, professor.....	Council Bluffs.....	Pottawattamie.
Charles E. Tibbets, professor.....	Oskaloosa.....	Mahaska.
John L. Therme, druggist.....	Farmington.....	Van Buren.
A. W. Thompson.....	Brooklyn.....	Poweshiek.
G. W. Thompson.....	Dunlap.....	Harrison.
A. A. Veblen, professor.....	Decorah.....	Winnebago.
Chas. Wachsmuth, M. D., naturalist.....	Burlington.....	Des Moines.
Hon. J. K. Wagner, M. D.....	Blairstown.....	Benton.
Chas. F. Waldron, M. D.....	Brush Creek.....	Fayette.
Wm. Ward.....	Near Algona.....	Kossuth.
Carl Werner, farmer.....	South Amana.....	Iowa.
Horatio Wetherell, farmer.....	Horace.....	Audubon.
Mrs. Daniel B. Wheaton.....	Near Independence.....	Buchanan.
A. O. Williams, M. D.....	Ottumwa.....	Wapello.
James S. Whittaker, merchant.....	Corydon.....	Wayne.
F. M. Witter, professor.....	Muscatine.....	Muscatine.
Arthur L. Wright, M. D.....	Carroll.....	Carroll.
John C. Wright, M. D.....	Clear Lake.....	Cerro Gordo.
Wm. E. Wright, M. D.....	Knoxville.....	Marion.
Morris Wygant, farmer.....	Denison.....	Crawford.
R. P. Wylie, professor.....	Aledo.....	Illinois.
Henry Young, M. D.....	Manson.....	Calhoun.

The great majority of these observers have proved themselves faithful to the task they have voluntarily assumed for the benefit of the service, and have thereby merited the thanks of the public. It would be very desirable to be able to furnish a full set of standard instruments to about twenty of the best observers, properly distributed over the State.

SUPERVISION OF THE STATIONS.

The management of the work of so many observers requires a great amount of correspondence, in addition to the printed directions furnished each observer, and the circular letters (printed by electric pen and duplicating press), issued from time to time, as called for by special circumstances. Besides, a personal inspection of the stations, combined with revision of the instruments and personal instruction of the observers, is needed at least once in three years for each station.

Thus far it has been impossible to find the time for such visits of inspection, except to a limited extent. The service is under obligation to quite a number of railroads in the State for passes, but few of which have thus far been actually used, for lack of time. The most extended tours of inspection were made by me in July and August, 1878. To make these trips as useful as possible to the State, I made, by the means of instruments kindly loaned by the Coast Survey, a preliminary magnetic survey of our State, being the first systematic survey of this kind ever undertaken in Iowa.

The labor of supervision of stations and observers during the past two years has been much greater than anticipated; but, being work of prime importance, involving the value of the results obtained, the necessary time has been taken, though the preparation of the final reports has thereby been delayed.

STATION REPORTS.

During the year 1878, fifty-four stations sent complete reports for each of the twelve months, or 648 monthly reports; thirty-four stations sent 245 monthly reports in the aggregate; so that 893 monthly reports were received from eighty-eight stations in the year. In addition, a considerable number of observers sent a synopsis of the entire year, and fifteen stations furnished decade reports for three of the summer months. Nearly all observers secured a health report for the summer months from a reliable physician in their town. The entire

number of reports received from stations in 1878, thus, will exceed eleven hundred.

It is hardly necessary to add, that every one of these reports is carefully filed for reference. The system of filing adopted is so simple that any specified report can be produced in a few moments.

For the present year, the summing up of the reports received has not yet been made. As an indication of the number of reports received, I give the following table, comprising only the reports which were received promptly, that is, in time for use in the preparation of the *Press Bulletin*, drawn up on the 3d or 4th of each month:

	June.	July.	August.	Summer.
Monthly reports	82	76	81	239
Pentade reports.....	78	78	78	234
Special reports.....	28	10	38
Total weather reports.....	188	164	159	511
Crop reports	54	40	102	196
Total reports received.....	242	204	261	707

The total number of reports received from the stations will, for the present year, probably exceed two thousand.

The reports received from the stations after the *Press Bulletin* has been drawn up are considered tardy, and have not been included in the above table; but they are all used in preparing the final report of the service. For July, sixteen monthly reports were received after the close of the *Bulletin*, bringing the total number of monthly station reports, for July, 1879, up to ninety-two.

THE PRESS BULLETIN.

Promptly upon the receipt of the Station Reports, they are carefully examined and revised as to the summing up, and the most important data contained in them are tabulated for future publication, and for immediate use. These results are also entered upon blank maps, and from the tables and maps and notes thus obtained from the entire body of station reports received up to noon of the fourth of each month, the *Press Bulletin* of the preceding month, is drawn up. The *Press Bulletin* was printed by electric pen and duplicating press until January, 1879, when a general rule issued by the Postmaster-Gen-

eral requiring letter-postage on such printed matter made a change to ordinary print necessary. Since then this rule has been revoked, but the mode of publication of the *Press Bulletin* has remained the same, because the ordinary letter-press is so much more readable than electric pen work.

Advance proofs for publication are mailed (on the 4th or 5th) to all dailies of the State having promised to publish the same in full or in part. An edition of six hundred copies of this *Press Bulletin* in quarto is the next day mailed to all volunteer observers, all State officers and State institutions, to all members of the General Assembly, to a large number of weeklies which have promised to republish the same at least in part, and to meteorologists and meteorological institutions at home and abroad.

The *Press Bulletin* gives, in words, a brief history of the condition of the weather for the preceding month, based upon the observations made at the Central Station, and at all individual stations throughout the State as far as their reports are received up to the fourth of the month following. The *Bulletin* is therefore very full and reliable, although as brief as possible.

It is published more promptly than the corresponding publication of any other weather service.

The *Press Bulletin* for September, 1879, is the 74th in the series issued; a series of bulletins giving a concise and reliable history of the condition of the weather in Iowa for the past four years. It has directly, and by republication in the papers indirectly, been brought to the knowledge of a large portion of the people of the State. During the season just closed, the *Press Bulletin* also contained a brief account of the condition of the principal crops at the close of the month, based upon the reports received from the crop reporters of the service.

During the year 1878, the *Bulletin* published at the Central Station by means of the electric pen comprised, in addition to the *Press Bulletin*, one page quarto of weather maps of the State, and one page quarto of noon observations at the Central Station. At times, the *Bulletin* comprised six pages quarto; but the work of preparing the same interfered so much with the labor required for the final report, that for this year the monthly bulletin of the service has consisted exclusively of the *Press Bulletin* referred to.

In this connection it may be proper to state that the Central Station furnishes a *daily bulletin* to the dailies published at Iowa City, and that nearly thirty stations furnish local papers with a *weekly bul-*

letin for publication. It is hoped that in a near future all stations will furnish their local papers with such weekly bulletins.

THE IOWA WEATHER REPORT.

The final report, which it is my duty to prepare, is in course of publication, and enough has been published already to judge of the value of the same. While other services, having a distinct corps of officers, whose sole duty it is to attend to the work of such service, are usually several years behind date with their final report our State service is but one year behind date with its final report. By reducing the labor of supervision of stations, and especially by cutting short the work involved in correspondence, it is hoped in another year to reduce this interval to but a couple of months. In this connection it should also be borne in mind that the very large share of work required for the preparation of the final report rests upon me, and has to be done at the time which should be devoted to rest and recreation after the completion of the hard day's work of professional labor. The selection of the material and form of the final report has been a subject of very considerable study to me. In this weather report, the climatological facts should be made prominent, and as far as possible the form should harmonize with international rules, so as to facilitate all comparisons.

The IOWA WEATHER REPORT is published in 8 vo., and consists of two parts. The first part comprises monthly and annual tables of the results of observation at the stations of the service. Part second contains descriptions of noted storms and of other remarkable phenomena and general results. In this manner, the more statistical data are all printed by themselves, and arranged in the most convenient form for reference. In part second a full description of the great storm of Easter Sunday, April 21, 1878, has been issued thus far. The description is illustrated by a series of maps, photo-electrotypes of my drawings. One of these maps gives the tracks of the tornadoes which moved up along the valleys of the Boyer and Maple rivers.

In the same manner other storms, meteors, etc., will be described and illustrated in this part.

Part first gives, on the first sixteen pages, a brief enumeration of stations and observers, the division of the State into twenty-seven weather districts adopted, illustrated by a map; also, statistics of population, timber area, magnetic declination, and other matter of interest. Now follows the tabular exhibit of the weather for the entire State by

months and by the year, the exhibit for each month being exactly of the same form and extent; and, to still more facilitate the use of these tables, each month has a separate and heavy inside paging. The following shows the contents of each of these monthly forms of sixteen pages:

Page 1. Reprint of *Press Bulletin* of the month.

Pages 2 to 5. *Observations at the Central station*, namely: on pages 2 and 3, the result of observations at 7 A. M., 2 P. M., and 9 P. M., printed in full in the form adopted by the International Congress of Meteorologists; on page 4, the noon observations at the Central station are given, together with a very important table of the *change* of the indications of the barometer and thermometer; and on page 5, insolation, sun-spot, and ozone observations, together with the international summary.

Pages 6 to 8. *Summary of observations at all stations of the service.* In this summary the stations are arranged invariably in the same order, beginning with the northwest and running down to the southwest, then taking up the middle part of Iowa, as north, central, and south; and finally giving eastern Iowa in a like manner from northeast to southeast. A comparison of any of these tables with the map accompanying the report will show the advantage of this system. At the same time it should be stated that the reports for each month are filed in exactly the same order in the filing-case of the month, so that the corresponding report of the station can be instantly produced.

This summary comprises total rainfall, and the greatest rainfall on one date, giving that date; also, the number of days with rainfall, snow, thunder and lightning; also the actual amount of rainfall collected, on the most noted storm-day or storm-days of the month; finally, an enumeration of the most important phenomena observed, these phenomena being printed in a very small space by using the international weather symbols, special matrices of which were cut expressly for this service. All of these data are obtained by my own personal examination and revision of the station reports sent by volunteer observers. Brief notes accompany these tables when circumstances require it.

Pages 9 to 14 for each month give the observations in full at ten stations for each day, arranged so as to contain five days to the page. The ten stations have been selected to satisfy two requirements, namely, a proper distribution of the ten stations over the entire territory of the State, and the presence at the station of a good observer. By means of these tables, weather-maps can be constructed for each day,

and for the three hours of observation of each day, giving a sufficiently full exposition of the weather at each of these hours throughout the State. In other words, the six pages 9 to 14, of each month, give a concise tabular exposition of the weather for the entire State for three distinct hours of observation for each day. By means of these tables it is therefore easy to find the condition of the weather at any time for any part of the State. To still further enhance the value of these synoptic tables, the list of stations has been raised to thirteen for 1879, so as to occupy pages 9 to 16, four dates to a page, as will be seen by reference to the report for April, 1879, the only one of 1879 as yet published.

Page 15 gives tabular exhibit of the temperature and rainfall in the principal districts of the United States from published data of the Signal Service.

Page 16 gives the results for the month of the oldest series of observations in Iowa, namely the observations of Prof. T. S. Parvin, in Muscatine (1839 to 1859), and at Iowa City (1860-1874.)

Thus far it has been impossible to publish the very full series of weather maps which I have to construct for each month and for shorter periods, exhibiting the distribution of rainfall, rain frequency, heavy rainfall, thunder-storms, etc. The means at the disposal of the service are insufficient for this purpose. To give an idea of the character of these maps, a number have been drawn by me with the electric pen and published in the *Bulletin* of 1878; and a smaller number have been photo-electrotyped from my drawings and printed as plates in the report. It would be very desirable if the full series of maps could be so published or lithographed.

This brief exposition of the contents and systematic arrangement of the Iowa Weather Report, and an examination of the portions actually published, will show that the duty imposed upon me has not been neglected. It is my ambition that the thought and labor bestowed upon this Report may prove useful to the State and to science.

In conclusion I would add, that the brief Report for 1877 was put through the press during the year 1878, and therefore constitutes work done during this biennial period.

I would also call especial attention to the fact, that the matter for all monthly parts up to date is ready for the printer, excepting only the three pages of synopsis of all stations (pp. 6 to 8 of each month); and these pages lack only the entry of the *tardy stations*; i. e., stations,

the report of which were not received in time for the *Press Bulletin*. From this statement it will be seen that we may expect a more rapid publication in the future.

CROP REPORTS.

Sunshine and Rain being the principal meteorological conditions affecting the growth and development of plants, it is of great scientific importance to trace the effect of the varying intensity of these cosmical and atmospheric agencies on the most important and most uniformly distributed plants, i. e., the crops. Since Iowa has not yet any system whereby the condition of the growing crops is regularly examined and reported, and these reports tabulated and published, it was doubly important to attempt this work.

Accordingly, I issued a circular-letter early in April, 1879, inviting qualified persons, especially practical farmers, to volunteer to act as Crop Reporters for the season. A very favorable response was generally made, and enough crop reports were received for April 30 to give already in the *Press Bulletin* for April a brief statement concerning the condition of the crops in our State on that date.

Crop Reports have been received regularly until October from quite a number of responsible volunteer crop reporters, and after tabulation and mapping the results ascertained have been published in the *Press Bulletin*.

In addition a more complete Harvest Report was obtained on blanks furnished, the data not yet published will be presented in the second part of the Weather Report for 1879.

The reports so obtained differ materially from others of this kind in having the results stated, not in the alphabetical order of the counties, but by regions as marked on the crop maps constructed from the reports received. I shall take pains to insert at least a few of these maps in the Report.

CROP REPORTERS.

The following is an alphabetical list of the volunteer crop reporters of the Service.

NAME.	P. O. ADDRESS.	COUNTY.
J. A. Alexander.....	Crawfordsville.....	Washington.
Washington Allen.....	Sac City.....	Sac.
Capt. G. A. Appelman.....	Clermont.....	Fayette.
I. P. Bailey.....	Sibley.....	Osceola.
Wm. Bowman.....	Maquoketa.....	Jackson.
A. N. Buckman.....	Harlan.....	Shelby.
Thos. M. Cassin.....	Bellevue.....	Jackson.
Geo. C. Calkins.....	Hayes.....	Adams.
P. R. Clark.....	Tabor.....	Fremont.
Hon. B. F. Clayton.....	Macedonia.....	Pottawattamie.
E. J. Couch.....	Grand Junction.....	Greene.
Hon. Joseph Dysart.....	Dysart.....	Tama.
B. T. Edwards.....	Webster City.....	Hamilton.
J. M. Elder.....	Concord.....	Hancock.
Thos. J. Evans.....	Stellapolis.....	Iowa.
S. A. French.....	Faulkner.....	Franklin.
M. B. Frisbie.....	Walnut.....	Pottawattamie.
Wm. P. Gildings.....	Algona.....	Kossuth.
Henry Hosper.....	Orange City.....	Sioux.
Ed. Hartsock.....	Clarion.....	Wright.
H. P. Hatch.....	Wittemore.....	Kossuth.
Curtis Houghton.....	Fairfield.....	Jefferson.
James Hughes.....	Centerville.....	Appanoose.
R. W. Humphrey.....	Charles City.....	Floyd.
M. L. Ink.....	Mt. Vernon.....	Linn.
G. R. Irish.....	Iowa City.....	Johnson.
Nelson Johnson.....	Decorah.....	Winneshiek.
J. R. Kenyon.....	New Hampton.....	Chickasaw.
H. R. Laird.....	Sidney.....	Fremont.
Hon. Frank Larrabee.....	McGregor.....	Clayton.
Chas. W. C. Law.....	Davenport.....	Scott.
B. F. Little.....	Brush Creek.....	Fayette.
B. T. Louthan.....	Dowville.....	Crawford.
John McDonough.....	Woodburn.....	Clarke.
Robert W. McGee.....	Ida.....	Ida.
S. P. McNeill.....	Garden Grove.....	Decatur.
Hon. Samuel McNutt.....	Muscatine.....	Muscatine.
Capt. G. A. Madson.....	Ottumwa.....	Wapello.
Gregory Marshall.....	Cresco.....	Howard.
O. Midland.....	Fort Dodge.....	Webster.
Edwin Miller.....	Grant City.....	Sac.
N. F. Miller.....	Knoxville.....	Marion.
Hon. W. D. Mills.....	Marshalltown.....	Marshall.
B. Moore.....	New York.....	Wayne.
O. A. Moore.....	LeMars.....	Plymouth.

CROP REPORTERS—CONTINUED.

NAMES.	POST-OFFICE.	COUNTY.
W. D. Ogden.....	Hamlin.....	Audubon.
Thos. Parker.....	Des Moines.....	Polk.
Hon. Chas. Paulk.....	Waukon.....	Allamakee.
H. M. Perry.....	Afton.....	Union.
S. H. Pettibone.....	Algona.....	Kossuth.
Hon. C. C. Platter.....	Red Oak.....	Montgomery.
N. H. Reintz.....	Aplington.....	Butler.
Julius C. Riley.....	Osceola.....	Clarke.
S. G. Rogers.....	Logan.....	Harrison.
A. B. Scott.....	Fairfield.....	Jefferson.
L. W. Scott.....	Hesper.....	Winneshiek.
E. D. Seeley.....	Rolfe.....	Pocahontas.
C. P. Sheldon.....	Tipton.....	Cedar.
Maj. E. H. Smith.....	Dubuque.....	Dubuque.
W. G. Smith.....	Lamoille.....	Marshall.
David Stanton.....	Earlham.....	Madison.
T. E. Stevens.....	Mt. Pleasant.....	Henry.
S. Stewart.....	Chariton.....	Lucas.
Jesse Strawbridge.....	Iowa City.....	Johnson.
C. S. Stryker.....	Creston.....	Union.
W. Sutherland.....	Estherville.....	Emmet.
Thomas S. Teylor.....	Denmark.....	Lee.
Hiram Thomley.....	Wolfdale.....	Woodbury.
F. A. Tiedemann.....	Pleasant Grove.....	Des Moines.
Hon. C. E. Whiting.....	Whiting.....	Monona.
Jas. Wood.....	Anamosa.....	Jones.
L. W. Wough.....	Spirit Lake.....	Dickinson.
Morris Wygant.....	Denison.....	Crawford.

I beg leave to thank these gentlemen for the trouble they have taken in behalf of the service. Quite a number of these seventy-three reporters have already notified me that they will also report for the next season. May we hope that the season will prove as favorable as the one now closed.

CENTRAL STATION.

The central *station* proper of a system of meteorological observations comprises the observatory at which the series of observations made is the most comprehensive and complete in the service, and at which instruments and methods are tested for the use of the other stations of the service. At the same time, it is very desirable that the observers should occasionally visit the Central Station for instruction.

As the service does not possess means for building such an institution, and as improved accommodations for these purposes were absolutely required for the good of the service, I have, during the past season, built an observatory, sufficient for our present wants, and as complete as I may hope to be able to pay for in a reasonably near future.

This Observatory for the Central Station comprises a room on the third floor,* with almost free view to all sides of the horizon, and the flat roof or terrace above the same. Both in the room and on the terrace instruments are placed for the observations recorded on the four pages (2 to 5), of each monthly number of the Report. These observations comprise four regular observations daily on the barometer, thermometer, hygrometer, and other instruments, giving the pressure, temperature, humidity, cloudiness, cloudform, direction, and force of the wind, and the rainfall. Also three daily observations of the ozone of the air, and two daily observations of the noon and maximum insolation, that is, the temperature indicated by a thermometer, the blackened bulb of which is inclosed in a vacuum tube and freely exposed to the sun. The maximum and minimum thermometers are also observed daily. Whenever possible the sun's disk is carefully examined for sun-spots by means of a telescope belonging to the laboratory of the State University and used for this purpose at this institution, except during vacation, when these observations are also actually made at the Central Station. In addition, all notable changes and meteorological phenomena are observed and recorded.

A more complete meteorological and physical observatory should be possessed by a great State like Iowa, best in connection with its State University, so that still more complete observations could be made under unchanging conditions on the atmospheric and physical constants of the State. A full set of self-registering instruments should

* The corresponding room on the second floor serves largely for the purposes of Central Office, and contains the file of Station Reports and publications.

complete the observations made by the observers maintained at such an institution. In this manner, data would be obtained, more complete and extensive than can be obtained by any one person at even the greatest sacrifice of time and means; and, the installation of the instruments being maintained unchanged for centuries, a true history of the change of climate, if any, would be obtained. Until the State shall generally feel the need of such an institution,* the small observatory which now constitutes the Central Station will have to suffice, at least so long as I may be able to maintain the same and to carry on the very full series of observations enumerated above.

In addition to my own observations referred to, a series of observations is being made by my daughter, exactly like those made throughout the State at the ordinary Weather Stations of the Service. By this means it will be possible in a near future to determine the small corrections which the ordinary temperature observations may be subject to, provided the exposure of the thermometers and the individual corrections of these latter, shall have been determined during the personal inspection of the Station by the director.

Finally, to cheaply provide the observers with thermometers and barometers, a few of such instruments are constantly being compared with the standard instruments at the Central Station, and afterwards furnished to such of the observers as desire to procure them, upon refunding the maker's wholesale price—the cost of transportation being borne by the service, and comparison and table of corrections being made free of charge by me. In this manner, the observations of temperature and pressure become quite reliable, though it would be desirable for the State to furnish, say twenty qualified observers, properly distributed over the State, with first-class standard instruments to remain the property of the Service.

One of the more important duties performed at the Central Station, is the hoisting of

WEATHER-FLAGS,

indicating, with a high degree of probability, the approaching condition of the weather. These flags are nine in number, of three colors, and three different forms of each color. The *red* colored flag indicates a high barometer for the season, the *blue* flag signals a low barometer, while the ordinary or average height of the barometer is represented by

* The construction of such an institution was recommended by me in my report to the president of the University, six years ago.

a *white* flag. The change of the barometer is signaled by the *form* of the flag. A streamer, or pointed long flag indicates that the barometer is *rising*; a cut-out flag or guidon, shows that the barometer is *falling*, while a *stationery* barometer is represented by a square flag. The motion and direction of the flag signal also indicates the force and the direction of the wind, while the state of the sky is visible to all. But the condition of the *barometer*, as to hight and change, the direction and force of the *wind*, and the condition of the *sky* constitute the three elements which generally determine the condition of the coming weather according to simple rules. When hoisted by experienced observers, familiar with the normal conditions of the weather and the normal course of the barometer in their locality, and when proper regard is taken by these observers of other signs of the weather, especially of the condition of the sky at sunset, humidity of the air, coronæ, and halos, the observer will but rarely fail promptly to recognize the coming high or low barometer, and thus his signal flags will prove of great utility at his station. If by additional means a few telegrams can be transmitted to and from stations, a still higher degree of reliability can be obtained.

In this connection a few general facts should not be lost sight of:

First. Great and extensive disturbances of the atmosphere, that is, extensive storms, never will be missed by this system of signaling, and smaller, though locally quite intense, storms will in no other way be indicated.

Second. The inferences drawn from the flag hoisted by the simple rules given, are fully as definite as any probability yet furnished anywhere, and have the merit of applying to the locality of the observer in particular, and not to an indefinite place somewhere within a territory equal to several states. While this constitutes a decided advantage in favor of this system of local flag signals, it is unfortunately true that people generally make much higher demands of the local prognostication than of the much more easily made indications for a great territory.

Third. It is of supreme importance that our people should learn to help themselves, and not vainly rely upon a distant power which even at best cannot reach them until too late. Weather telegrams are of greatest possible value, but only as aids to properly organized local work. We should aim to so simplify and systematize this work that every community can secure the advantages of a local signal sufficient

to enable every intelligent person to obtain a fair probability of the coming weather. In fact, any isolated farmer may, by making himself sufficiently familiar with this work, and regularly observing a barometer, and wind, and sky, obtain a better indication of the coming weather than could be telegraphed to him from any far distant place.

As it is advisable to transmit daily some definite instant of time by the telegraph, so it is also very useful to transmit certain meteorological data in this manner, daily, if the means are available; but as it would be very foolish to throw away sun-dial and watch, and to rely on the time being constantly transmitted, so it is equally unwise to neglect the local indications of the barometer, the sky, the wind, and the old and popular signs of sunset, and rely on any distant power to indicate, darkly and in ambiguous, partly contradictory terms, that which we might read with much greater clearness and certainty in the sky, the wind, and the pressure of the air as measured by the barometer.

A faithful record is kept of all signals hoisted at the Central Station. Nearly every storm has been indicated thus far in a reasonable time in advance by the corresponding flag signal.

As soon as we shall have more numerous barometers throughout the state, and observers capable not only of reading the hight, but also to understand this reading of the barometer, such weather signals will become more and more numerous throughout our state, and be useful both in giving timely warning and in again causing the people to look into and read the sky.

For further details on this subject I beg leave to refer to the circulars on Flag Signals issued on June 25th and July 5th, and to the proper divisions of the final Weather Reports.

CENTRAL OFFICE.

In addition to the different kinds of work carried on at the Central Station of observation, there yet remains a large amount of office-work proper to be done to carry on this service. This office-work consists in the preparation and distribution of *directions* for observers, the reduction, tabulation, mapping, and general study of the station reports for the purposes of permanent record and publication, the printing and publication of blanks, bulletins and reports, the extensive mailing of circulars and publications, and the general correspondence.

The means at the disposal being mainly used for material, printing, and postage, but little remains for clerical help. Still, the general

mailing, including the numbering of station blanks prior to their mailing, the copying of reports for publication, and the office printing of blanks, circular letters and bulletins, has been done by the clerical help at my disposal.

An idea of the amount of work included under these heads may be obtained from the following data, taken from the records:

Mailing.—During the ten months from March to December, 1878, there were mailed 397 letters, and 5,519 parcels of printed matter, many of which latter parcels required considerable work in marking, collecting, and folding. The total amount of postage on these letters and parcels, including the stamps on the envelopes sent to the observers for the mailing of their reports, was \$172.47. In the same manner, during the first nine months of 1879, from January to September inclusive, 253 letters have been mailed, and 4,981 parcels of printed matter; total postage sent, \$113.67. Adding hereto for January and February, 1878, the corresponding figures, we obtain for the twenty-one months from January, 1878, to September, 1879, the total of 703 letters, 11,500 parcels of printed matter of all kinds, carrying \$311.14 of postage.

Office-Printing.—During the year 1878, this work has been very great. Since the temporary change in postage for electric-pen work, taking effect January, 1879, much less work of this kind has been done. After the restoration of the former rate of postage on this matter, the work having partly changed in the meanwhile, and the time being all required for work on the report now begun, the work of office-printing by electric-pen and duplicating-press was not resumed on so extensive a scale; thereby the expense for paper has diminished, but larger bills for printing have taken its place. Even now, however, a very considerable amount of office-printing proper continues to be done, because the printing of the many blank forms of different kinds would be too expensive for the means of the service. No specified record of office-printing having been kept in 1879, I sub-join merely the list for 1878:

Total number of stencils made	166
Total number of copies printed from these stencils.....	44,502
Average number of stencils per month.....	13
Average number of copies printed per month	3,700
Average edition of each stencil, about.....	300

Each of these stencils is large quarto, and each printed sheet nine by twelve inches. Quite a number of these stencils are maps, and thirty-six are as many different forms of *blanks*, of which 10,578 copies were printed. Any one familiar with the cost of printing, by ordinary means, blank forms with rules running both vertically and horizontally, thus requiring double justification, will readily appreciate the great saving accomplished by making the thirty-six forms by means of the electric pen and duplicating press. All forms of which not a very large edition is required, continue to be printed in this manner at the office.

The aid rendered in copying station reports for publication, proof reading, revision of observations at the Central Station, and the taking of these observations during my absence, is clerical work which it is impossible to represent by numbers. The drawing of maps, the writing of stencils with the electric pen, and the writing of letters and the study and summarizing of reports from the stations, as well as the writing of the bulletin and reports, has of necessity devolved entirely upon myself. The item of letter-writing has been especially laborious; five hundred and ninety-eight pages quarto in the copy-books testify to this. The other office-work done by me in behalf of this service is already indicated in the first sections of this report, and to a small extent also represented by the quarto volume of *Bulletins*, and the octave volume of *Reports* of the service issued during this biennium. The filing-cases, containing the unpublished material nearly ready for the printer, should also be considered in this connection.

The extent of the data to be studied in preparing these reports may perhaps best be appreciated by the fact that during the four years, over four thousand monthly reports have been received and are systematically filed in this office. Each monthly report contains the observations for at least thirty days, making 120,000 days of observation, and at least 240,000 full observations from the different parts of our State. These figures also demonstrate the fact that the service is accumulating a very notable material of observations for future research.

MAGNETIC SURVEY.

By means of instruments furnished by the Coast Survey Office at Washington, a preliminary magnetic survey of Iowa has been made by me, mainly during the months of July and August, 1878. The determination of the declination (commonly called the magnetic vari-

ation) and horizontal intensity has been made at twelve stations, namely: Iowa City, Fairfield, Afton, Council Bluffs, Sioux City, Fort Dodge, Waterloo, Dubuque, Clermont, McGregor, and Decorah, in Iowa, and at Madison, Wisconsin. The last station was selected in order to connect this work with the observations made by the Coast Survey at their permanent magnetic station and underground magnetic observatory in the campus of the of the State University of Wisconsin.

The most important results of this survey are published in the third map of the first plate of the Report for 1878, giving the lines of equal declination. A more complete synopsis of the result was presented at the meeting of the Iowa Academy of Sciences, held at Grinnell, in September, 1878. The most noteworthy fact referred to is the apparent influence of the drainage and river system on the course and distance of these lines. A like influence I detected in the results for north-eastern Missouri, sent me last winter by Professor Nipher of St. Louis. His observations of this season have established the very great effect of the eastern course of the Missouri river on the magnetic declination, which effect I had indicated to him as highly probable on the strength of my own field-work in Iowa, and from my general theory of the origin of the earth's magnetic force.

CONCLUSION.

In conclusion it is my pleasant duty to thank the State officers for friendly co-operation on many an occasion; the volunteer observers and their associates for the very extended and often laborious work they have carefully and faithfully done; the press of the state for extensively republishing the monthly Press Bulletin; the crop reporters for enabling us to trace the effect of rain and sunshine on the development of the crops; railroad officers, for diminishing the cost of inspection of stations and the magnetic survey; and all others who in any way may have helped the work of this young service.

If the work is less complete than might be desired it is not on account of lack of energy or labor on my part. While probably seeing the shortcomings and imperfections more clearly than any one else, and regretting their existence, still I am conscious that all has been done that was possible under the circumstances. The time that should have been devoted to rest and recreation has been freely given to the

work of this service; even my researches on various special subjects of physical science have been discontinued to find time to perform the work required for the service.

In the establishment of the Weather Service, our State is the first in the Union. The work and publications of this service have added to the credit of our state abroad. That the work of this service may prove increasingly useful is my earnest endeavor; and that it may continue to be kindly received at home is my hope.

APPROPRIATION.

The appropriation made in section 4 of the act establishing the Iowa Weather service has been drawn and expended, as shown below by list of warrants, classified synopsis of expenditures, and complete list of individual vouchers sent to the Auditor of State.

I. STATE WARRANTS RECEIVED.

DATE.	NO. OF VOUCHERS IN RETURN FOR WARRANT ISSUED.	AMOUNT.
1878.		
April 28	Vouchers 1 to 7, inclusive	\$ 268 50
July 30	Vouchers 8 to 25, inclusive	214 38
Oct. 12	Vouchers 26 to 49, inclusive	270 58
1879.		
Jan. 24	Vouchers 50 to 62, inclusive	253 80
April 22	Vouchers 63 to 78, inclusive	219 41
July 2	Vouchers 79 to 103, inclusive	296 03
Sept. 29	Vouchers 104 to 118, inclusive	228 20
	Total.....	\$ 1751 40

II. SYNOPSIS OF EXPENDITURES.

Postage: 15900 stamps, and 3500 cards*	\$ 320 00
Publication, blanks and cuts	634 78
Inspection, including magnetic survey	137 22
Clerk-hire.	420 00
All other expenditures	239 40
Total.....	\$ 1751 40

* This includes, of course, the stamps on stamped envelopes, and the cards, sent to observers for report to Central Station.

III. LIST OF VOUCHERS.

DATE.	PERSON.	OBJECT.	Number.	AMOUNT.
1878.		Expenditures, January and February, 1878.	1	\$ 195 00
March 16	G. Hinrichs.....	Photo-engraving.....	2	4 00
March 16	Levytype Co., Philadelphia.....	Photo-electrotypes.....	3	5 25
March 16	Photoelectrotypes Co., Boston.....	1100 stamps.....	4	25 00
March 18	B. Owen, P. M.....	300 stamps, 1000 cards.....	5	16 00
March 20	B. Owen, P. M.....	Printing.....	6	16 25
March 28	J. P. Irish.....	Printing.....	7	7 00
March 28	Wilson, Rodgers & Shields.....	Clerk-hire, March.....	8	20 00
April 1	G. Hinrichs, Jr.....	Box rent.....	9	1 00
April 1	B. Owen, P. M.....	Stationery, and book-paper.....	10	40 83
April 20	Mrs. J. G. Fink.....	300 stamps.....	11	9 00
April 20	B. Owen, P. M.....	Cutting matrices of weather symbols.....	12	15 00
April 22	Barnhart Bros. & Spindler, Chicago.....	Rubber, stamps, and type.....	13	5 20
April 26	J. R. Holcomb & Co.....	500 stamps, 500 cards.....	14	10 00
April 27	B. Owen, P. M.....	Blank books, stationery.....	15	31 00
April 27	James Lee.....	Letter-scales.....	16	3 60
April 29	Price & Schell.....	Stylographs (letter-books).....	17	5 00
May 3	McDonald & Johnson, Chicago.....	Dating stamp.....	18	6 00
May 6	J. R. Holcomb & Co.....	Cutting matrices for weather symbols.....	19	30 00
May 9	Barnhart Bros. & Spindler, Chicago.....	600 stamps.....	20	10 00
May 5	B. Owen, P. M.....	500 stamps.....	21	15 00
June 7	B. Owen, P. M.....	Iowa weather symbols—types.....	22	5 50
June 10	Barnhart Bros. & Spindler, Chicago.....	Manifold and carbon paper.....	23	5 00
June 15	McDonald & Johnson, Chicago.....	Four electrotypes.....	24	2 75
June 17	Photoelectrotypes Co., Boston.....	Printing blank maps.....	25	4 75
July 8	J. P. Irish.....	Book paper and stationery.....	26	15 40
July 8	Mrs. J. G. Fink.....	Box rent.....	27	1 00
July 8	B. Owen, P. M.....	700 stamps.....	28	10 00
July 10	B. Owen, P. M.....		29	

LIST OF VOUCHERS—CONTINUED.

DATE.	PERSON.	OBJECT.	Number.	AMOUNT.
1878.				
July 15	R. A. McChesney	Expressage	30	\$ 30
July 15	Wilson, Rodgers & Shields	Paper for blanks	31	4 50
July 15	J. P. Irish	Book paper	32	1 56
July 15	R. A. McChesney	Expressage	33	40
July 15	G. Hinrichs, Jr.	Clerk hire, April, May, and June	34	60 00
July 19	Allin, Wilson & Smith	Tent for magnetic survey	35	11 25
July 24	Sheets, Gesberg & Co.	Drawing boards, etc.	36	1 80
July 24	J. B. Berryhill	Straps for tent	37	1 00
July 24	Joel Lightner	Wrapper for tent	38	90
July 26	R. A. McChesney	Expressage, tent to Clermont	39	80
July 31	G. Hinrichs	Travel to Clermont and back	40	10 90
August 6	R. P. Clarkson, Des Moines	Printing 1000 reports, 1877	41	40 00
August 7	B. Owen, P. M.	1200 stamps	42	20 00
August 20	United States Express Co.	Tent from Clermont	43	80
August 20	G. Hinrichs	Travel, 784 miles, 9 days	44	30 52
August 23	United States Express Co.	Tent	45	2 60
August 23	B. Owen, P. M.	400 stamps	46	10 00
Sept. 4	G. Hinrichs	Travel, 612 miles, 9 days	47	39 65
Sept. 28	C. R. I. & P. R. R. Co.	Freight on books from Des Moines	48	1 45
Oct. 1	B. Owen, P. M.	Box rent	49	1 00
Oct. 3	B. Owen, P. M.	500 stamps	50	5 00
Oct. 22	Mrs J. G. Fink	Envelops, printing paper	51	29 65
Oct. 23	James Lee	Paper, filing-cases, etc.	52	30 25
Oct. 26	Geo. H. Bliss, Chicago	Duplicating press, paper	53	22 80
Oct. 28	Keuffel & Esser, New York	102 rain scales	54	7 65
Nov. 9	Culver, Page, Hoyne & Co., Chicago	Filing-cases for reports	55	13 50
Nov. 9	B. Owen, P. M.	600 stamps	56	10 00
Nov. 12	United States Express Co.	Transportation, instrument to Washington	57	3 40
Nov. 16	American Express Co.	Expressage from Chicago	58	2 15
Nov. 29	B. Owen, P. M.	1000 stamps	59	20 00

Dec. 2	G. Hinrichs, Jr.	Clerk hire, July, August, September, and October	60	80 00
Dec. 5	Culver, Page, Hoyne & Co., Chicago	Filing-cases	61	14 40
Dec. 11	B. Owen, P. M.	500 stamps	62	15 00
Dec. 24	Keuffel & Esser, New York	Planimeter	63	30 00
Dec. 31	G. Hinrichs	Petty expenses	64	2 70
1879.				
Jan. 9	J. R. Holcomb	Rubber numbers	65	3 20
Jan. 25	B. Owen, P. M.	700 stamps	66	10 00
Jan. 25	Mrs. J. G. Fink	Stationery, envelopes	67	10 56
Jan. 30	James Lee	Paper and binding	68	33 70
Feb. 10	United States Express Co.	3 parcels to observers	69	75
Feb. 15	J. P. Irish	Printing bulletins	70	6 00
Feb. 15	Iowa City Republican	Printing blanks and circulars	71	9 50
Feb. 23	B. Owen, P. M.	300 stamps	72	5 00
March 6	G. Hinrichs, Jr.	Clerk hire—November, December, January	73	60 00
March 10	B. Owen, P. M.	500 stamps	74	5 00
March 21	Siessfeld, Lorsch & Co., New York	Barometer	75	30 00
March 31	Tiffany & Co., New York	Pedometer	76	5 00
April 5	B. Owen, P. M.	500 stamps	77	5 00
April 18	G. Hinrichs	Petty expenses	78	3 00
April 19	B. Owen, P. M.	300 stamps	79	5 00
April 21	United States Express Co.	Theodolite to Washington	80	2 80
April 24	B. Owen, P. M.	1000 cards	81	10 00
April 26	W. Hohenschuh	3 assorting cases	82	8 00
April 26	J. P. Irish	Printing	83	4 75
April 28	B. Owen, P. M.	1000 cards	84	10 00
May 5	United States Express Co.	To Washington	85	1 00
May 7	B. Owen, P. M.	900 stamps	86	15 00
May 10	J. P. Irish	Printing	87	3 00
May 12	G. Hinrichs, Jr.	Clerk hire—February, March, April	88	60 00
May 12	Western Union Telegraph Co.	Telegram to Sioux City	89	2 55
May 14	Iowa City Republican	Printing	90	2 00
May 14	F. E. Nipher, St. Louis	Prismatic compass	91	18 00
May 21	G. Hinrichs	Travel—to Emmet and return	92	23 00
May 24	Mills & Co., Des Moines	Printing maps	93	14 00
May 24	Clarkson Bros., Des Moines	Printing	94	9 00
June 2	Mrs. J. G. Fink	Paper, and rubber stamps	95	25 78

LIST OF VOUCHERS—CONTINUED.

DATE.	PERSON.	OBJECT.	Number.	AMOUNT.
1878.				
June 6	Photo-electrotype Co., Boston	Photo-electrotypes	96	\$ 17 60
June 6	B. Owen, P. M.	500 stamps	97	5 00
June 16	B. Owen, P. M.	500 stamps	98	15 00
June 23	James Lee	Binding and stationery	99	9 90
June 25	G. Hinrichs	Expenses for signal flags, etc.	100	8 00
June 27	J. P. Irish	Printing	101	14 25
June 27	B. Owen, P. M.	400 stamps	102	10 00
June 27	G. Hinrichs	Petty expenses	103	2 40
July 7	B. Owen, P. M.	500 stamps	104	5 00
July 19	J. P. Irish	Printing	105	9 25
July 23	Culver, Page, Hoyne & Co., Chicago	Filing-cases	106	13 50
August 4	B. Owen, P. M.	500 stamps	107	5 00
August 9	Wilson, Rodgers & Shields	Printing	108	10 25
August 11	B. Owen, P. M.	300 stamps	109	5 00
August 12	Photo-electrotype Co., Boston	Photo-electrotypes	110	28 65
August 22	B. Westermann & Co., New York	Drechsler Witterung zu Dresden	111	3 80
August 25	B. Owen, P. M.	300 stamps	112	5 00
Sept. 3	G. Hinrichs, Jr.	Clerk hire—May, June, July and August	113	80 00
Sept. 9	B. Owen, P. M.	400 stamps	114	5 00
Sept. 19	J. P. Irish	Printing	115	10 00
Sept. 19	Mills & Co., Des Moines	Printing	116	28 20
Sept. 23	Mrs. J. G. Fink	Stationery	117	14 70
Sept. 23	G. Hinrichs	Petty expenses	118	4 85
	Total			\$ 1751 40

REPORT

OF

COMMITTEE ON ELECTIONS

IN THE CASE OF

BULL VERSUS HENDERSON

For a Seat in the Senate, from the 27th Senatorial
District.

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